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The Database of the EMoBookTrade Project.
A Proposal to Encode
Early Modern Book Prices and Privileges*

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ABSTRACT

The EMoBookTrade project, funded by the European Research Council and directed by Angela Nuovo, has developed a database on book prices (ca. 1530-1630) and book privileges (Venice, 1469 to 1603). This web application shows that digital humanities can play an innovative role in historical research at the same time respecting traditional scientific methods and the needs of ground-breaking inter-disciplinary research. Indeed, the EMoBookTrade DB takes into account both the representation of different kinds of sources and the processing of data deriving from them. Therefore, thanks to a rigorously designed conceptual model, the front end allows for a simple and straightforward source and data representation together with a complex search engine, the results of which can be downloaded in a CSV format suitable for statistical analyses.
This article also aims to propose an ontology of price setting and privilege grants, considered as events concerned with the history of the book and the economic history.

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The EMoBookTrade project (EMoBookTrade 2016), funded by the European Research Council (Advanced Grant no. 694476) and directed by Angela Nuovo, has developed a database consisting of two main parts, one for book prices set in the period ca. 1530-1630 (EMoBookTrade 2019) and the other for book privileges issued by the Republic of Venice from 1469 to 1603 (EMoBookTrade 2018). The electronic resource is made up of a relational database that can be updated through a web application, and the data can be consulted online and downloaded freely. To date, about 17,000 prices and more than 3,400 privileges have been processed. The researchers will continue to enter data until the end of the project, after which the use of this tool will be extended to anyone interested in adding information to it. According ERC's rules, the Host Institution of the EMoBookTrade project (University of Milan), will take care of its maintenance and availability in the future years.

1. Preliminary remarks

At the root of the project lies the conviction that the European publishing world can be reconstructed in an innovative way from an economic and legal point of view, thus abandoning the usual case-study approach that constitutes the prevailing methodology in the history of the book and book trade studies. Although it is evident on one hand, even in a superficial analysis, that the proto-industrial dimension of the book trade spread quickly to Italy and other European areas, the specific essence of books as bearers of texts and images capable of powerfully influencing the evolution of society and cultural practices has obscured the primary economic nature of printed books as market goods, with their prices (obviously mutable over time) framed in the context of other market goods during the same period. Book prices in turn are characterized by dynamics strictly connected to the availability of goods and the interests of readers and customers. On the other hand, book privileges represent the first legal infrastructure in the publishing world, where copyright laws would not exist for centuries; their main functions were to encourage the new industry by protecting investors' interests. Therefore, studying privileges is the best way to focus on the structure of the publishing market, the mechanism of competition, the exclusivity, and in part also the prices. In short, studying privileges allows us to understand the organization itself of publishing firms in relation to territorial markets.

To achieve this type of analysis requires data sets as large and systematic as possible. Therefore, our database needed to take into consideration a variety of sources that could nevertheless be gathered, aggregated and processed using the same data architecture. In fact, the EMoBookTrade relational database makes it possible to compare prices from different areas and in different currencies.

Most of these sources are manuscript: book trade lists, documents coming from the only archive of a sixteenth-century publishing firm surviving today (Plantin/Moretus), a major list produced after the acquisition of a private library (owned by Gian Vincenzo Pinelli), and inventories of bookshops for sale. All sources are commercial, and sources containing large sets of data provide the most reliable information (Coppens 2008; Ammannati and Nuovo 2017; Coppens and Nuovo 2018). Although it may seem counterintuitive, no effective paid prices are considered because we are not informed about the kind of negotiation that may have taken place at the moment of the actual purchase. Moreover, paid prices are often registered in real money, not in money of account, which is the only kind of money suitable to an extensive analysis like the one carried out by the EMoBookTrade project. In addition, retail prices usually pertain to bound items, as opposed to (mostly) unbound items in

wholesale transactions. This has led to the exclusion (among others) of the vast series of prices paid (and recorded) by Fernando Colón (1488-1539) during his travels, as well as the prices paid by a remarkable book collector in Siena, Bellisario Bulgarini (1539-1619), who had the same habit of recording in his copy the event of the purchase and the price paid.

Therefore, lists of book prices used to build our database are divided into manuscript sources and printed sources. The latter have naturally a more crucial role, given that they were in a certain sense public from the start, although they were not, as a rule, addressed to a client in the retail market, but more often intended for wholesale commerce. Manuscript sources with book prices were produced in different circumstances; they may sometimes be representative of a strictly local market (for instance, bookshop inventories). Nevertheless, the project includes two outstanding documents among them, which were in reality global in their aim and were created in some of the most successful publishing houses, that of the Giunti and of Christopher Plantin. The documents are the so-called 'stockbook' of Bernardino Giunti, now at UCLA, University Research Library - Department of Special Collections, Manuscripts, 170/622 (Ammannati and Nuovo 2017; Bruni 2018), and the *Catalogue des éditions Plantiniennes de 1555 à 1593*, held by the Museum Plantin-Moretus, Archives, M296, which was added to the EMoBookTrade research at a later stage, thanks to a grant received from MIUR-Bando FARE for the project *Early Modern European Book Prices*. These documents record thousands of books from different areas with their prices; they were conceived and composed precisely to gather as much information as possible on the circulation and prices of books available in order to gain control of the market and the value of books. Needless to say, whereas the scope of the EMoBookTrade project is European, most of the data come from the real book hubs of the early modern period, namely, Antwerp (with Paris) and Venice. In these cities especially, book prices were set with the best understanding possible of the market conditions and with the greatest knowledge of the editions already available.

A distinctive feature of the EMoBookTrade database shared today by more and more research databases is the process of building on existing bibliographical databases and tools (EDIT16, GW, ISTC, STCV, SUDOC, USTC, VD16, etc.). These resources are essential for the identification of editions, and without these solid roots, produced by generations of librarians and scholars, a project like EMoBookTrade could not even have been conceived. The availability of reliable data sets, recognized at an international level, is what dramatically changed research in book history in the past decades. This is shown by quantitative analysis and statistics which are increasingly taking hold in research and becoming a familiar approach for book historians. In the meantime, however, these methodologies have shown limits and failures, which throw in their own right a revealing light on the research process when it is not sufficiently supported by a close examination of materials. We tried to avoid this risk by choosing our sources carefully and by handling them with the utmost care in the architecture of the EMoBookTrade database.

We hope that the experience gained in constructing, correcting and populating a tailor-made resource will be of help to other researchers dealing with similar issues, i.e., scholars who need to experiment in the field of digital humanities, with its characteristic back-and-forth between empirical and conceptual work.

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2. Information Technology and the History of the Book

The online publication of the database gives the opportunity to reflect on the substantial improvements and change of scale that information technology can offer to the history of the book. In fact, although digital humanities have gone beyond the adult stage, it seems useful to evaluate how the application of information technology is really useful to humanistic disciplines instead of – as was written about digital libraries – a way to access "content that is superseded, rightly disregarded or unreliable" (Deegan and Sutherland 2009, 145; see also Gooding 2013). Basically, can digital humanities advance the history of the book? This question has been discussed in numerous academic writings related to this discipline's nature (in Italy, e.g., Buzzetti 2012; Orlandi 2012; Perazzini 2013; on the history of the book, e.g., Shep 2016; Mann 2018), and a scientific answer must be provided because many historians still refuse to work in shared web applications.

The EMoBookTrade project shows that digital humanities can increase a team's creativity if it meets working criteria firmly anchored to the historical scientific method, that can be improved through new experience, but not redefined from the beginning (Antonijevic and Stern Cahoy 2018). When tools for historians are developed, no historical data would be considered reliable without enough information on their origin. Moreover, when historical sources are at the basis of the research, automatically entered information hardly can be considered reliable without human intervention. In fact, the web application EMoBookTrade simultaneously can represent sources in integral transcriptions, and manage the resulting information, i.e., editions, currencies, prices and privileges. Respecting these basic aspects of historical research, information technology plays an innovative role, above all when it applies to fields in which a significant amount of previous information is not available, and in which interpretative criteria encompassing pre-established schemes are sought instead. In such cases, the database is a fundamental tool in defining new data categories and their processing. The EMoBookTrade project started in a totally experimental way because no research procedure has ever been tested on the economic history of the book, particularly on prices and privileges. In this context – which straddles the history of books and culture, economic history and the history of law – a relational database offers an added value concretely realised in different functionalities. First, all information can be stored in a database definitively beyond the capacities of human memory and the limits of paper instruments. The relational database then allows for inserting data inside a conceptual model, thereby making it possible to process automatically – as well as at a statistical level – not only data of the same nature (e.g., prices, subjects and publishers), but also complex information (e.g., prices of French 16th century medicine books). Each datum stored within a correctly designed conceptual model can be retrieved and handled from different perspectives. For all these reasons, despite the undeniable impact from the most advanced methods of data representation (from high-definition digital photographic reproductions to geo-localisations), the formalisation of data at a deep level is the most important contribution offered by information technology to the humanities – a contribution that makes it possible to open up new research directions (De Smedt 1999; Buzzetti 2018).

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3. Conceptual Model

The EMoBookTrade team started designing the application by drawing the data conceptual model, i.e., focusing on what the public does not see, but which demonstrates quality precisely in the efficacy of queries and in the success of the representations of data. As mentioned above, the conceptual model drawn up by the EMoBookTrade project is completely new and takes into account both the representation of sources in their original forms and the processing of the data derived from them.

The combination of these two information classes exceeds a dichotomy typical of the history of humanities computing, highlighted several times in extant scientific literature, in which the mere source representation has been opposed to the processing of data extracted from them (Vitali 2004; Buzzetti 2018, 38–41).

Instead, in the EMoBookTrade database every historical event related to prices and privileges (information) has been conceived as an interpretation of a part of a text (data taken from the source), which always must be verified both by the researchers and those who will consult the database. In addition, privileges are discursive textual documents whose full transcription allows for a free search within the source for the most different purposes.

Also the interdisciplinary nature characterising the EMoBookTrade project exerted a fundamental impact on the design of the database conceptual model. First, it was essential to respect the quantitative approach of economic history that needs to use unambiguous and comparable categories and therefore requires normalisation of these data that, within historical sources, appear in the most disparate forms, i.e., prices expressed in different currencies, established as retail prices or in the context of a wholesale evaluation, referring to editions with different material characteristics (format, number of leaves, illustrations made with engraving or carving technique engraving), all of which are relevant in the definition of production costs (on quantitative methods in the humanities see Lemercier and Zalc 2019). Second, at each stage of the procedure, the authority records and the bibliographic descriptions of editions already published on the web can be imported automatically through use of the original repositories' identification codes (IDs), e.g., the ID of the Virtual Authority File (VIAF). Recording external IDs in the EMoBookTrade database assures interoperability both with bibliographic systems and international authority files.

The resulting conceptual model is represented in Tables 1 and 2, while the main entities are listed below grouped by functional contiguity and followed by their main attributes.

Source. *Attributes*: shelfmark, abbreviation, typology (account book, commercial letter, handwritten price found in one copy, inventory, notification and display of privileges found in editions, notification of the print license found in editions, petition letter, printed catalogue, printing license, private letter, privilege resolution, register, stockbook), title, extent, origin date, introduction, link to images and notes.

Collection. *Attributes*: name.
Repository. *Attributes*: name.
Settlement. *Attributes*: name.

Transcription. *Attributes:* locus (leaf or page), order number, date, language, text, editorial note, note.

Price. *Attributes:* price as in the source, price expressed in the minimum submultiple of the original currency, currency, type (set by the publisher, set by a bookseller, paid price, set in privilege resolution, set in privilege petition, evaluation), addressee (unknown, wholesale merchants, retail merchants, open sale), date and price per printing sheet.

Origin/Place. *Attributes:* country and name.

Currency. *Attributes:* name, submultiples and ratio among submultiples.

Exchange. *Attributes:* year, value in Venetian denari (the minimum submultiple of Venetian lire) and value in grams of silver.

Privilege. *Attributes:* category (privilege grant, privilege petition), issued (yes/no: when the source is a petition, it is possible that the request has not been accepted), date (date when the privilege is granted or requested), edition date (when the source is the edition, the privilege date is derived from the edition itself), edition title (as in the document), duration, extension (when an extension of the privilege is requested), publication in the book (no/information not found/yes), any links with other privileges granted to the same person and for the same work (yes/no) and price paid. To these attributes, another (issuing body) is added that indicates the existence of privileges granted by other states.

Innovation. *Attributes:* description.

Edition. *Attributes:* identification (identified, unidentified, unpublished, not survived), ID in online catalogues, description, classification (DDC), place of publication, publication date, *editio princeps* and note.

Publication places. *Attributes:* name.

Volume. *Attributes:* description, extent, collation, number of leaves, format, printing sheet and language.

Physical description. *Attributes:* red ink, illustrations, typefaces, indices and tables and large paper.

Issue. *Attributes:* variants.

Copy. *Attributes:* shelfmark, binding and note.

Name. *Attributes:* name, qualifier, dates and VIAF ID. Can be linked to several other entities, e.g., Source, Transcription, Privilege, Edition, Copy and assuming different roles, e.g., author, publisher, owner (Table 3).

Bibliography. *Attributes*: abbreviation, date and bibliographic description. Can be used to document several other entities, e.g., Source, Transcription, Privilege, Edition, Innovation and Name (Table 4).

4. Sources, Data and Information: An Example

Let's consider Bernardo Giunti's stockbook. Giunti recorded prices inside a huge manuscript beginning in 1600 and continued for about 40 years. For these reasons, in the database, this source is dated 1600-1640, expressed in the standard form AAAA-AAAA, not to a specific year.

However, to design the chronological development of prices – attempting, for example, to answer a question like, 'Did newly published books cost more than books in stock?' – it is necessary to date them to a single year, which requires making choices and re-evaluate the data documented in the source. To do this, in the specific case of the 'stockbook', it can be decided that if an edition is dated before 1600 (e.g., 1598), the corresponding price can be dated to at the same range of years as the source, i.e., 1600-1640. Instead, if an edition is dated after 1600 (e.g., 1610), the range of years where the price can be placed cannot be the same as that of the source, but must be moved to the years 1610-1640. Therefore, price dating is not always the same as source dating, and it is not evident in the source. In some cases, it must be resolved by researchers and considered separately.

Keeping source dating and price dating separate in the conceptual model was a fundamental choice. Even if in most cases, they coincide – e.g., in all printed catalogues explicitly dated to a specific year – the source date and price date are different conceptually because sources show evidence of the price setting event, but are not that event.

Moreover, if the chronological trend of the prices, including those datable to a range of time and not only those dated to a single year, will be represented, it is necessary to distinguish the actual price dating further from statistically treatable average dating.

Using the examples from above again, the 1600-1640 dating range could, for hypothesis purposes, be brought back to 1620, as a treatable average dating, and the 1610-1640 dating range to 1615. Thus, the chronological representation of prices would be enriched quantitatively, while its reliability would assume a greater connotation of hypotheses.

In any case, the processing of the price date and the calculation of a statistically treatable date, based on the date of a source, are examples of how, in the field of humanities computing, it is often necessary to add to the representation of sources a codification of the original data, which is sometimes hypothetical in nature (Vitali 2004, 44). Only the creation of a rigorous conceptual model allows for the correct computational treatment of data and information.

5. Other similar projects

The EMoBookTrade web application can be viewed as an expert system because it respects the scientific historical method and enables innovative developments through a rigorous formalisation of data of an interdisciplinary nature. The comparison with the data structure adopted in other recent databases confirms that the data analysis carried out by EMoBookTrade also is valid in other contexts, even if international standards covering prices and privileges are not established yet. For example, the conceptual model designed by the project *Le biblioteche degli ordini regolari in Italia alla fine del sec. XVI* (*Libraries of Regular Orders in Italy at the End of the 16th Century* – RICI) is comparable to EMoBookTrade in the treatment of catalogues, transcriptions of items and bibliographical descriptions. RICI's aim is the editing and analysis of the book inventories collected by the Congregation of the Index in Rome in the late 16th century. Such lists represent collections from religious Catholic orders' convents and monasteries, and illustrate clerics' readings and interests. The project also entailed identification of editions briefly described in those lists, as the EMoBookTrade project does with priced editions.

The European project Middlebrow Enlightenment: Disseminating Ideas, Authors and Texts in Europe (MEDIATE) structures and describes in its database (still not available to the public) information on catalogues, items and editions to provide a sort of comprehensive description of book collections from 18th century Europe and to anchor to them an evaluation of the dissemination of book content and corresponding philosophical ideas (Montoya 2019). The French project Biblissima developed an application of XML TEI P5 to historical book inventories (Bisson, Goloubkoff and Kuhry 2019).

A data oriented approach is instead that of the project on the archive of the Société Typographique de Neuchâtel (STN). This project in its database entails 'books', 'spaces, 'people', and 'events', but not sources, except in the form of bibliographical references. In fact the manuscripts which contain evidence of data are described separately and recalled as sources through abbreviations, but they are not transcribed or made available to the public in their entirety. It is interesting to note that for this research team "'Events' are the building blocks of the STN database, and each of them can be identified in time and space. At present most 'events' are book trade transactions by the STN and its clients, though we also have 'events' such as printings and stocktakes. In future research projects, the range of such events might be widened to take in other book related activities which can be geospatially and chronologically located – e.g. the inclusion of books in a catalogue; the seizure of books at customs, etc…" (STN Online Database Archive).

A similar lesson also can be drawn from the CIDOC Conceptual Reference Model (CRM), which aims to document cultural heritage, especially works of art. In fact, the CIDOC CRM does not limit itself to describing classes of objects, as cataloguing traditional standards, but formalizes also their properties, exactly as it is necessary to do in a database for history. In a conceptual model intended to describe historical phenomena, the description of objects and actors – such as sources, editions and people – is not sufficient. It is also necessary to structure the main events that involve them and link them in specific contexts.

Different types of events also are considered as modelled objects within the application OntoME, made available online by the Data for History consortium, whose purpose is the management of ontologies of a historical nature (OntoME).

Nevertheless, price settings and privilege grants managed by EMoBookTrade are two types of specific events that have never been represented before in book-history databases.

In the STN Online Database Archive an event called 'book trade transaction' is taken into consideration, but – even if this term implies payments theoretically, it operates without reference to the sales' economic value, as the project's interest is focussed on the circulation of books, not economic history. Each event of this nature instead includes (judging from the STN Online Database Archive front end) the attributes date, edition, number of copies, recipient of the order, sender of the order and the title abbreviation of the handwritten source.

Two historical events comparable to the price setting and privilege grant instead are encoded in CIDOC CRM: they are termed Purchase and Right.

E 96 Purchase (subclass of E8 Acquisition): "This class comprises transfers of legal ownership from one or more instances of E39 Actor to one or more different instances of E39 Actor, where the transferring party is completely compensated by the payment of a monetary amount." (CIDOC CRM. Volume A, 43–44).

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E 30 Right: "This class comprises legal privileges concerning material and immaterial things or their derivatives. These include reproduction and property rights" (CIDOC CRM. Volume A, 19; OntoME http://ontome.dataforhistory.org/class/29).

A future comparison between the criteria adopted by CIDOC CRM and EMoBookTrade can lead to the development of common ontologies.

6. Book Prices in the EMoBookTrade Database

Research on price setting is a fundamental factor, both for book trade evolution and for the history of culture. Prices indicate society's interest in books and their content, as well as books' availability on the market. Moreover, the analysis of the material, historical and legal characteristics of editions can help to understand what their production costs were and what other elements determined the producer's decision-making process when setting book prices (Ammannati and Nuovo 2017). For these reasons, in the EMoBookTrade database the entity Price adopted several attributes, that we list here as a proposal for the development of future ontologies.

The first of these attributes encodes the type of price. A price can be defined by the publisher, such as in several printed advertisement lists of books published by Aldo Manuzio Jr., or in account books, such as those of Christopher Plantin, kept at the Plantin-Moretus Museum in Antwerp, Belgium. In other cases, a bookseller may establish a price, as is the case for prices discussed in the letters written to Giovanni Bartolomeo Gabiano (1522), or it may still be the result of an expert's evaluation, as happens in the inventory of Gian Vincenzo Pinelli's book collection. Finally, the database also provides the possibility of recording prices – which is extremely rare – indicated at the time of the request or grant of a privilege.

Prices also are characterised by specific types of recipients, e.g., they can be aimed at wholesale or retail booksellers, or they can be considered as offers for anyone. Each price has a date, is set in a place and is expressed in a specific currency, with multiples and submultiples (e.g., the *carolus* guilders used in Antwerp can be divided into *florijnen* and *stuivers*). It is also possible to indicate whether or not each price is reliable.

Each price is an amount of money expressed in the original currency used in the source, but it also assumes attributes derived from two exchange transactions: the exchange in Venetian *lire*, expressed in lower submultiples i.e., *denari,* and the corresponding value in grams of silver. Both calculations are based on the exchange testified in economic historical sources and represented by the entity Exchange.

The exchange of all values to Venetian lire/denari and silver grams allows for comparing prices established in different monetary areas, but it should be kept in mind that this analysis only can produce indicative results because a direct comparison between two values emerging in distant markets risks underestimating the local economy's impact on the setting and the resulting price (Ammannati 2018).

7. Book Privileges in the EMoBookTrade Database

Privileges are also important events in book history because they represent the legal instrument with which governments have protected and promoted the printing industry. The granting of privileges, being bound by the novelty requirement, stimulated the printing of unpublished texts and, therefore, a diversified publishing production. To those who obtained it, privilege guaranteed a temporary protection in the granting state. In fact, one of the attributes assigned to Venetian book privileges in the database is duration, which can vary from a minimum of a few months to a maximum of 30 years, although the average duration lasts 10 years. For the same work, a temporal extension of the privilege could be granted if motivated by serious reasons that are advantageous for the Republic of Venice (privilege renewal is indicated with the 'extension' attribute) (Squassina 2016; Squassina 2017). Furthermore, after legislation was enacted in 1534, works protected under Venetian privileges had to be printed in Venice, and failure to comply led to privilege revocation, so it could have been necessary to request more than one privilege for the same work. In the database, this type of link is highlighted with the assignment of a specific attribute ('edition with more than one privilege').

Following the EMoBookTrade research procedure, privileges may be classified according to the beneficiary to whom the privilege was addressed and the object or activity it was intended to protect. The 'category' attribute includes three types of privileges: privileges granted to printers and publishers; privileges granted to authors; technical-privileges protecting new inventions and technologies that emerged as part of the printing industry's development.

An attribute indicates whether the privilege was stated in the edition. The privilege could be notified by printing the entire privilege text or an extract of it in the book itself, or indicating formulas, such as *'cum gratia et privilegio'*. In the event that in the book, in addition to the Venetian privilege, references existed to privileges granted by other states, this information was indexed in the 'issuing body' field, where the name of the granting authority and privilege duration are entered. In fact, privileges were valid only within the jurisdictional borders of the state that granted them, so providing information about any privileges granted by other states shows markets for which a particular edition was destined.

The EMoBookTrade project aims to discuss these attributes at international level in order to elaborate standard descriptions of privileges and privilege grants (Squassina 2019).

8. Usability: A Key Requirement of the Back End

Another fundamental aspect of digital humanities projects that should not be underestimated is the development of a usable procedure that can be well-received even by researchers accustomed to working independently, on paper or on spreadsheets and in non-relational databases involving the use of a single window at a time (Barbero and Tessarolo 2018).

Therefore, introducing a web application into a research team required taking some essential measures; otherwise, computer applications often remain unused. If a comparison with the commercial market is allowed, as a not 'usable' (in technical terms) commercial site does not produce profit, so a not 'usable' cultural application is progressively abandoned, when it does not even remain completely unused. Therefore, solutions have been adopted in order to create a simple navigation free from error risks and matching the research procedure that single researchers follow. The software's

adherence to the research activities is essential, even if the relationship between the two does not proceed in a single direction and is of a two-way nature instead. During the designing of the back end, the research methodology gave shape to the software procedure, but sometimes the database structure and data management system also improved the research methodology (on how humanists' research practices changed: Antonijevic and Stern Cahoy 2018). E.g. in the development of the research, it was crucial to distinguish primary sources – i.e. historical documents – from secondary sources – i.e. secondary literature. In the database, primary sources are considered the entity Source, while secondary sources are considered Bibliographic records on sources. Considering historical sources and scholarly publications as a single entity would have led to logical errors, with negative consequences for user searches and data display results.

In addition to a back end coherent with researchers' activities, functionalities that facilitate the insertion of data are also an important complement in digital humanities applications. For this reason, the data-entry procedure was designed to be as fast as possible by applying a few automatisms, e.g. the software handles the printing-sheet calculation – based on the division of the number of sheets by the format of the volume – and the exchange from the original currencies to Venetian lire or silver grams.

9. The public front end

While the main concern in the back end has been to improve researchers' working conditions, communicating research content effectively has been the principal aim in developing the front end. Due to the fact that the research results on prices and privileges are totally new and, consequently, that the user's eye is not familiar with them, we developed new, clear and comprehensible forms of representation.

Any front end's purpose is to achieve the highest degree of usability and utility and – as in any other domains – even in historical research applications, usability comprises navigation efficiency (Nielsen 2012). We tested the front end by performing a few minute tests with the help of 10 university students taking a course in cultural heritage studies. These students were asked to perform the following tasks.

1) Looking at the homepage, explain what the application is about.
2) Starting from the homepage, look for the price of a Francesco Petrarca edition and explain the result obtained.
3) After the first search, starting from the webpage where the student was, search for the sources of the information obtained.
4) From the webpage where the student had performed the previous task, look for Venetian book prices for the period 1580-1590.

All users were able to perform the required tasks and did not make any errors.

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After having defined usability, the other fundamental aspect of any application is *utility*, which in the field of scientific research has a specific connotation. An application developed in the field of historical research first must be exhaustive scientifically and meet the needs of a specialist audience comprising researchers in the history of book trade and economic history. Second, as a European project implies the widest dissemination possible, the front end must be comprehensible to a public interested in cultural and literary history.

Figure 1. The *EMoBookTrade Prices* homepage

To serve both kinds of users, the front ends offer various search possibilities and data representations (Figure 1).
- A form allows for combining different search criteria.
- In a second section, users can access the alphabetical list of priced editions in the Prices front end or the chronological list of privileges granted by the Republic of Venice in the Privileges front end.
- Finally, editions of sources are published.

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The 'Search' form is useful not only for those who are looking for specific information, e.g., the price of a single edition, but also for those who want to search and link different classes of data, e.g., privileges granted in a specific period of time. In this section of the front end, after obtaining a list of summary answers, it is possible to visualise all available information for each of them, or to make selections from the obtained results using the filters (facets), which show in brackets the classification of frequencies of each attribute (Figure 2).

Figure 2. Search results and facets

However, the 'Search' form has a limitation: initially, it is populated by empty boxes that only users who know which questions to ask can use (Whitelaw 2015). On the other end, the list of the priced editions and the list of privileges comprise the main project results and benefit those who are not already aware of Early Modern book prices and privileges. The combination of a 'mute' research form and thematic representations of information is a solution that recently has been adopted in numerous cultural heritage catalogues, especially in museums, which consider visitors' needs not just those of

researchers. In the EMoBookTrade database, each item obtained from the 'Search' form or visualised in the lists of priced editions and privileges leads to the display of complete records, i.e., all data related to a single price or a single privilege.

The 'List of sources' provides information about the sources exploited in the project.

To facilitate understanding of the results obtained through the 'Search' mask, the project is also experimenting the automatic processing of graphs.
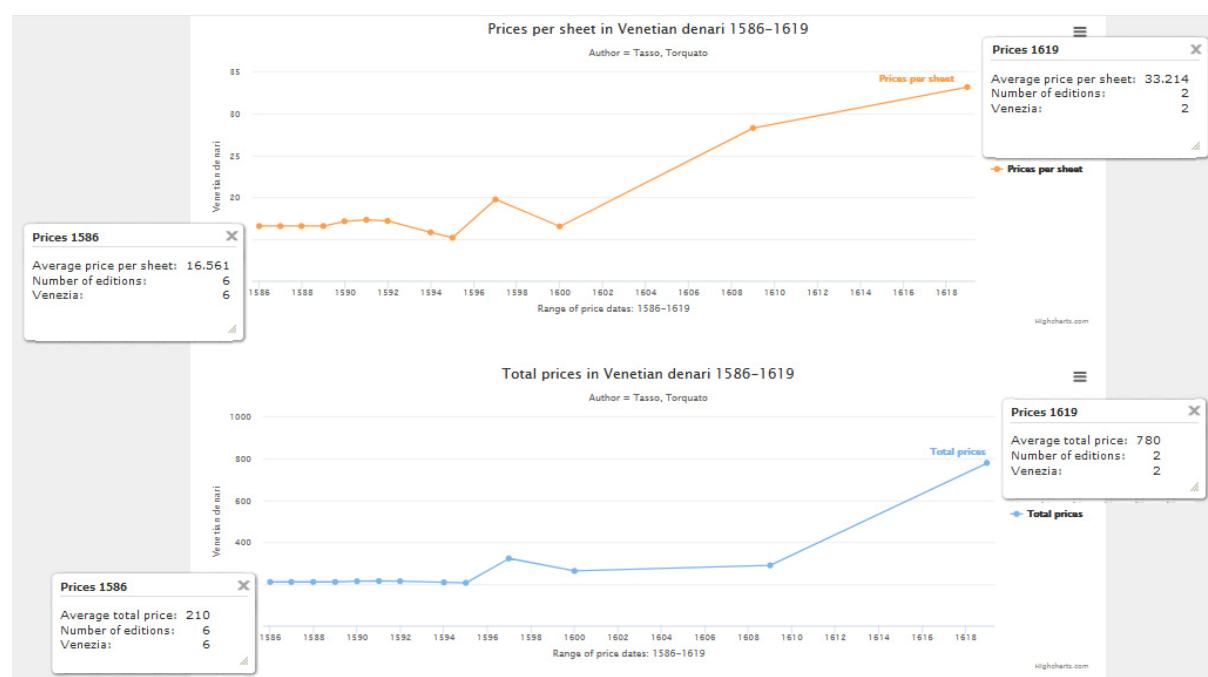

Figure 3. Graphs

These graphs aim to represent chronological price trends, both total prices' and printing-sheet prices' evolution over time. The graphs' representativeness obviously depends on the number of prices available. The average price that each node represents can be calculated from one or more prices. The considered price quantity and their location appear by clicking the mouse on individual nodes. For example, Figure 3 represents the trend for 188 prices for Torquato Tasso editions published between 1586 and 1619. The first node, corresponding to the year 1586, gives an average price of 16.561 Venetian denari per printing sheet, based on an average of 6 prices, all set in Venice. The last node, dated to the year 1619, represents an average price of 33,214 Venetian denari per printing sheet, which is the average of only 2 edition prices.

The P.I. and the team are working toward inserting graphics in the front end to provide visual access to data processed in the database.

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10. Statistical opportunities and related issues

The database on book prices and privileges offers a well-stocked and complex amount of information accessible through the front end. Nevertheless, it makes it possible to extract information in a format suitable for subsequent processing and statistical analyses. Indeed, a service has been implemented for downloading data in CSV format, which provides two possible layouts (see Figure 4 for details).

Figure 4. The export-processing form

In Layout 1, each edition is repeated for as many rows as the prices assigned. In Layout 2, each edition is the unit of interest, and the corresponding prices are in different columns. During this phase, the user also can choose which other information related to the edition and prices is interesting enough to export. In Figure 4, the different opportunities are listed.

In this way, all the historical information that never before has been collected and inserted into a database is readily available for appropriate statistical processing.

However, some issues have arisen concerning the treated data's historical nature. The classification proposed is the well-known Dewey Decimal Classification (DDC), which allows for analysis at specific description levels. It is uniquely important to define *place of publication* and not create ambiguities in the edition placements. Also, the *language* variable needs to be treated carefully, as the editions' complexity and the presence now and then of sections in different languages make it difficult to obtain an exhaustive list of modalities, which are incompatible with each other, but only in this way it is possible to analyse this variable appropriately.

The accurate data-cleaning process carried out by the researchers involved in this project has allowed for obtaining a complete data matrix necessary to perform the most varied univariate and multivariate statistical analyses. It will be possible to analyse some descriptive aspects of prices, indexes of position and variability, to study price trends at different times, to verify whether some links between edition prices and languages exist, and to deepen the association between edition price and format.

11. Final observations

The web application described in this contribution is in line with the first developments in humanistic computer science, which from its origin – even before the foundation of the World Wide Web – has focussed on creating effective computational support tools for innovative research. Our database aims to open new directions beyond merely sharing large amounts of 'crude' data (Buzzetti 2018). The EMoBookTrade web application considers data that never have been related to each other in previous automatic procedures, and for this reason, an expert system capable of containing and processing them had to be developed. Such a system has shown how useful the correct application of new technologies can be for historical data computation.
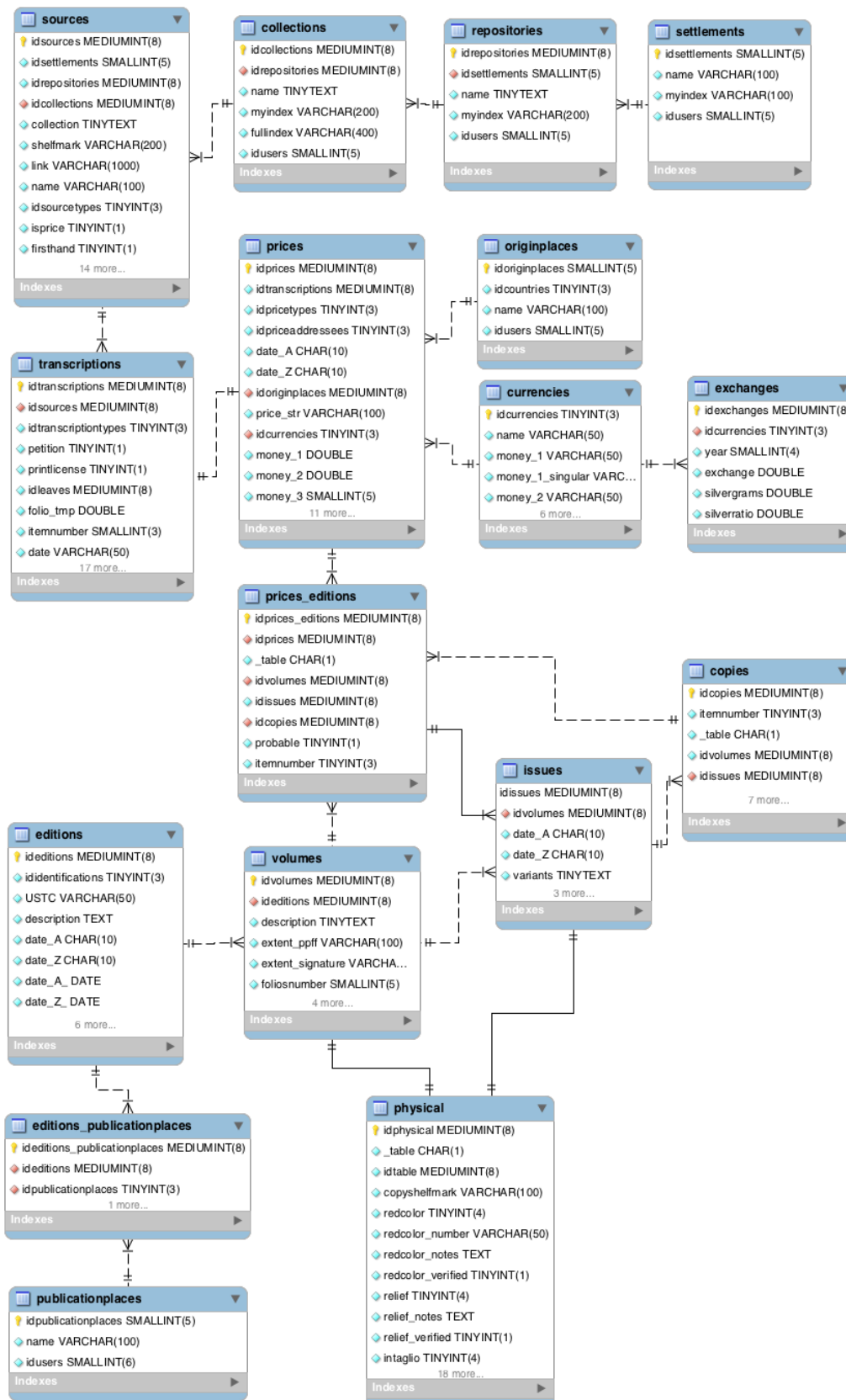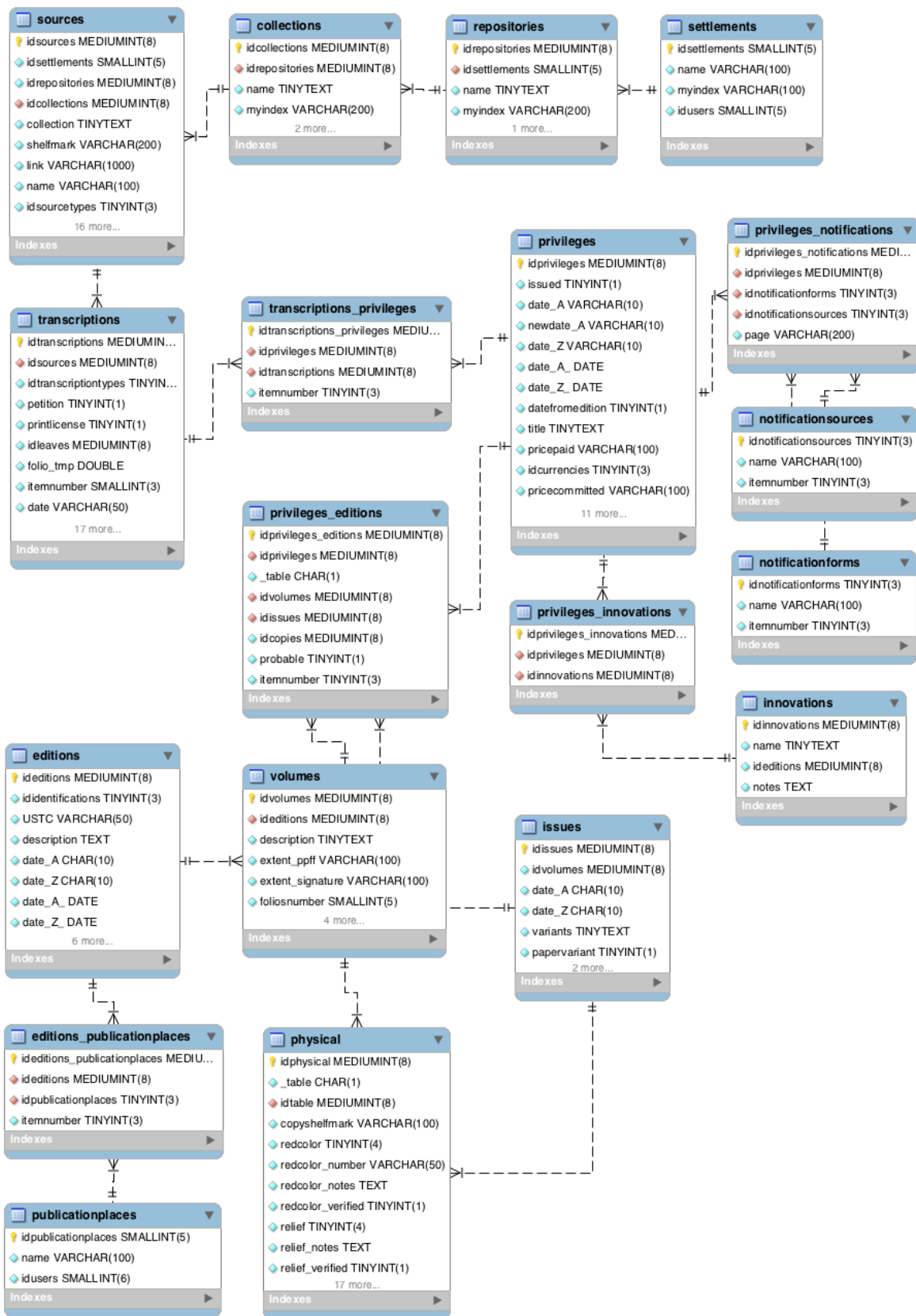
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Table 1. Elements linked to Prices

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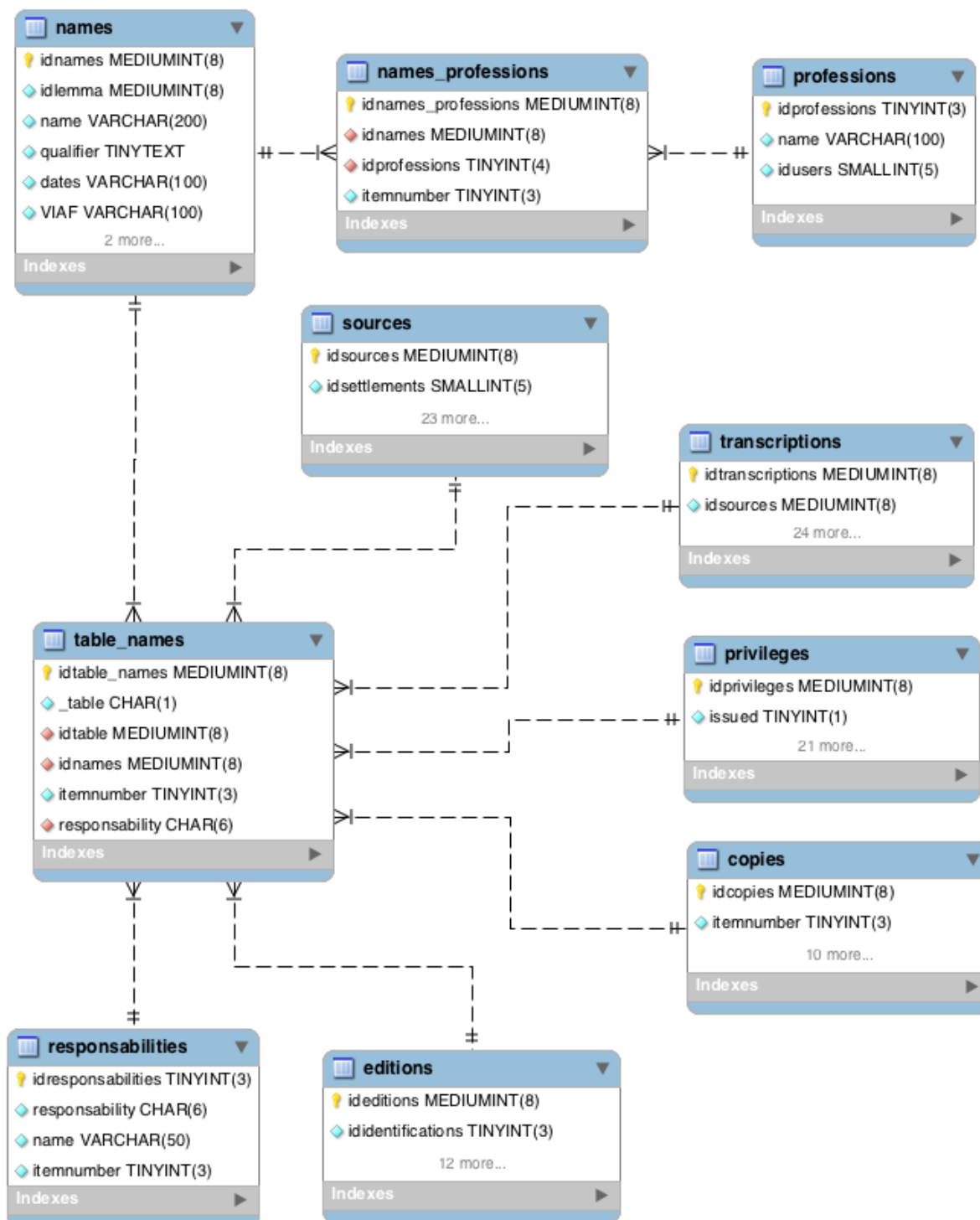Table 2. Elements linked to Privileges

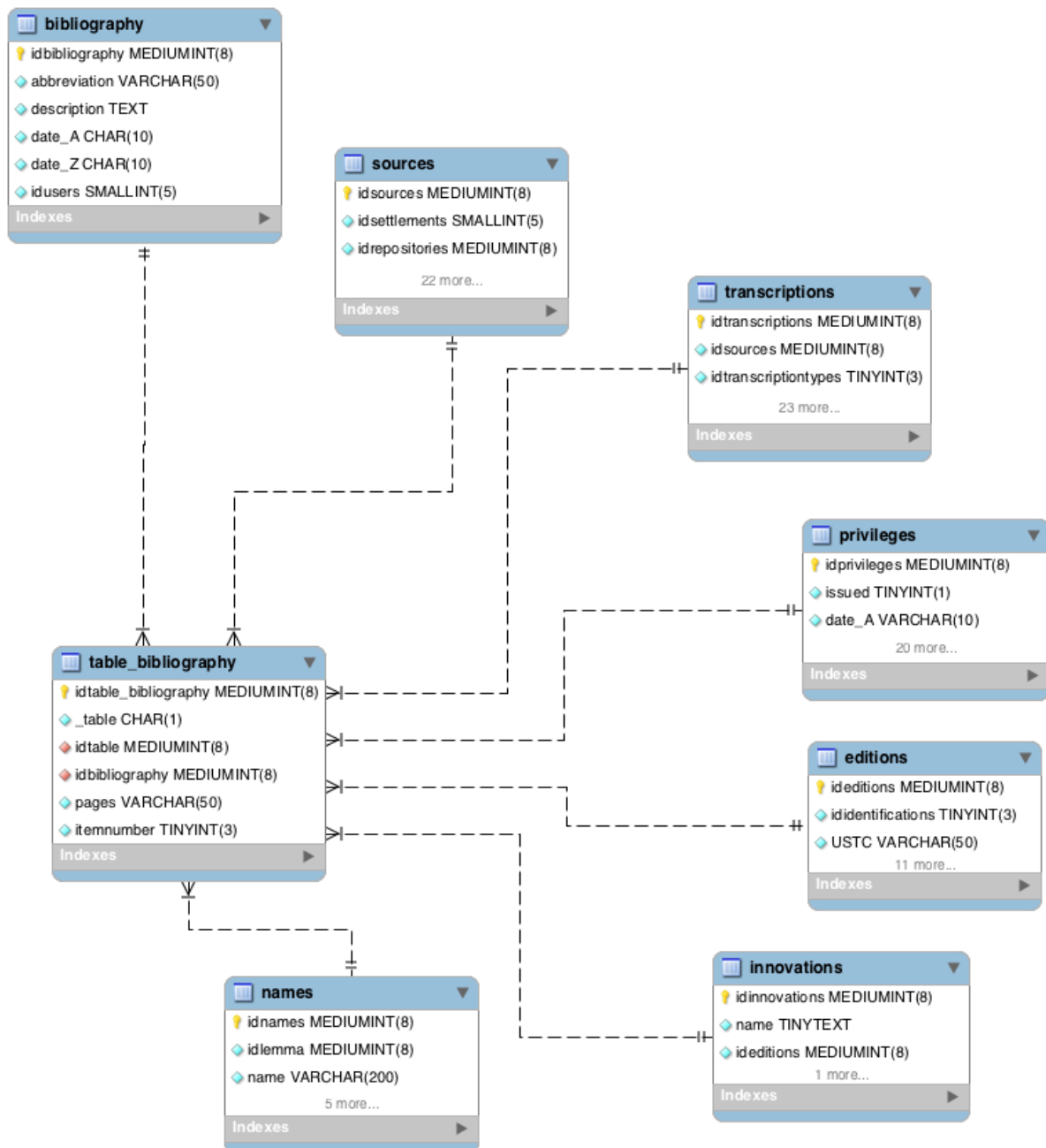JLIS.it

Table 3. Elements linked to Names

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Table 4. Elements linked to Bibliography

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