Exploring the Transformation of French Trade in the Long Eighteenth Century (1713-1823): the TOFLIT18 Project[1]

Loïc Charles[a]; Guillaume Daudin[b]; Paul Girard[c] & Guillaume Plique[d]

[a]Université de Paris 8, Led & Institut national d'études démographiques, France. Orcid id: https://orcid.org/0000-0001-9698-3707

[b]Université Paris-Dauphine, PSL Research University, CNRS , IRD, LEDa, DIAL, Paris, France. Orcid id: 0000-0001-9698-4750

[c]OuestWare, Nantes, France. Orcid id : 0000-0001-9332-3308

[d] Sciences Po, médialab, Paris, France. Orcid id: 0000-0003-4916-8472

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[1]   CONTACT: Guillaume Daudin E-mail: guillaume.daudin@dauphine.psl.eu

Abstract

The TOFLIT18 project documents French bilateral international trade flows from the 1710s to the 1820s. This article presents the TOFLIT18 dataset and its exploration tool (the "datascape"). We make four contributions: first, we discuss the institutional framework in which the sources were produced; second, we present our method to standardize the collected data and reduce the variety of commodity names, partners, and measurement units; third, we document how ad hoc classifications can be created to aggregate the dataset; fourth, we describe the use of our datascape in a case study of the loss of Canada by France. We show how the datascape's interactive data visualizations can help quantitative historians analyze key events in French and European eighteenth century.

Keywords: TOFLIT18, datascape, international trade, eighteenth-century France, historical trade data

Introduction

Most of the competing interpretations of the Industrial Revolution concur that the long eighteenth-century from the Glorious Revolution to the fall of Napoleon laid the economic ground for the entry of Western Europe into the era of modern economic growth.[2] International trade has always been considered a piece of the Industrial Revolution puzzle, though a minor one. The situation has changed recently, and many recent historical interpretations feature global trade and colonial empire as determinants of the Industrial Revolution (Pomeranz 2000; Allen 2009, 2011; Clark, O'Rourke, and Taylor 2014). Whereas extra-European trade is comparatively well known and has been the object of good synthetic studies, intra-European trade has been somewhat neglected.[3] Only a few studies, all partial and based on heterogeneous methods, exist on this subject (Scheltjens 2009; Léon 1975; Veluwenkamp and Scheltjens 2018). To a large degree, this is the outcome of the paucity of detailed data on trade. While a handful of "new" commodities such as slaves, coffee, cocoa, sugar or indigo makes up the bulk of colonial trade, which explains that it is relatively easy to quantify its growth, the evolution of intra-European trade is much more difficult to explore.

In this context, the aim of the TOFLIT18 project and its associated database is to

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[2]   Recent surveys are: Crafts (2011) and Kelly, Mokyr, and Gráda (2014). North and Thomas (1973) proposes a different chronology, insisting on the role of changes that occurred between 1000 and 1600CE, but despite its impact on the profession, economic historians did not adopt this timeline.

[3]   On extra-European trade, see Roitman, Pétré-Grenouilleau, and Emmer (2006); for a specific discussion on the French case, see Tarrade (1972).

provide a larger picture of European trade in the early modern period, where extra as well as intra-European trade can be assessed and analysed. Generally speaking, the project builds on the wealth of trade data collected by the kingdom of France (like many European states from the late seventeenth century onward Charles and Daudin [2015]). The methods used by early modern States to collect information about their international trade, or as they named it, their "balance of trade", had various degrees of efficiency and comprehensiveness. The two most powerful European economies of the time, England and France, were able to produce comprehensive trade statistics series from respectively the end of the seventeenth-century and the early eighteenth-century. Such trade statistics are the most complete and coherent source of quantitative macroeconomic information available for these economies in this period. While eighteenth and early-nineteenth English trade has been studied, including by Ralph Davies in a series of articles and a book (Davis 1954, 1962, 1973, 1979; G. N. Clark 1938; Schumpeter 1960), French trade has not been thoroughly investigated.[4] As we shall see (section 1), this is partly because these data have been scattered across several archival repositories.

Traditionally, economic historians who studied the evolution of the French economy during this period have relied on two methodologically incompatible strategies. On the one hand, economists and historians from the ISEA and Maddison (who used ISEA's data) were able to work out some macroeconomic aggregates of the eighteenth century French economy using a retrospective approach (Marczewski 1961; Toutain 1997;

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[4]   Clark provides a general if slightly dated overview on British trade statistics.

Maddison 2003). On the other hand, economic and social historians from the *Annales* school produced a series of regional studies of Old Regime France based on detailed archival research into Old Regime economic series – especially price series.[5] Neither of these research strategies provide a definite picture of the eighteenth century French economy. Faced with a dearth of macroeconomic data prior to 1830, the ISEA reconstruction is too crude to reach beyond a heroic approximation of how much and in which way the French economy evolved during the eighteenth and early nineteenth century. The *Annales* approach never succeeded in providing a synthesis of the regional studies because they did not rely on a unified methodology, precluding the aggregation of their data. The work of *Annales* historians therefore left us with detailed local and regional quantitative and qualitative information on trade which is impossible to combine into a quantitative macroeconomic framework.[6] Indeed, most studies on French external trade in the eighteenth century have resorted to a limited range of archival sources, mainly the printed tables from the Archives Nationales (Léon 1974, 1975; Morineau 1965, 1978). Regional-scale historical studies never used the whole range of centrally-gathered French data. As a result, the studies of international trade and shipping in France on a local scale (Dardel 1963; Meyer 1969; Carrière 1973; Butel 1974) include reflections on the economic effect of external trade at the local level, but they do not provide an in-depth discussion at the country level. Recent research has

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[5]   The most archetypal example is (Baehrel 1961), it also inspired a series of Phd thesis on the French ports that used the Labroussian methodological template of *histoire sérielle*: (Dardel 1963; Meyer 1969; Carrière 1973; Butel 1974).

[6]   (Ridolfi 2017; 2019) is currently trying to produce macro-economic data in an innovative way, but is not interested in international trade.

shown more interest for this issue and some of the bilateral trade between France and other countries/European regions has been closely examined (Marzagalli 1999; Pourchasse 2006; Crouzet 2008). Yet again, these works do not develop a systematic quantitative treatment of overall French trade.

The records of the Bureau de la Balance du Commerce hold the promise to break away from this double bind between crude macroeconomic reconstruction and heterogeneous local data . First of all, because these records are by nature macroeconomic data, they make it possible both to complete and test the retrospective accounts constructed by ISEA economists. Second, as they also contain microeconomic information, such as individual commodity prices and regional flows of trade, they could help economic historians to articulate the local and regional studies of the *Annales* school and those of the ISEA group to produce a solid synthesis on the evolution of the French economy throughout the eighteenth and early nineteenth century.[7]

This was the main motivation behind the TOFLIT18 project, funded by the Agence Nationale de la Recherche (French national agency for research) for the period 2014-2017. The core of TOFLIT18 is a database documenting bilateral trade flows between France and the rest of the world. It covers a period that spans from the 1710s to the 1820s. In its current version, this database contains over 550,000 observations, each with multiple items of information on geography, commodity quantities, prices and values. Its primary source is the very rich data on French trade collected by the Bureau

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[7]   For an early attempt based on a crude version of the data, see Daudin (2005).

of the Balance of Trade (*Bureau de la Balance du Commerce*), a small department that formed part of the royal economic administration, and its successors. These documents are unique as they provide quantitative information on several geographical levels with considerable detail on the nature of the commodities exchanged. As such, they can potentially be used to study the economic effects of international trade on the French economy as a whole, on the economy of a single region or a port town, as well as on the economic behavior of communities of merchants from a single town or region.[8] They can also be used to get a more accurate understanding of the interplay that existed between these different geographical levels, and to study specific sectors or sets of commodities, such as linen goods, jewelry, etc. This dataset improves our knowledge of the French economy on the eve of the Industrial Revolution, and of the process of economic development that unfolded during this period.

To reveal such opportunities, we built an innovative research instrument composed of a comprehensive data-set combined with a data exploration tool. Our approach is in line with the current surge of interest in data visualization in the humanities, revisiting the principles of exploratory data analysis with web interactivity (Tukey 1977; Latour *et al*. 2012). Our ambition is to provide scholars with complex interpretative features by designing researcher-data interfaces that addresses two kinds of heterogeneity issues (Drucker 2011). On the one hand, we want to allow many scholars to use our work in their own research. Our tool is therefore designed to respond to the needs of

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[8]   See for example Carrière (1973).

heterogeneous research interests, with each requiring different ways to filter, aggregate and project the sources. We combined a generic exploration tool with an advanced classification system opened to customization, which allows users to scrutinize and reverse the assumptions that were required to build the data-set. On the other hand, although the archival data we collected were quantitative in the first place, combining these data over a long period of time brings a high level of heterogeneity regarding terms and/or format used. Providing material for a long-term quantitative analysis requires a very carefully designed chain of references transforming archival material into interpretative tools (Latour 1993) . We use visual exploration to gain knowledge from this heterogeneity rather than trying to hide it behind a black-box uniformization process.

This article presents the conceptual and technical obstacles the project had to overcome to develop the TOFLIT18 database and its data exploration tool. We illustrate how the methodological choices we have made open up new opportunities for studying French and European 18th century history through the analysis of French historical trade statistics. The article first reviews the institutions that produced the sources. Secondly, it discusses how the archival sources were transformed into an usable dataset. An important part of this transformation was the devising and continuous, on-going updating of various classifications to deal with the multiplicity of research interests. Thirdly, the article presents the visual data exploration tools (a datascape) we created to allow quantitative analysis in the long run, illustrating its usefulness through the exploration of the economic consequences of France's loss of Canada to Great Britain in 1763.

Eighteenth century French trade statistical institutions

The Bureau of the Balance of Trade was created in 1713. Although it was formally abolished in 1792, the *Bureau des archives du commerce* took over its tasks with little changes up to the end of the Napoleonic era. The breadth of data collected by the Bureau of the balance of trade as well as its complexity make it particularly difficult to handle. Most of the original sources were destroyed during the French Revolution, when the Parisian crowd burned down the archive of the General Farm (*Ferme générale*), the private institution in charge of the collection of taxes and *traites* (trade duties), and which also produced the French external trade statistics. While some of these documents survived the bonfire and were later deposited in the French National Archives, what remains is scattered in several boxes and very incomplete. We supplemented this first set with the personal papers of trade administrators from this period, and with the archives of the regional chambers of commerce which have kept copies of some of the Bureau's records. As a result, we collected statistical documents from more than fifteen different archival repositories around France and one in Amsterdam.[9]

The records of the French balance of trade present some unique and interesting

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[9]   The French national archives in Paris ; the French colonial archives in Aix-en-Provence ; the French national library in Paris ; the Lyon, Paris, Rouen and Saint-Brieuc municipal libraries, the library of the French Institute (Paris), the Charente Maritime, Gironde, Haute-Savoie, Hérault, Loire-Atlantique and Pyrénées Orientale departmental archives (in La Rochelle, Bordeaux, Annecy, Montpellier, Nantes and Bayonne, respectively), the archives of the chamber of commerce of Dunkerque, Marseilles and Rouen and the archives of the Amsterdam Institute for social science research.

characteristics. These data were produced locally by the General Farm and aggregated at the national level by the Bureau of the Balance of Trade from 1716 on.[10] There were several administrative reshufflings throughout the period. In particular, the Bureau underwent major change in the early 1780s. The data production process changed at that time, as documented by Figures 1 and 2 below. These changes had a significant impact on the type of documents that were produced by the Bureau.

During the first period, from its formal creation in 1713 until 1780, the Bureau was a small administrative unit consisting of 2 to 3 clerks headed by a first clerk (*premier commis*), under the supervision of the director of commerce.[11] The production of balance of trade statistics involved three different organizations: the General Farm, the chambers of commerce and the royal administration. The General Farm collected the raw data in their local bureaus where the commodities coming into and going out of the French custom territory were recorded.[12] Each month, its regional departments of the

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[10]   For a detailed discussion on the history of the Bureau of the balance and its functioning during the eighteenth-century, see (Charles and Daudin 2011).

[11]   The director of commerce oversaw all the administration concerned with trade policy and regulations. In particular, he headed the Bureau of trade where economic regulations and policies were discussed.

[12]   The French Ancien Regime customs system was such that the tariff frontiers, the so-called *cinq grosses fermes* (five large farms), was different from the political frontiers. However, in the eighteenth-century, the General Farm recorded the flows of goods coming in and going out of France, even for goods for which there were no tariffs imposed and localities that were not part of the *grosses fermes*. There were parts of France which trade was not recorded,, but most of them gradually included in the statistical territory, for example the free ports of Marseille in 1725 and Bayonne in 1747. Only Dunkirk, a free port, and the regions designed as *provinces à l'instar de l'étranger effectif*, that is the territories who

customs (*direction des traites*) compiled and sent to the Bureau a statistical report of the flows recorded in the local offices of the customs (*bureaux de la direction des traites*) during the previous month. These reports indicate the quantities of each of the commodities traded, as well the prices of those that were taxed *ad valorem*. The Bureau of the Balance of Trade added up these monthly figures to produce a first draft of the French balance of trade for the year. This draft was made of several books or registers, one for each fiscal area. Then, the Bureau sent these registers to the local chambers of commerce (or provincial intendants where there was no chamber of commerce), asking them to check the prices recorded by the General Farm employees as well as to provide information on those that were missing. After a few weeks, or sometimes a few months, the chambers sent the completed registers back to the Bureau of the Balance of Trade. The Bureau then drew a complete annual balance of trade that it presented to the Bureau of Trade in a formal session. Two types of documents from this period (with a few variants) have survived in the archives.

Firstly, the regional registers have been kept in the archives of the chambers of commerce. The chambers of commerce were transformed *de jure* during the French Revolution. Nevertheless, as these were assemblies of merchants and as such private institutions, they in fact kept their buildings, their *modus operandi*, and, more importantly for us, their archives. Two of them were however severely damaged during

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were custom-wise considered as foreign to France, were excluded from the balance of trade statistics until 1789. They included most of Alsace-Lorraine and a small territory around Avignon.

World War II in Dunkirk and Rouen. We were able to recover most of the original materials in other locations – Bayonne, Bordeaux, Marseille, Nantes and La Rochelle – although quite a few archives are missing.[13] These sources are essential, as they collate not only the value of the flows recorded, but also the original quantities, unit of quantities and individual prices, all information that is often missing from national balance of trade records.

Secondly, some national registers referred to as *Objet général* survived. These were the end product of the Bureau. However, several of them are missing. Throughout the whole period, we were able to recover complete registers for 26 years only.[14] Most of them contain only limited information, namely the commodity names and the value of individual flows, but some of them also have information on individual quantities, prices and measurement units. In a few rare instances, we also have an indication of the regional office where the flow was recorded.

Figure 1 around here

A major change occurred at the end of the 1770s. Jacques Necker, who was then in

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[13]   Out of about 12 or 13 locations, we have been able to trace and recover at least partially eight of them. Only once were we denied access to an extant source, the books for the region of Lyons that are kept in the archives of the Lyons chamber of commerce. As to the others, they were most probably destroyed in circumstances that we have not been able to document up to this day.

[14]   1750, 1752, 1754 to 1761, and 1767 to 1780, 1782, 1787-1788. 1750 is not really an *Objet Général*, but a serie of partner-specific booklets mentioning the fiscal area where each trade flow has been registered. 1752, 1782 and 1787 do not include all intercontinental trade.

charge of the economic administration of France, commissioned an audit on the Bureau of the Balance of Trade's practices and statistical production. The physiocrat Du Pont de Nemours was in charge of this audit. He pointed out several issues in the construction of figures and evaluation of trade flows. The consequence was a considerable reorganization of the process of data production. A new Bureau was created in 1781 in a very different administrative setting, and the old Bureau was terminated in 1782 after the release of the balance of trade for the year 1780. The new Bureau was now headed by a *maître des requêtes*, a high-ranking official, instead of a clerk. The director of the Bureau was a member of the government in charge of relations with the General Farm, and he did not really take part in the day-to-day operation of the Bureau, which was administratively managed by a vice-director. Its staff went from a mere three clerks to a dozen in a few years. Bureau personnel were attached to the General Farm. Its offices were located in the *Hôtel des Fermes*, the head office of the General Farm. Moreover, in 1783 the Customs administration was transformed into a public company (Matthews 1959, 84).

Although the new organization for collecting and constructing the balance of trade was different from the previous one, the raw data on which they relied were the same: the flows of trade as registered by the local Farm offices and the monthly reports assembled by the regional Farm offices and sent to Paris. There were, however, some significant changes as Figure 2 illustrates. Firstly, there was no longer any exchange of information with the chambers of commerce. Prices were now set by the Bureau using information provided by the General Farm's employees. In the absence of any positive

documentation, it is difficult to fully understand the rationale behind this choice.[15] It is probably linked to the standardization of physical measurement units that is characteristic of the data produced by the new Bureau. Indeed, while the national register produced by the former Bureau, the *Objet général*, included different units of measurement of diverse regional origins, the statistical documents produced by the new Bureau only used standardized units, such as the *livre* (pound) and its multiples (*quintal*) for weight, and the *velte* and its multiples (*pinte*, *muid*) for liquid measurement.

Secondly, by 1784, colonial trade was recorded first-hand by the ministry of the Navy in the colonies instead of being recorded in the French mainland by the Farm. In the context of the new colonial commercial regime put in place in 1784, the colonies of the French West Indies had been allowed to trade some goods directly with other countries and European colonies. Therefore, trade had to be measured from the colonies, which were outside the jurisdiction of the General Farm. Following this legal change, the Ministry of the Navy and the General Farm entered a controversy about their respective colonial trade figures. The new Bureau even conducted a specific study to resolve this issue, which concluded that the figures were actually compatible.[16] Documents on

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[15]   The process of setting prices by the merchant communities (the chambers of commerce) went smoothly and complaints coming either from the Bureau or the General Farm about these prices seems to have been very rare.

[16]   French Colonial Archives (Aix-en-Provence, CAOM), FB 14 "Observations sur les différences qui résultent de la comparaison du commerce de St Domingue, en 1787, suivant les états adressées par M. de Marbois et ceux du bureau de la balance du commerce", 1788.

metropolitan trade in colonial goods for this period seem to have been produced by the Ministry of the Navy, maybe based on data collected by the General Farm, but we have not been able to confirm it.

Figure 2 around here

The *Bureau de la balance de commerce* ceased to exist on October 19th 1792. It was replaced on the same day by the *Bureau des archives du commerce*, headed by Ambroise-Marie Arnould. Arnould had been working at the former Bureau since 1783, assisting its director since 1791.[17] While this suggests a clear continuity between the two institutions, we lack more specific information on the way the new Bureau collected its data. We can nevertheless outline some of the most salient aspects of its work.[18] First, customs borders were now aligned with the political frontiers of the French state. This process of convergence – which had begun in the 1780s with the progressive inclusion of all the areas located outside the jurisdiction of the Bureau of the Balance of Trade – was complete. By 1789, Dunkerque, Strasbourg and all the "*provinces à l'instar de l'étranger effectif*" had been included into the accounts of the balance of trade. This evolution was coherent with the destruction during the French Revolution of all internal customs and privileges inherited from the Old Regime . Second, the General Farm disappeared. Abhorred by the French people, the institution was one of the victims of the deep transformation of French government during the

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[17]   https://www.ccomptes.fr/fr/biographies/arnould-ambroise-marie-henry, last viewed 1/12/2020.

[18]   This paragraph draws on Beaud (1964) and Charles and Daudin (2011).

Revolution. It was replaced by a Customs administration integrated in the Ministry of Interior. However, a large share of the personnel of this new institution came from the General Farm. The *Bureau des archives du commerce* thus seems to have been a rather straightforward renaming of the former Bureau rather than a genuine institutional creation. Third, the simultaneous expansion of the economic administration around the Bureau and the shrinking of its workforce attested its relative marginalization. Whereas it used to be, especially in its latest period, one of the main centers of economic expertise during the Old Regime, after 1792, it became a small administrative unit whose limited aim was to produce a simplified synthesis of the French balance of trade.[19]

From archival documents to a quantitative dataset

Despite the continuity underlined above, the different Bureaus of the Balance of Trade and related institutions produced documents with very significant differences. The canonical document produced by the Bureau took the form of Fig. 3. (see below), an *Objet général*. It contained kingdom-wide flows of trade consigned in a specific framework. The commodity flows are classified in alphabetical order of their names (*Acier* {steel}, Agaric, etc.). On the left page are incoming commodities and, on the right page, commodities going out of the French kingdom. The third type of information contained is that of the trade partner (*Pays*), to or from which the commodity was going

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[19]   For example, the Bureau ceased to record ship movements, capital movements and the balance of services. All these tasks that were among its prerogatives in the 1780s were entrusted to other administrations.

or coming. Then (third column), the quantity and measurement units, and finally the value of each flow. Each flow is thus characterized by six types of information - commodity name, whether it is an import or export, its regions of origin or destination, its quantity, measurement unit and its value. These are the six common pieces of information we stored in our dataset.

Figure 3 around here

However, as we can see in Table 1 below, there were several other types of documents that we used as sources for our database. These sources contained in some cases more information than the six common categories of information listed above.

Table 1 around here

Local (L) sources (see Fig. 4a) are the richest. Not only do they provide the six habitual types of data, but they also systematically provide the French region of departure or arrival for each flow. Some also contained additional detail such as the tax per unit collected or the description of the local unit used. Some national sources (categories Ntd, Ntdtp) also contain information on the French region of departure or arrival. Other sources however provide less information. For example, the *Résumé* (R) provides only a limited set of data: commodities are grouped into about 200 categories and we only have the value of each flow, not the quantities of goods.

Figure 4a around here

Some of the sources we collected were not integrated into the database. First, some documents are not compatible with the data model we have chosen. Data on national trade in 1671 and on monthly Rennes custom area's trade in 1714 does not include

values or unit values, only quantities. Local trade data for Grenoble's custom area from 1726 to 1728 uses a periodization that does not match the regular year.

Second, all the available data have not been digitized. a tiny part of the data collected from the local sources (L) have not been transcribed and are therefore missing from our dataset.[20] Hopefully, we will secure additional funding in the near future to complete the database.

The transcription of balance of trade records is indeed challenging. A number of them are relatively readable, but even so, the great diversity of names for commodities and units of measurement encountered in the eighteenth century as well as the huge variations in spelling are a daunting issue (the next section explains how we have dealt with it). Although these aspects are time consuming, they also carry very interesting information for eighteenth-century and early nineteenth-century social historians. For example, unusual variations of spelling signal either that an inexperienced pen-pusher did the writing, or that the commodity was previously unknown to the bookkeeper and, therefore, quite rare in the place where it was recorded. The same goes for the unit of measurements, since imported commodities were often measured in specific measurement units borrowed from their place of origin, such as *millerolles* for Marseille's olive oil and wine. Not only is it difficult to compare these units with more

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[20] More precisely, a few years from local custom areas (Nantes and Marseille especially) need to be digitized. It represents about one hundredth of the actual dataset. Their inclusion will not change the structure of the database.

current units such as *livres* (pounds), *pintes* (pints) and muids as well as the modern metric system, but they are also often misspelled. In addition to the spelling variations, the documents can sometimes be very hard to read due to the book keeper's handwriting and stylistic shorthand (see fig. 4a and below 4b).

Figure 4b around here

In the above, the commodity names are relatively easy to decipher even if the spelling is antiquated (*beuf* instead of *bœuf* {beef}, *bled* instead of *blé* {wheat}). The difficulty comes from the units of measurement and prices. In the second line, for example, one should read that the flow is made of 1,509,150 pounds (*livres poids*) of salted butter (*beure salé*) at an estimated unit price of 21 *livres tournois* (the shorthand sign in uppercase after 21 is *lt* for *livres tournois*) per one hundred pounds (the shorthand "*le %*" means per one hundred units, that is pounds). In the third line, one should read that the flow is made of 150 barrels (*thonneaux* is for *tonneaux*) of wheat, at an estimated unit price of 130 *livres tournois* per barrel (*tonn* is for *tonneaux*).

This short sample already shows how transcribing the documents can, more often than not, be a challenging task. In the course of the development of the TOFLIT18 project, we constructed an informal list and then a dictionary of commodity names as well as a database of French Old Regime units of measurement and their modern equivalents in the metric system. The former was used to create a glossary where one can find definitions of most of the commodities names. The latter allowed us to be able to transcribe a large part of the Old Regime units into modern equivalents, a necessary task to be able to compare our dataset of French trade with other similar datasets, such as

that of the Sound toll registers.[21] In the next section, we describe in detail the process that allowed us to manage this very large set of commodity names and spellings. Rather than simplifying our task by erasing them, and in the process losing an important batch of information on our sources and more generally on the practices of trade and how Old Regime administration endeavoured to classify trade, we made the choice of recording the raw information and then developing a series of tools in order to deal with its complexity to produce databases that can be used by quantitative economic historians.

A hierarchy of term classifications

Trade statistics include a lot of numerical categories (values, quantities and prices). These are mostly straightforward to re-transcribe, verify and interpret. They also include, in a period when harmonized classifications of goods did not yet exist, a lot of textual information describing merchandise. As of January 2020, there were nearly 55,000 different product names, many of which included many different words, in the transcribed source. More than 28,000 are hapaxes that only appear once.

The huge number of different commodity names makes it difficult for historians to produce analyses that can be compared with results from other contexts, such as eighteenth-century England or nineteenth-century France. We therefore created research tools to deal with three separate challenges stemming from the variations in recorded commodity names:

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[21]   http://www.soundtoll.nl/index.php/en/over-het-project/sonttol-registers. See Charles and Daudin (2018).

- "typography": different manners of writing or transcribing the same product name

- "de-aliasing": different product names for the same commodity (synonyms)

- "aggregation issues": research issues require historians to find ways to aggregate specific product categories, which were recorded as heterogeneous products with different names at different times and/or in different locations and/or by different administrative units (locals branches of the General Farm or Bureau of the Balance of Trade).

Our ambition is to offer researchers a system that will help them handle these issues according to their research issues. In light of this, each possible way to aggregate would only answer a limited set of research issues. As a consequence, we did not design a single classification, but a tool that can help researchers build a satisfactory classification for their research. We imagined a hierarchical classification system (see Figure 5) that allows scholars to adapt the exploration tool to their research interests, while reusing common purpose theme-free classifications.

 This hierarchy offers successive levels of aggregation, from a complete listing of the sources to a narrow thematic classification.

Figure 5 around here

This classification system contains two types of classifications: five "general" classifications we designed to provide a simplified version of the raw data for all users, and several "specific" classifications, which are built by researchers targeting a specific

issue and are neither created nor maintained by us.

The first "general" classification is an "orthographic" normalization. It addresses the typographic issue: one same commodity name has been written in the database in many different ways, either because it was first written in different ways or because the transcriber made a mistake.[22] For example, "Aiguiles", "Aiguille", "Aiguiller", "Aiguilles", "Eguilles" and "aiguilles" are all versions of "aiguilles" (needles). The most extreme case is "cuirs de bœuf tannés" : it is written in sixty-five different manners in the database. By standardizing the spelling, we reduced the number of product names from 55,000 to 25,000 (still including 11,000 hapaxes).

The second "general" classification merges aliases: different names that actually designate the same thing. For example, "Mercerie en aiguilles" and "aiguilles" are both needles. Wheat and indigo are designated by more than twenty names each that have the same meaning. This classification reduces the number of product names down to 18,500 (including 8,043 hapaxes).

Figure 6 and Figure 7 illustrate the consequences of this simplification work. They show the cumulative share of trade flows and trade values for the most important products. In the raw data set, the most important 200 products cover only 61 per cent of all trade flows. In the simplified classification, the most important 200 products cover 80 percent of all trade flows. Another way to look at the same issue is to remark that one has to study around 600 products in the source to identify 80 percent of trade flows,

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[22]   French spelling was not normalized until the nineteenth-century.

but only 200 products using the simplified classification. This is a manageable number. Still, leaving aside the distribution tail of products might be misleading for some research questions. As a result, we classify as many as these products, including hapaxes, into more aggregate classifications. Only 1,000 products (mostly hapaxes) out of 18,500 cannot be identified precisely enough to be classified.

Thus other "general" classifications are aggregations. "Revolution and Empire", "SITC18" and "Aggregate Revolution and Empire" aim to create a manageable number of categories of goods (respectively 150, 24 and 10) that can be used to analyse the whole dataset for every year. A researcher interested in studying fishing is much better off knowing that all 270 sea products are easily found under the category "Pêche et fruits de mer" in the "Revolution and Empire" classification, rather than having to identify these 270 items in the 18,500 item long "Simplification" list. It must be noted that these classifications are based on different perspectives: the last two are based on a template first produced just before the Revolution and implemented with adjustments until the fall of the Napoleonic Empire, while the first one is based on an international classification published in 1950 (the "Standard International Trade Classification") (Department of Economic and Social Affairs, Statistics Division 2006).

Figure 6 around here

Figure 7 around here

The "specific" classifications are of a different nature. They are built to answer specific research questions, such as the evolution of trade in medicinal drugs, or Venetian glass beads, or goods affected by the 1787 Eden trade treaty. These classifications have been

designed by researchers, some of them external to the project. The TOFLIT team simply host the classifications and make them available to other researchers, to explore the dataset through these specific points of view. For instance, the cotton classification aggregates the goods into three simple groups: "not raw cotton", "raw cotton", "maybe raw cotton" (Note that a classification does not have to aggregate the complete products list). This system also allows concurrent classifications. With the same root set of data, researchers are able to develop alternative ways to aggregate them to address different research questions. The creation of those classifications required ample use of specialist knowledge of the eighteenth century material world, and the consultation of eighteenth century and early nineteenth trade handbooks and dictionaries as well as more recent historical literature.

As illustrated in Figure 8, French trade partners pose roughly the same kind of issue as commodity names. We have applied the same method. The exercise was much easier as we started from less than 1,100 trade partners and their identification is much easier than goods.

Figure 8 around here

An algorithm to update classifications

One of the issues we encountered when implementing these classifications is that multiple researchers were working in parallel to feed our database with more and more data points. Not only did transcribing some of the most voluminous sources take time, but we were also discovering more archives to be transcribed and included into the database, which is also likely to happen again in the future. Furthermore, as is the case

with most taxonomic endeavours, the rules and rationale of some of the downstream classifications (such as those aiming at normalizing orthography) changed several times during the course of the project to better fit our understanding and framing of the data. A problem therefore arose when adding or modifying names since our classifications are organised in a set of hierchical relations, or as a dependency tree. The source of the hierarchy comes from the documents. The more we aggregate, the more we establish hierarchical relations or chain classifications, each downstream classification being related to an "upstream" one. We refer to classifications as "upstream" when they are positioned above a given classification, whereas a classification is called "downstream" when we analyse its dependency link to a specified upstream classification. This means the source data, directly drawn from manuscript sources and documents, cannot be downstream, as it forms the basis of our hierarchical arrangement, presented in Figures 5 and 8. We needed to decide how to aggregate the new piece of information added to the classification system. This meant that the whole hierarchy had to be updated regularly so we could integrate new commodity or partner names. This promised to be a huge burden for our team as well as for researchers who would have to parse the whole system after each addition. We therefore designed a semi-automatic solution to keep the whole system fluid and able to accommodate additional or enhanced information when it became available. Only the first classification of the hierarchy ("orthographic"), which is based directly upon the sources, has to be updated manually to include genuine orthographic items linked to the new commodity or partner name.

We designed a bespoke algorithm to evaluate, for each downstream classification, how each new item should be aggregated into existing groups or not. The objective of our algorithm is to determine whether altered groups in an upstream patched classification

split or merge aggregated groups within downstream classifications. We are thus able to focus our human resources on those "breaking changes". Its rationale is to preserve the distribution of source items in the downstream classification in spite of the new data. Our algorithm detects the cases where a change in the upstream classification creates the need for a different set of source items in the downstream classification, that can neither be automatically comprehended nor mathematically resolved using set theory assertions. The algorithm points these cases to the team, who can then solve them by slightly changing the classification system to accommodate the new items that were pushed into the database. Conversely, if a downstream group is not much affected by the addition of new items or by underlying group moves, i.e. if the group remains contained in another one without overlap between conflicting groups, then we simply accept the new aggregation scheme.

Let us, for the sake of clarity, consider the example of a classification C that includes a group *grains* bringing together *blé*, *froment grains* and *grains froment*. If new data results in adding a new item to the group *grains froment* (for example *grains de blé de froment*), then we do not need to worry about downstream classification based on C, because the set of preexisting items of the group "wheat" does not change. But imagine the item *blé millet* comes up. This item suggests that not all *blé* is froment, but that some is *millet*. In this case, we now have three groups: *grains froment* brings together *froment grains* and *grains froment*; *grains millet* contains *blé millet*; and *undefined blé* contains *blé*. In that case, the decision to rewire downstream classification groups using this group cannot be made automatically, as the *grains* aggregation does not exist anymore, nor can *grains froment* be considered a simple renaming of *grains*. A more thorough explanation of the algorithm can be found in Appendix 2.

Our algorithm produces a table that helps our team to only focus on such problematic cases that have to be solved by hand, while ignoring the others - they are the majority - that our process pruned for them. Furthermore, our algorithm provides researchers with suggestions on how to solve the problematic cases.

Dealing with quantities

Seventy percent of trade flow observations contain information on quantities and unit prices in addition to values. We have endeavoured to convert these quantities into modern units: kilograms, numbers of items, centimeters, sheets and liters (respectively 52, 13, 1.9, 1.3 and 1.1 percent of trade flows giving quantity information). Again, we used successive classifications (see Figure 9). Most cases are not difficult to treat: for example dozens (*douzaines*) and pounds (*livres*) (42 percent of trade flows with quantities) can unambiguously be translated into modern units.[23] This is more difficult for units such as barrels (*barils* and *tonneaux*) or casks (*barriques*), since there were huge variations of weight and countenance depending on the location where the unit was recorded and the type of products, for example liquid or solid.[24] Following a

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[23]　There were many local types of *livres* with different weights, but only one was used in balance of trade records: the *livre de Paris*, alternatively named *livre de poids de marc,* weighing 489,5058 grams.

[24]　*barils* and *tonneaux* were two different measurement units in old regime France, the former being used in general for solids, but there was some diversity in practice, between the different localities or even scribblers. There were also important variations between localities for each of these units: a *tonneau* of wine in Bordeaux did not contain the same quantity of liters as a *tonneau* of wine in Nantes. Moreover, the *baril* is sometimes used as a measure of volume that can be converted into liters, sometimes used as a measure of

method similar to Scheltjens's (Scheltjens 2009, 2015) we produces a multi-keyed table ("classification_quantityunit_metric2") thanks to various sources to deal with this issue (especially Doursther [1840]). This work is still in progress, but as of late 2020 we have less than 3 percent of trade flows with quantities not converted into modern equivalents.

Figure 9 around here

Results: a datascape on eighteenth century French trade

In addition to the database, we have developed a web application that provides an exploratory tool to analyze the dataset (https://toflit18.medialab.sciences-po.fr). We call this kind of research instrument a "datascape". Datascapes have been designed to ease the exploratory analysis of complex datasets (Venturini et al. 2017). They feature filtering and aggregating functions that allow users to create various interactive data visualizations. With these functions, the user of the database can emulate both descriptive statistics and sophisticated data visualizations to explore the dataset in its many dimensions. Moreover, the combination of expert knowledge on an issue and the datascape features help researchers to better design their research or even suggest new research questions.

In the following, we provide a detailed illustration of this particular exploratory research process and how the researcher can make use of it. To do so, we invite the reader on a visual exploratory journey through our datascape about the effects on French trade of

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weight that can be converted into kilograms and even, in some rare cases, as a measure of quantity that may be converted into a certain number of items.

the loss of Canada in 1763.

Case study: the loss of Canada

From 1756 to 1763, the Seven Years War opposed the main European countries and their colonial dependencies.[25] This war is often considered as the first global conflict as, in addition to Europe, the battleground reached the other continents: Americas, Africa and Asia. The Paris Treaty concluding the war was humiliating for France, which lost a fair share of its colonial empire, in particular New France (French North America). However impressive in terms of territory, this loss has often been deemed very marginal from an economic point of view and consequently has never been studied thoroughly from this perspective.[26] The TOFLIT18 dataset and datascape provide a renewed perspective on the impact of the loss of Canada, at both the macroeconomic (national) and the local level. Our argument is that by comparing different data features, mixing levels of aggregation and mobilizing a data classification system, the web application allows us to identify the right focus and to show the issue of the economic consequences of the loss of Canada in a different light. The short exploratory journey we will follow is summarized in Figure 10.

Figure 10 around here

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[25] See for a useful introduction: Baugh (2014)

[26] Voltaire captured well this general belief in his classic and very successful novel *Candide*, where he stated that France and Great Britain "are at war about a few acres of snow somewhere around Canada, and that they are spending on this beautiful war more than all Canada is worth" (Voltaire 1918, 122).

Although this section does not pretend to make a definite contribution to the study of the consequences of the Seven Years War on the French economy, it suggests ways to go beyond the thin literature on the subject (J. G. Clark 1981; Riley 1986). Note that all the figures used in this section were produced by using the datascape itself without specific scripts or analyses.

We are focusing on the period 1750-1770, comparing the periods before, during and after the Seven Years War. In **Step 1** we show that the available local data in this period includes the trade from seven French customs regions: Marseille, Nantes, La Rochelle (except for 1755 and 1763), Bordeaux, Rennes and Bayonne (note that the year 1750 counts much more local information than any other except year 1789). The metadata view reveals among other things the variability of the coverage of our dataset from year to year and from fiscal area to fiscal area.

Figure 11 around here

To study a particular trade partner (Canada) we first have to deal with the heterogeneity of French trade statistics: transcriptions contain more than a thousand different trade partner names. In **Step 2**, we use the country classification system to reduce trade partners' heterogeneity. At the source level (transcriptions), French North American colonies are referenced under multiple names such as "îles françaises de l'Amérique, Canada et Terre-Neuve", "Colonies françaises de l'Amérique" or even included under the heading "Colonies de l'Amérique et de l'Inde" with various spellings (See Figure 10, right column "Source"). In our upper classification called "Simplification", these multiple references are aggregated into groups such as "Îles françaises de l'Amérique", "Colonies Françaises" (Figure 12, left column "Simplification"). This allows us to

narrow down the 19 different names into six standardized names or categories. However, neither the source names nor our simplified names enable us to focus on Canadian trade, as Canada is usually mixed with other French colonies.

Figure 12 around here

We therefore need to create an indirect method to abstract trade with French Canada from trade with the other French colonies to be able to analyse it. In **Step 3**, we begin by looking for the relative importance of the aggregations of chosen trade partners in French trade. It is clear that trade is dominated by "Îles françaises de l'Amérique" or "Colonies françaises" (see Figure 13).

Figure 13 around here

To visualize the geographical structure of French trade, we can now use a trade network built by aggregating trade flows as edges between two types of nodes: customs regions (*directions des traites*) and trade partners – this is **Step 4**. Such a network[27] using flow values as edge weights is represented in Figure 14 below. "*Îles françaises de l'Amérique*" stands out as the most important trade partner in value. Its three main trade partners in value are Marseille, Bordeaux and Nantes.

Figure 14 around here

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[27]   The network visualisations are all obtained by applying the "ForceAtlas 2" algorithm which tends to put nodes closer as they share the same neighborhood (Jacomy et al. 2014).

However, as seen in Figure 12, "Îles françaises de l'Amérique" covers a much wider area than Canada alone. Many of the flows recorded as coming from or going to "Îles françaises de l'Amérique" are in fact relevant to the Carribean area or even Louisiana, rather than Canada which was a much smaller commercial partner than the French sugar islands. We are able to provide an indirect measure of this in Step 5 (Figure 15). We focus on the co-occurrences network of product terms (a link between terms indicates the value of trade flows for products whose names include both terms, one immediately following the other) in import trade flows with "Îles françaises de l'Amérique" between 1750 and 1770. The product terms are produced by isolating the words composing the product names which are taken from the "Simplification" product classification (as for trade partners, a hierarchical and concurrent classification system has been built to aggregate commodity names). Only the labels of the terms with the greatest value are displayed. We can thus show that the most valuable trade sectors are: sugar (*Sucre - Terré - Brut - Blanc*), coffee (*Café*), raw materials (*Cotton - Indigo - Laine*[28]) and codfish (*Morue - Séchée*). The first three are from the West Indies, while only the last is from the Northern Atlantic bordering Canada.

Figure 15 around here

Therefore to isolate trade with Canada, we have to build a specific product classification (named "Canada") to identify products that were produced or may have been produced

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[28]   No wool is imported in France from the French West Indies, obviously. However, *Coton en laine* designates raw cotton in the source.

in Canada (Step 6 Figure 16).[29] This classification is based on and therefore more aggregated than "Simplification" (hierarchical system). It is a specific thematic classification out of many others in our product classification hierarchy.

Figure 16 around here

We can then recompute the products term network in imports, but this time by filtering products "from" or "maybe from" Canada (Step 7 Figure 17). Figure 17 shows that Canadian imports were mostly (in value) codfish - the network of terms linked to *Morue* -, and furs and skins - the network of terms linked to *Peaux*.

Figure 17 around here

Using this classification, we can now isolate the trade flows of imports from Canada and thus check which parts of France were importing the most from Canada. In Step 8 (Figure 18) we examine the number of import flows (not their value) from Canada for each fiscal area. At this level, the number of flows only reflects the diversity of commodities in trade. We therefore use another view to draw up time series of values for the first four fiscal areas (Step 9 - Figure 17) (sorted by decreasing average number of flows).

Figure 18 around here

La Rochelle was indeed the main French port importing Canada's products in both

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[29]   The first version of this classification was produced by Quentin Vidal for his Masters degree dissertation.

number and value of flows until 1761 (Step 9 Figure 19), although for a few specific years (1739, 1741 and 1742), Marseille had a greater value share.[30] La Rochelle imports declined from 1750 to the end of the period, while Marseille replaced La Rochelle as the main importer of "Canadian" products in France after the Seven Years War. It must be noted that ports of Rennes's custom area also captured part of the import trade in "Canadian" products after 1760.

Figure 19 around here

Step 10 (Figure 20) allows us to study in more detail the changes triggered by the 1763 Paris Treaty, which put an end to the Seven Years War. On the one hand, the treaty sanctioned the loss of French mainland Canada territories, and hence the collapse of the trade of commodities such as furs and skins that France was now banned from importing directly from Canada, and which had formed the largest part of La Rochelle's import trade from Canada. On the other hand, as the Paris Treaty also guaranteed to France the dominion over the Saint-Pierre-et-Miquelon island and the associated right to fish in Newfoundland, the codfish trade recouped its losses after the peace settlement and was redirected to the ports which were either more dynamic (Marseille) or more specialized (Saint-Malo in the custom area of Rennes).

Figure 20 around here

Step 11 (Figure 21) gives more insight on La Rochelle trade. In addition, by using the export feature to download the underlying data as a CSV file, we can compute (with

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[30] For an excellent overview on Marseille's port activity during the eighteenth century: (Carrière 1973)

STATA) the evolution of import and export shares of "Îles françaises de l'Amérique" in La Rochelle trade for five years before 1756 and after 1763. The average import shares from "Îles françaises de l'Amérique" diminished from 75% to 63% (-12 points) while exports dropped from 47% to 20% (-27 points). For Bordeaux, Nantes and Marseille the evolutions of the same export rates were respectively -8, +4 and +3.

Figure 21 around here

Step 12 (Figure 22) provides a more detailed view of the evolution in La Rochelle's trade due to the loss of Canada. We compare La Rochelle's product terms networks of imports and exports before (1750-1755) and after (1765-1770) the war. If the main commodity terms that composed the network remained present throughout the two periods, their relative places changed but, more importantly, we can observe an important decrease in the diversity of commodity terms in both imports and exports (networks are less dense) after the war. By removing one important trading partner, the loss of Canada diminished the quantity and the variety of La Rochelle trade. Before the Seven Years War, La Rochelle was a mid-size international trading hub with a genuine specialization due both to its specific local productions (salt and cognac) and to its quasi-monopole on trade with Canada. La Rochelle was shipping in hides (*peaux*) from Canada, which it re-exported to several destinations, sometime after having transformed them, especially into hats (*chapeaux*). It was exporting to Canada first necessity products like iron-made objects and tools, as well as a variety of textile products including predominantly cloth products (*toile*). But besides these main categories, a wide range of other products, mostly linked to the West Indies trade, were exported or re-exported via La Rochelle. After 1765, the imports network was dominated by

products destined for shipbuilding (commodities made of wood, iron and to a lesser extent copper) - and goods from the West Indies (sugar). The trade in hides almost disappeared and exports were dominated by a handful of colonial products. Even the international trade of La Rochelle's traditional exports, salt and brandy, was badly hit. One hypothesis is that instead of going directly to a foreign destination, these products were now directed to other French Atlantic ports (Nantes and Bordeaux) from which they were exported. After 1765, La Rochelle was no longer a significant international port and even if it regained a decent volume of trade in the 1780s, it relied almost entirely by then on the slave trade, and was financed entirely by Bordeaux and Nantes merchants (J. G. Clark 1981).

Figure 22 around here

We can then verify in Step 13 (Figure 23) that this impact on La Rochelle trade diversity did not occur in Nantes trade by comparing the number of products exchanged (both import and export) during the period. In both ports, the number of products declined during the Seven Years War. Nantes experienced a recovery afterward: this was not the case of La Rochelle.

Figure 23 around here

Table 2 confirms the result of our data exploration with more traditional tools. We have used a linear regression explaining the log of the number of products traded in Nantes and La Rochelle, using a time trend and period-specific fixed effects. The reference period is the peace period just before the Seven Years War. It is clear that both cities suffered from the Seven Years War, and Nantes apparently suffered even more than La

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Rochelle. However, Nantes's trade recovered from the war and the number of products it traded from 1763 to 1783 was not statistically scientifically different than before 1756. By contrast, the number of products traded by La Rochelle declined between 54% (=1-e$^{-0.77}$) and 75% (=1-e$^{-1,4}$).

Although the Seven Years War is not considered to have had an important long-term impact on French trade, it had a very significant impact on La Rochelle and its local economy, which lost a very important trade market and lost its position as a significant international port of trade.[31]

Table 2 around here

Behind the datascape

As shown by our case study on the impact of the Seven Years War on the French economy, the datascape is a powerful tool to facilitate the understanding and analysis of complex datasets thanks to a set of dedicated interactive data visualizations. This software is a free and open source tool (available here: https://github.com/medialab/toflit18) : a single-page web application publishing documentation and interactive data visualizations (developed in JavaScript) uses an Application Programming Interface (API) delivering data upon request by querying a graph database (developed in node.js on top of a Neo4J database (http://neo4j.com). We chose a graph database to ease the development of our classification tree system. Indeed this system is recursive (each classification is based on an other classification) and

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[31] This was underlined by J. G. Clark (1981, 17–18).

dynamic (users can add/modify classification). The traditional relational database option was discarded because the recursivity of their query systems does not support undefined depth traversal very well (Girard et al. 2016). The need for a dynamic index also made the search engine option irrelevant because it would have required to re-indexing the whole data set for each modification of the classifications, which would take too much time. Nevertheless, this choice was made when we wanted to allow users to modify classifications directly from the user interface. Since we ultimately had to drop the classification direct edition feature because of a lack of time, the search engine option would actually have served this web application very well (Girard et al. 2019). To release a new version of the dataset in the tool, we use a continuous data integration process which automatically rebuilds the database when a new version of the dataset is published (see the public github repository https://github.com/medialab/toflit18_data; the dataset is published as a data package (https://datahub.io/docs/data-packages): https://github.com/medialab/toflit18_data/blob/master/datapackage.json).

Conclusion

This paper presents the database and associated tools on French eighteenth-century and Revolutionary trade created by the team of the ANR-funded TOFLIT 18 project. This work was based on the collection and exploitation of the documents created by the *bureau de la balance du commerce* and the related organizations, either public or private, that it coordinated. This very rich source is however exceptionally difficult to use for two reasons. Firstly, because of the French Revolution and other historical incidents, its archives have been largely destroyed and the surviving ones widely dispersed throughout France and even Europe. Secondly, the variations in spelling in

commodity names combined with the sheer profusion of measuring units used in the documents produced by the bureau is a challenge for historians who want to conduct a quantitative assessment of French and European trade and economies.

This paper documents the techniques we designed to allow the use of this data-set in a wide variety of research, be it qualitative or quantitative. Our datascape facilitates the exploration of the database through visualizations that document the evolution, the sectorization and the regionalization of French trade using nothing more than a web browser, which makes it possible to use it in a classroom setting. Our hierarchy of classifications can help both to research individual trades such as Venetian glass beads or grains, and to study the evolution of French and European trade and economies as a whole. This flexible aggregation system leverages the interpretative power of datascape data visualizations for many different research interests concerning 18th-century French trade. Finally the transcribed dataset is published as open data, to let anyone reuse it freely without the tools we produced.

In addition to the database itself, our team has developed a set of tools, in the form of a datascape to help researchers immerse themselves more effectively into the dataset we created.

This paper presents a visual exploratory journey in our database to illustrate the potentialities opened by the datascape. In our case study, we have shown how the datascape tools can be useful to investigate the idea that the loss of Canada had not affected the French economy in any significant way. While this makes sense at the national level, we were able to suggest that the damage was much more significant at the regional level when the loss of Canada precipitated La Rochelle, the fifth or sixth

French port and a significant hub to North America, into a rapid decline from which it never recovered. We showed in our article how researchers can use these tools effectively to:

Check (easily) what data is available and the direction the data exploration should take through visual documentation (Metadata view used in steps 1 and 8);

Help them to reduce the sources' heterogeneity through progressive and concurrent classifications and to create aggregates or sets of commodities relevant to a great number of varied issues (Classifications view in steps 2 and 6);

Provide powerful insights through the use of sophisticated visualizations of the dataset or part of the dataset, arranged by time (Time Series, steps 3, 9, 10 and 11), space (Locations, step 4) and terminological variables (Product Terms, steps 5 and 7);

Track down transcription errors (step 11);

Download the appropriate data series directly from the exploration tool into a format (.csv) that can be exported into statistical softwares such as STATA.

As such the datascape is a tool that can be adapted and used in a wide array of database building and exploitation activities. It can enable researchers to address a broad range of research topics, removing barriers to access through a freely available web application, open source software and open data.

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Appendix 1: Archival sources

"AD" stands for "Archives départementales"

"AN" stands for "Archives nationales (Paris)"

"ANOM" stands for "Archives nationales d'Outre-Mer (Aix-en-Provence)"

"BM" stands for "Bibliothèque Municipale"

"IIHS" stands for "International Institute of Social History (Amsterdam)"

Local

AD17 41 ETP 270/9385-9501

AD33 C4268-4269

AD33 C4386-90

AD34 C5488

AD44 C706

AD44 C716-C718

AD64 2 ETP 104-105

AD76 7F97 - was destroyed in 1944, but partially re-transcribed by Pierre Dardel

ANOM Col F2 B 13 (tableaux 37 et 38)

ANOM Col F2 B 14 (tableau 25)

Archives de la CCI de Marseille - I 21-25 and I 29-31

Archives de la CCI de Rouen Carton VIII

BM Lyon ms 1490

Objet Général

AN F12 1835

AN F12 242-248

BM Rouen, Fonds Montbret, 155-1 and 155-2 and 849

BNF MF 6431 (Compagnie des Indes)

IIHS-122A-G

Résumé

AN F12 251

National toutes directions partenaires manquants

AN F12 1665

AN F12 1666

AN F12 1667

AN F12 1667 et CCI Marseille I 31

AN F12 1835

AN F12 835

AN Marine B 7 514 et ANOM Col F2 B 14

ANOM Col F2 B 13 and 14

BNF N. Acq. 20538 et 20541

BM de Saint-Brieuc, Fonds Gournay - M85-87

IIHS-133

National partenaires manquants

AN F12 250 et 1835

BM Rouen, Fonds Montbret, 155-1

Bibliothèque Historique de la ville de Paris, Fonds Montyon 101FOSS/25

National toutes directions tous partenaires

BM Saint-Brieuc, Fonds Gournay - M84, 85, 86 and 87

BNF, MF, 6431 (Compagnie des Indes)

National toutes directions sans produits

AN F12 245-248

BM Rouen, Fonds Montbret, 155-1

IIHS-123

Tableau des quantités

AN F12 251

Tableau Général

AN F12 252 and 1834B

IIHS-128

(Romano 1957; Weber 1904)

Personal communication from François Velde

Tableau de marchandises

AN F12 251

1792-first semester

AN F12 251

1792-both semester

AF F12 252 et F12 1843B

Compagnie des Indes

BNF Ms. 6431

Appendix 2: Outline of the Classification Tree Rewiring Algorithm

Adapted from the project's repository documentation:

https://github.com/medialab/toflit18/blob/master/docs/patching.md

The related source code was written in JavaScript for Node.js and can be found here:

https://github.com/medialab/toflit18/blob/master/lib/patch.js

Rationale

Let's consider a classification as a list of item/group pairs. One item can only exist once in such a list, while groups may gather several items. When an item is not linked to a group (null), such item is said to float in limbo.

Classifications can be seen as a hierarchical tree based upon an initial flat dataset (in TOFLIT18's case, over products and partners) and can recurse as many times as required.

So, at level 0, a classification aggregates items from the source itself, while a classification at level 1 aggregates groups from an upper classification.

The aim of the algorithm is to enable a user to apply a patch to an existing classification while safeguarding as much of the current structure as possible. Such a patch can therefore be applied over a whole classification, or just over a subset of said classification. The goal here is to only perform the least possible amount of

modifications to the tree's structure underlying the classification system, so that downstream dependent classifications remain as consistent as possible.

Process

Checking inconsistencies in the patch, e.g. whether some items were aggregated in more than a single group (this is impossible because we consider a tree that can only be an acyclical graph).

Checking the integrity of the patch:

Did we find items that do not exist in the upstream classification?

How many items are missing from the patch?

Did we find empty groups aggregating nothing?

Transforming the formalism of the patch into a series of atomic edits over the original classification tree while allowing the following operations:

Group creation

Group renaming

Item movements, without forgetting items being dropped into limbo, and former limbo items now newly aggregated

Simulating the application of the patch and observing the results to produce a report of operations being applied automatically and gather conflicting cases for researchers to solve.

Finally, applying the patch along with researchers' choices in order to rewire every downstream classifications accordingly.

Miscellaneous considerations

How do we know if a group was renamed?

Let us consider a group *g* from a given classification and another group *pg* coming from the applied patch.

We say *g* was renamed into *pg* if and only if *pg* is identical to *g* or if *pg* is a superset of *g*.

On the other hand, with *rg* being *pg* minus the items that were added to a group (i.e. an item that was not aggregated in the classification before the patch), we say a renaming operation is "pure", i.e. we can automatically solve the case without even requiring input from the researchers, if *g* and *rg* are identical.

How to rewire downstream classifications?

Let's consider a classification C, a patched classification C', a classification B on which C is based (i.e. an upstream classification) and finally D, one of the multiple downstream classifications.

For each affected group *g* in C (a group is affected if it is the source or the target of any operation and is not new):

Project in downstream: get the group *dg* aggregating *g* in D. If it does not exist, skip the

group.

Project back from downstream: get every group *ag* from C aggregated by *dg* (such as *g* ∈ *ag*).

Project in upstream: create a set S gathering items from B aggregated by *ag* in C.

Project in upstream before modification: create a set S' gathering items (minus those which previously did not exist in C) from B aggregated by any *ag* in C + C'.

Compare sets of upstream items before and after: If S is strictly equal to S'

then the relevant links from *ag* to C' should exist.

else the relevant links from *ag* to C' have to be reviewed by the research team.

Linking operations should be flagged so that users can decide what to do afterwards.

It is also a good thing to check for obsolete groups in C' (i.e. groups now aggregating no items).

Appendix 3: List of data visualisation figures permalinks

For the sake of readability, we shorten the URL used to reference Tofilt18 application web page from which the screenshots were taken. We provide here the list of the complete permalinks which can be used to reference the figure screenshots.

Figure 9 - step 1

Short permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_9_step_1
Complete permalink: http://toflit18.medialab.sciences-po.fr/#/exploration/meta?model=region&sourceType=Best%20Guess%20customs%20region%20product%20x%20partner

Figure 10 - step 2

Short permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_10_step_2

Complete permalink: http://toflit18.medialab.sciences-po.fr/#/classification/browser?kind=partner&selected=partner_simplification&selectedParent=partner_source&queryItem=%28%3F%3Acanada%7Ccolonie.*Am%E9rique%7Clouisi%29

Figure 11 - step 3

Short permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_11_step_3

Complete permalink: http://toflit18.medialab.sciences-po.fr/#/exploration/indicators?lines=%5B%7B%22color%22%3A%22%23504342%22%2C%22partnerClassification%22%3A%22partner_simplification%22%2C%22partner%22%3A%5B%7B%22id%22%3A%22%CEles_fran%E7aises_de_l%27Am%E9rique%7Epartner_simplification%22%2C%22name%22%3A%22%CEles%20fran%E7aises%20de%20l%27Am%E9rique%22%7D%5D%7D%2C%7B%22color%22%3A%22%23C14F4C%22%2C%22partnerClassification%22%3A%22partner_simplification%22%

2C%22partner%22%3A%5B%7B%22id%22%3A%22Colonies_fran%E7aises_d%27A
m%E9rique%7Epartner_simplification%22%2C%22name%22%3A%22Colonies%20fr
an%E7aises%20d%27Am%E9rique%22%7D%5D%7D%2C%7B%22color%22%3A%
22%23A563B7%22%2C%22partnerClassification%22%3A%22partner_simplification
%22%2C%22partner%22%3A%5B%7B%22id%22%3A%22Louisiane%7Epartner_sim
plification%22%2C%22name%22%3A%22Louisiane%22%7D%5D%7D%2C%7B%2
2color%22%3A%22%2385C85B%22%2C%22partnerClassification%22%3A%22partn
er_simplification%22%2C%22partner%22%3A%5B%7B%22id%22%3A-
1%2C%22name%22%3A%22partner%20matching%20%27colonies%20fran%E7aises
%27%22%2C%22value%22%3A%22colonies%20fran%E7aises%22%7D%5D%7D%5
D

Figure 12 - step 4

Short permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_12_step_4

Complete permalink: http://toflit18.medialab.sciences-
po.fr/#/exploration/network?classification=partner_simplification&sourceType=Best%2
0Guess%20customs%20region%20product%20x%20partner&kind=total&dateMin=175
1&dateMax=1770&nodeSize=value&edgeSize=value&labelThreshold=2&labelSizeRat
io=4

Figure 13 - step 5

Short permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_13_step_5

Complete permalink: http://toflit18.medialab.sciences-
po.fr/#/exploration/terms?nodeSize=value&edgeSize=value&labelThreshold=3&labelSi
zeRatio=5&classification=product_simplification&sourceType=Best%20Guess%20cust
oms%20region%20product%20x%20partner&partnerClassification=partner_simplificat
ion&partner=%5B%22%CEles_fran%E7aises_de_l%27Am%E9rique%7Epartner_simp
lification%22%5D&region=%24all%24&kind=import&dateMin=1750&dateMax=1770

Figure 14 - step 6

Short permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_14_step_6

Complete permalink: http://toflit18.medialab.sciences-
po.fr//#/classification/browser?kind=product&selected=product_canada&selectedParent
=product_simplification

Figure 15 - step 7

Short permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_15_step_7

Complete permalink: http://toflit18.medialab.sciences-po.fr/#/exploration/terms?nodeSize=value&edgeSize=value&labelThreshold=2&labelSizeRatio=6&classification=product_simplification&sourceType=Best%20Guess%20customs%20region%20product%20x%20partner&childClassification=product_canada&child=%5B%22Exclusivement_Canada%7Eproduct_canada%22%2C%22Peut-%EAtre_Canada%7Eproduct_canada%22%2C%22P%EAche_d%27Am%E9rique_avant_1763%7Eproduct_canada%22%5D&partnerClassification=partner_simplification&partner=%5B%22%CEles_fran%E7aises_de_l%27Am%E9rique%7Epartner_simplification%22%5D&kind=import&dateMin=1750&dateMax=1770

Figure 16 - step 8

Short permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_16_step_8

Complete permalink: http://toflit18.medialab.sciences-po.fr/#/exploration/meta?model=region&productClassification=product_canada&partnerClassification=partner_simplification&products=%5B%22Exclusivement_Canada%7Eproduct_canada%22%2C%22Peut-%EAtre_Canada%7Eproduct_canada%22%2C%22P%EAche_d%27Am%E9rique_avant_1763%7Eproduct_canada%22%5D&partners=%5B%22%CEles_fran%E7aises_de_l%27Am%E9rique%7Epartner_simplification%22%5D&kind=import&sourceType=Best%20Guess%20customs%20region%20product%20x%20partner

Figure 17 - step 9

Short permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_17_step_9

Complete permalink: http://toflit18.medialab.sciences-po.fr/#/exploration/indicators?lines=%5B%7B%22color%22%3A%22%23C14F4C%22%2C%22productClassification%22%3A%22product_canada%22%2C%22partnerClassification%22%3A%22partner_simplification%22%2C%22product%22%3A%5B%7B%22id%22%3A%22Exclusivement_Canada%7Eproduct_canada%22%2C%22name%22%3A%22Exclusivement%20Canada%22%7D%2C%7B%22id%22%3A%22Peut-%EAtre_Canada%7Eproduct_canada%22%2C%22name%22%3A%22Peut-%EAtre%20Canada%22%7D%2C%7B%22id%22%3A%22P%EAche_d%27Am%E9rique_avant_1763%7Eproduct_canada%22%2C%22name%22%3A%22P%EAche%20d%27Am%E9rique%20avant%201763%22%7D%5D%2C%22partner%22%3A%5B%7B%22id%22%3A%22%CEles_fran%E7aises_de_l%27Am%E9rique%7Epartner_simplification%22%2C%22name%22%3A%22%CEles%20fran%E7aises%20de%20l%27Am%E9rique%22%7D%5D%2C%22region%22%3A%22La_Rochelle%22%2C%22kind%22%3A%22import%22%2C%22sourceType%22%3A%22Best%20Guess%20custom

s%20region%20product%20x%20partner%22%7D%2C%7B%22color%22%3A%22%23504342%22%2C%22productClassification%22%3A%22product_canada%22%2C%22partnerClassification%22%3A%22partner_simplification%22%2C%22product%22%3A%5B%7B%22id%22%3A%22Exclusivement_Canada%7Eproduct_canada%22%2C%22name%22%3A%22Exclusivement%20Canada%22%7D%2C%7B%22id%22%3A%22Peut-%EAtre_Canada%7Eproduct_canada%22%2C%22name%22%3A%22Peut-%EAtre%20Canada%22%7D%2C%7B%22id%22%3A%22P%EAche_d%27Am%E9rique_avant_1763%7Eproduct_canada%22%2C%22name%22%3A%22P%EAche%20d%27Am%E9rique%20avant%201763%22%7D%5D%2C%22partner%22%3A%5B%7B%22id%22%3A%22%CEles_fran%E7aises_de_l%27Am%E9rique%7Epartner_simplification%22%2C%22name%22%3A%22%CEles%20fran%E7aises%20de%20l%27Am%E9rique%22%7D%5D%2C%22region%22%3A%22Nantes%22%2C%22kind%22%3A%22import%22%2C%22sourceType%22%3A%22Best%20Guess%20customs%20region%20product%20x%20partner%22%7D%2C%7B%22color%22%3A%22%23A563B7%22%2C%22productClassification%22%3A%22product_canada%22%2C%22partnerClassification%22%3A%22partner_simplification%22%2C%22product%22%3A%5B%7B%22id%22%3A%22Exclusivement_Canada%7Eproduct_canada%22%2C%22name%22%3A%22Exclusivement%20Canada%22%7D%2C%7B%22id%22%3A%22Peut-%EAtre_Canada%7Eproduct_canada%22%2C%22name%22%3A%22Peut-%EAtre%20Canada%22%7D%2C%7B%22id%22%3A%22P%EAche_d%27Am%E9rique_avant_1763%7Eproduct_canada%22%2C%22name%22%3A%22P%EAche%20d%27Am%E9rique%20avant%201763%22%7D%5D%2C%22partner%22%3A%5B%7B%22id%22%3A%22%CEles_fran%E7aises_de_l%27Am%E9rique%7Epartner_simplification%22%2C%22name%22%3A%22%CEles%20fran%E7aises%20de%20l%27Am%E9rique%22%7D%5D%2C%22region%22%3A%22Marseille%22%2C%22kind%22%3A%22import%22%2C%22sourceType%22%3A%22Best%20Guess%20customs%20region%20product%20x%20partner%22%7D%2C%7B%22color%22%3A%22%2385C85B%22%2C%22productClassification%22%3A%22product_canada%22%2C%22partnerClassification%22%3A%22partner_simplification%22%2C%22product%22%3A%5B%7B%22id%22%3A%22Exclusivement_Canada%7Eproduct_canada%22%2C%22name%22%3A%22Exclusivement%20Canada%22%7D%2C%7B%22id%22%3A%22Peut-%EAtre_Canada%7Eproduct_canada%22%2C%22name%22%3A%22Peut-%EAtre%20Canada%22%7D%2C%7B%22id%22%3A%22P%EAche_d%27Am%E9rique_avant_1763%7Eproduct_canada%22%2C%22name%22%3A%22P%EAche%20d%27Am%E9rique%20avant%201763%22%7D%5D%2C%22partner%22%3A%5B%7B%22id%22%3A%22%CEles_fran%E7aises_de_l%27Am%E9rique%7Epartner_simplification%22%2C%22name%22%3A%22%CEles%20fran%E7aises%20de%20l%27Am%E9rique%22%7D%5D%2C%22region%22%3A%22Rennes%22%2C%22kind%22%3A%22import%22%2C%22sourceType%22%3A%22Best%20Guess%20customs%20region%20product%20x%20partner%22%7D%5D

Figure 18 - step 10

Short permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_18_step_10

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3A%22%CEles_fran%E7aises_de_l%27Am%E9rique%7Epartner_simplification%22%2C%22name%22%3A%22%CEles%20fran%E7aises%20de%20l%27Am%E9rique%22%7D%5D%2C%22region%22%3A%22Marseille%22%2C%22kind%22%3A%22import%22%2C%22sourceType%22%3A%22Best%20Guess%20customs%20region%20product%20x%20partner%22%7D%2C%7B%22color%22%3A%22%23B89648%22%2C%22productClassification%22%3A%22product_simplification%22%2C%22partnerClassification%22%3A%22partner_simplification%22%2C%22product%22%3A%5B%7B%22id%22%3A-1%2C%22name%22%3A%22product%20matching%20%27peaux%27%22%2C%22value%22%3A%22peaux%22%7D%5D%2C%22partner%22%3A%5B%7B%22id%22%3A%22%CEles_fran%E7aises_de_l%27Am%E9rique%7Epartner_simplification%22%2C%22name%22%3A%22%CEles%20fran%E7aises%20de%20l%27Am%E9rique%22%7D%5D%2C%22region%22%3A%22Rennes%22%2C%22kind%22%3A%22import%22%2C%22sourceType%22%3A%22Best%20Guess%20customs%20region%20product%20x%20partner%22%7D%5D

Figure 19 - step 11

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Figure 20 - step 12

- La Rochelle imports 1750-1755

Shorte permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_20_step_12_imports_1750_1755

Complete permalink: http://toflit18.medialab.sciences-po.fr/#/exploration/terms?nodeSize=flows&edgeSize=flows&labelThreshold=3&labelSizeRatio=5&classification=product_simplification&sourceType=Best%20Guess%20customs%20region%20product%20x%20partner&region=La_Rochelle&kind=import&dateMin=1750&dateMax=1755

- La Rochelle exports 1750-1755

Shorte permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_20_step_12_exports_1750_1755

Complete permalink: http://toflit18.medialab.sciences-po.fr/#/exploration/terms?nodeSize=flows&edgeSize=flows&labelThreshold=3&labelSizeRatio=5&classification=product_simplification&sourceType=Best%20Guess%20customs%20region%20product%20x%20partner&region=La_Rochelle&kind=export&dateMin=1750&dateMax=1755

- La Rochelle imports 1765-1770

Short permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_20_step_12_imports_1765_1770

Complete permalink: http://toflit18.medialab.sciences-po.fr/#/exploration/terms?nodeSize=flows&edgeSize=flows&labelThreshold=3&labelSizeRatio=5&classification=product_simplification&sourceType=Best%20Guess%20customs%20region%20product%20x%20partner&region=La_Rochelle&kind=import&dateMin=1765&dateMax=1770

- La Rochelle exports 1765-1770

Short permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_20_step_12_exports_1765_1770

Complete permalink: http://toflit18.medialab.sciences-po.fr/#/exploration/terms?nodeSize=flows&edgeSize=flows&labelThreshold=3&labelSizeRatio=5&classification=product_simplification&sourceType=Best%20Guess%20customs%20region%20product%20x%20partner&region=La_Rochelle&kind=export&dateMin=1765&dateMax=1770

Figure 21 - step 13

- La Rochelle

Short permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_21_step_13_La_Rochelle

Complete permalink: http://toflit18.medialab.sciences-po.fr/#/exploration/meta?model=product&dataType=product_simplification&region=La_Rochelle

- Nantes

Short permalink: http://toflit18.medialab.sciences-po.fr/datapaper/figure_21_step_13_Nantes

Complete permalink: http://toflit18.medialab.sciences-po.fr/#/exploration/meta?model=product&dataType=product_simplification&region=Nantes