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Hindu-Arabic Numerals in Public and Private Accounts of The Southern Low Countries (1300-1800)*

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1. The New Numerals in Public Versus Private Accounts

Recent scholarship has connected the advance of Hindu-Arabic numerals in European commercial practices with the spread of human capital and the social transmission of knowledge. Moreover, it has been convincingly argued that a direct link existed between the new numerals, the commercial revolution of the thirteenth century and the late medieval and early modern “little divergence” between Europe and the North Sea area (mainly England and the Low Countries).¹ However, little is actually known about the diffusion of Hindu-Arabic numerals in the accounts of either the public administrations or private companies in the latter region. While there has been a substantial amount of research on the adoption of the new numeral forms in treatises and manuals,

* I thank the anonymous referees for their supportive and much appreciated comments. I am especially indebted to José María Perez Fernández who kindly invited me to his workshop at Prato in January 2022. It goes without saying that this paper is limited to the spread of the use of the new numerals in accounts. Their spread elsewhere (e.g., on coins and seals, for house numbers, etc.) warrants a separate study. Incidentally, the so-called Hindu-Arabic numerals were in actual fact neither Hindu nor Arabic (see D. A. King, *The Ciphers of the Monks. A Forgotten Number-Notation of the Middle Ages*, Stuttgart, 2001, p. 310).

¹ R. Danna, “Elaboration and Diffusion of Useful Knowledge in the Long Run: The Case of European Practical Arithmetic (13th-16th Centuries)”, in *Rivista di Storia economica*, vol. 38, no. 1, 2022, p. 58.

much less attention has been paid to the spread of the numerals in common accounts, despite being the material testimonies par excellence of everyday counting, calculating and accounting. As is also the case in other countries, public accounts in the Low Countries have the reputation of being more conservative than their private counterparts since the main reason for their existence – personal justification by an officer to a controlling agent or institution – did not change much over the centuries. Private accounts, by contrast, were the written record of a company's performance in a highly competitive environment and therefore had to continually adapt to new techniques and better instruments as these emerged.²

This paper discusses the adoption of Hindu-Arabic numerals in public and private accounts in the southern Low Countries. I will argue that private accounts adopted Hindu-Arabic numerals in the course of the sixteenth century. Public accounts were not unfamiliar with these innovations but would not introduce the new numerals until the seventeenth and eighteenth centuries. The new numerals were introduced gradually and in different phases. I shall illustrate this thesis by making a distinction between three different contexts which will be dealt with in three different sections: public accounts of central, provincial and local governments; public accounts of town administrations; and private accounts of individuals. Two subsequent sections are devoted to the late introduction and the driving force behind the new practices. As such, this study intends to shed further light on the different nature of two familiar types of documents: public and private accounts. It is also hoped that the paper will contribute to a better insight into the so-called "paths of transmission"³ of technical knowledge in the past.

² Here in the sense of company accounts with the exclusion of the private accounts of great households or land estates owing to their overall lack of preservation.

³ L. Hilaire-Pérez and C. Verna, "Dissemination of Technical Knowledge in the Middle Ages and the Early Modern Era: New Approaches and Methodological Issues", in *Technology and Culture*, vol. 47, no. 3, 2006, p. 542.

2. The Adoption of Italian Examples in Different Phases

Although probably already known to scholars in Europe in the ninth century, Hindu-Arabic numerals spread at a very slow pace from south to north, moving along the extensive urban network of inland trade rather than the great maritime commercial routes.⁴ From the late thirteenth century, there is clear evidence that the new annotation started to be used in private commercial and financial circles in Italy as Tuscan merchant-bankers adopted the numerals in their business practices.⁵ The northwestern part of the European continent imitated the Italian example with a considerable delay. Some countries quickly came to adopt the new numerals in scholarly environments, but their circulation remained restricted to intellectual authors for a long time. In England, the new figures began to be used sporadically in some account books in the course of the fifteenth century. Around the same time, the numerals were also present in the great towns along the Rhine.⁶ In all of these cases, their use was anything but a common feature in a cultural environment that hesitated to fully embrace the new arithmetic practice. This is quite a contrast with Florence, where Hindu-Arabic numerals were already in widespread use for all kinds of calculations and where they were so well established that they had become an essential part of the com-

⁴ P. Bertrand, *Les écritures ordinaires. Sociologie d'un temps de révolution documentaire (entre royaume de France et empire, 1250-1350)*, Paris, 2015, pp. 219-220; Danna, *Elaboration and Diffusion*, pp. 75 and 77.

⁵ A. Cappelli, *Lexicon abbreviaturarum. Dizionario di abbreviature latine ed italiane usate nelle carte e codici specialmente del medio-evo riprodotte con oltre 14000 segni*, 5th edition, Milan, 1954, p. LV; W. Endrei, "De l'abaque aux chiffres arabes, leur lutte en Europe", in L. de Rosa (ed.), *Studi in memoria di Federico Melis*, vol. 1, Naples, 1978, pp. 281 and 288-289; M. Kool, *Die conste vanden getale. Een studie over Nederlandstalige rekenboeken uit de vijftiende en zestiende eeuw, met een glossarium van rekenkundige termen*, Hilversum, 1999, pp. 21-22.

⁶ R. Danna, "The Spread of Hindu-Arabic numerals among practitioners in Italy and England (13th-16th c.): two moments of a European innovation cycle", in G. Nigro (ed.), *L'economia della conoscenza. Innovazione, produttività e crescita economica, nei secoli XIII-XVIII (The knowledge economy. Innovation, productivity and economic growth, 13th to 18th century)*, Florence, 2023, forthcoming, pp. 59-62; B. Kirchgässner, *Das Steuerwesen der Reichsstadt Konstanz, 1418-1460*, Konstanz, 1960, pp. 66, 67 and 74.

mercial mindset and day-to-day business.⁷

The few available examples clearly show that everywhere Italian influence was of vital importance for the introduction and assimilation of the Hindu-Arabic numerals. For England, Raffaele Danna has demonstrated a very early use of the new numerals, already in 1435-1436, to be in the account books of the port of Southampton. Indeed, in the late Middle Ages the large English port of Southampton welcomed Italian carracks and galleys with cargoes from every corner of the world. The first English firms to adopt the new numerals at the end of the fifteenth and the start of the sixteenth centuries were all active in international trade and familiar with Italian commercial techniques and practices.⁸ In the German area, on the other hand, one of the oldest traces of Hindu-Arabic numerals can be found in the bookkeeping of an important merchant of Nuremberg who had dealings with Venice at the end of the fourteenth century. His accounts were almost entirely kept in the new numerals.⁹ As we shall see below, Italian influence was also important for the diffusion of the new numerals in the southern Low Countries.

Scattered information seems to suggest that everywhere in Europe the Hindu-Arabic numerals were first used for pagination or foliation and to indicate the date, and only much later for stating amounts in money and in kind, or other quantities.¹⁰ This sequence was also followed in the Low Countries where the introduction of the Hindu-Arabic numerals took place gradually and in distinct phases: first appearing in pagination and to indicate the date, they were later also used to represent monetary amounts in non-official records, and finally for amounts of money in official documents. Even in this last stage, a distinction should be made between the appearance of the numerals in textual items illustrating and explaining

⁷ R. A. Goldthwaite, "The Practice and Culture of Accounting in Renaissance Florence", in *Enterprise & Society*, vol. 16, no. 3, 2005, p. 615.

⁸ Danna, "The Spread of Hindu-Arabic", pp. 70-72.

⁹ Ph. Braunstein, *Les Allemands à Venise 1380-1520*, Rome, 2016, p. 446.

¹⁰ Endrei, *De l'abaque*, p. 294; H. Jenkinson, "The Use of Arabic and Roman Numerals in English Archives", in *The Antiquaries Journal*, vol. 6, no. 3, 1926, p. 266.

the amounts and the representation of the actual amounts themselves.

3. Central, Provincial and Local Public Administrations

The magnificent series of accounts of the *recette générale des finances*, or the office of the receiver-general of the southern Low Countries, provides a good sample for studying the spread of Hindu-Arabic numerals in the financial documents of central government. From its establishment in 1387, this institution served as the central state treasury for public finances. The senior officer, the receiver-general of all finances, was in principle responsible for all of the central government's financial operations at the highest level, as concerns both revenue and expenditure. As such, his accounts reflected the conventional wisdom of the time held by the senior and junior staff members of the central financial administration. A labour-intensive search of these voluminous registers reveals that the receiver-general did not allow use of the new numerals for the full statement of amounts in the official accounts until 1753.¹¹

The appearance of the new numerals within provincial government can be followed in the equally impressive series of accounts of the receivers-general of East and West Flanders. Despite their title, these officials operated at a provincial level and managed the finances of a large part of the county of Flanders. The receiver-general for the western part of Flanders switched from Roman to Arabic numerals in 1697; his colleague responsible for the eastern part would follow him a few years later, in 1703.¹²

Demesne accounts offer a perfect test case to discover when local government agencies became so familiar with the new numerals that they dared to use them to express final monetary amounts in official documents. Extensive sampling of the series of accounts for the large

¹¹ Brussels, General State Archives, Chambers of Accounts, reg., nos. 2021 and 2022.

¹² Brussels, General State Archives, Chambers of Accounts, reg., no. 2842 and nos. 2991/3 and 2992.

demesnes of Antwerp and Brussels shows that the Brussels receivers used the new numerals for the expression of the final amounts from 1778,¹³ although one receiver introduced the numerals in his accounts for the years 1726-1730.¹⁴ However, his successors returned to the apparently much more familiar Roman characters. Their Antwerp colleagues followed on even later, in 1782,¹⁵ just one decade before the official end of the *ancien régime*. At first sight, all these dates seem extremely late but, as we shall see in the next section on urban governments, such a delayed introduction was not at all exceptional for public administrations in the southern Low Countries.

4. Urban Administrations

The financial staff of the urban patchwork of large and small towns also launched the use of the new numerals in “safe mode”, initially using them to denote days and years, in non-official documents, and to indicate page or folio numbers. When at a later stage the paymasters, receivers, stewards, treasurers and their subordinates finally became familiar with the new numerals to express amounts of money, they introduced them to the accompanying narrative text. It was well into the seventeenth century before the first urban governments also began using the new numerals to express amounts of money, on the right side of the page or folio, in the final version of their official accounts. Some examples can be given for a number of small towns: the town of Lier in the duchy of Brabant introduced Hindu-Arabic numerals after 1652;¹⁶ Diest, also situated in Brabant, between 1653 and 1662;¹⁷ Roulers (Roeselare) in the county of Flan-

¹³ Brussels, General State Archives, Chambers of Accounts, reg., nos. 4419 and 4420.

¹⁴ Brussels, General State Archives, Chambers of Accounts, reg., no. 4370.

¹⁵ Brussels, General State Archives, Chambers of Accounts, reg., nos. 5166 and 5167.

¹⁶ Lier, Town Archives, Oud Archief, no. 476, account Jan.-Dec. 1653.

¹⁷ Brussels, General State Archives, Chambers of Accounts, reg., no. 31,069 and no. 31,070.

ders in 1724;¹⁸ Aardenburg (in Zeeland Flanders) only after 1752;¹⁹ Aalst, on the border between the county of Flanders and the duchy of Brabant, somewhat later still, in 1756.²⁰ In the official accounts of large(r) towns, too, the folio numbering or dates in the texts for a long time provided the only traces of the more modern numerals. The town receivers of Leuven allowed the use of Hindu-Arabic numerals in their main accounts from 1686.²¹ Gent switched to using these numerals in its town accounts much later, in 1753-1754;²² Tournai (Doornik) did so in 1763-1764²³ and Bruges in 1764-1765.²⁴

In all these cases, the numerals were first tested in dates, sometimes in a rather curious combination with Roman characters.²⁵ This mixing of numeral formats is characteristic of all kinds of accounts throughout Europe.²⁶ And as stated earlier, the new numerals first made their appearance in non-official records such as informal draft notes and all kinds of preparatory documents. Leuven town receivers or their clerks, for example, were already stating the amounts in their separate alphabetical files and indexes (*Tafels*) in this way several years or even decades before 1686, the year in which they

¹⁸ W. Vallaey, *Onderzoek en beschrijving van typologische kenmerken van de stadsrekeningen van de stad Roeselare in het archief van de stad Roeselare in de vroegmoderne tijd (ca. 1529-1789)* (unpublished thesis, Advanced Master in Archival Science, University of Brussels, Brussels, 2022), p. 89.

¹⁹ G.A. Vorsterman van Oijen, *Theorie der Algemeene Rekenkunde*, Schoonhoven, 1866, p. 17.

²⁰ L. De Mecheleer, *Inventaris van het archief van de Rekenkamers. Delen en banden (registers). Reeks stadsrekeningen van Aalst 1395-1786*, Brussels, 2011, p. 15.

²¹ Leuven, Town Archives, Oud Archief, no. 5308.

²² Brussels, General State Archives, Chambers of Accounts, reg., no. 35,062 and no. 35,063.

²³ Brussels, General State Archives, Chambers of Accounts, reg., no. 40,168 and no. 40,169.

²⁴ Brussels, General State Archives, Chambers of Accounts, reg., no. 32,804 and no. 32,805.

²⁵ Numerous examples can be found in the Leuven town account of 1670-1671, such as "xxii Januarij anno 1518", "vii^a Junij 1578" or "xxi Julij 1608" (Leuven, Town Archives, Oud Archief, no. 5293, fol. 20, 49 and 62).

²⁶ Endrei, *De l'abaque*, pp. 288-289 and 296; Jenkinson, *The Use of Arabic*, p. 267; Kool, *Die conste vanden getale*, p. 36.

started using the new numerals in the official accounts.²⁷ In Lier, the new numerals turned up in draft versions of the town accounts in the second half of the sixteenth century, long before they were used in the official and final versions.²⁸ When they did finally make their way into the official accounts, they first appeared in the text narratives before being used to express the final monetary amounts a few decades later.²⁹ This gradual adoption process is well documented for the accounts of the small town of Roulers (Roeselare) in West Flanders. Here, while accountants applied the new numerals to indicate years in 1549 at the latest, it would be centuries – 1713 – before they used them to express amounts in the textual items of the accounts, and a further decade for official amounts in the right margin of folios or pages.³⁰

5. Private Individuals

Private individuals did not wait so long to put their faith in the new figures. Around 1500, Bruges broker Wouter Ameyde, at the current state of research the first native merchant to use double-entry bookkeeping in the Low Countries, was clearly familiar with Hindu-Arabic numerals, but did not use them to express final amounts in his journals, ledgers or other accounts.³¹ At roughly the same time, the bookkeeping of the Bruges company of Jacob Despars, which traded with Portugal, also began using the new numerals, although they

²⁷ Leuven, Town Archives, Oud Archief, nos. 5299, 5300 and 5304.

²⁸ Lier, Town Archives, Oud Archief, no. 638, fol. 181 (account Jan.-Dec. 1600). I thank Nadine Janssen for bringing this example to my attention.

²⁹ Lier, Town Archives, Oud Archief, no. 470, fol. 7v, 9v and 53 (account Jan.-Dec. 1626). Other examples in Lier, Town Archives, Oud Archief, no. 470, fol. 7 and 49 (account Jan.-Dec. 1627) and fol. 7v (Jan.-Dec. 1628). These examples refer to both dates and numbers.

³⁰ Vallaey, *Onderzoek en beschrijving van typologische*, p. 89.

³¹ B. Verbist, *Traditie of innovatie? Wouter Ameyde, een makelaar in het laatmiddeleeuwse Brugge 1498-1507* (unpublished doctoral dissertation University of Antwerp, History Department), Antwerp, 2014, pp. 90 (plate 7), 96 (plate 9), 188 (plate 18), 253 (plate 27), 256 (plate 28) and 258 (plate 30).

mainly appeared in the descriptive text of the accounts, and much less in the numerical totals, for which Roman characters were still used.³² The same pattern can be observed in most of the accounts of the famous della Faille company in Antwerp in the sixteenth century. Hindu-Arabic numerals appeared in the text narrative of the journal of the Florentine Affaitati in Antwerp in 1538, but Roman numerals were still used for the amounts in the right-hand columns. Some years later, in 1555, these Roman characters had disappeared from the company ledger.³³ In fact, some private accounts from the sixteenth century show full use of Arabic numerals throughout, in all parts and details.³⁴ The Antwerp cloth merchant Frans de Pape, for example, completely switched to Hindu-Arabic numerals around 1560.³⁵ Other evidence suggests that these numerals had become quite common among merchants by the end of the sixteenth century.³⁶

As suggested in the second section, Italian examples turned out to be of cardinal importance for the introduction of the new numerals and their subsequent diffusion among public administrations and private individuals in the southern Low Countries. It was definitely not a coincidence that the Hindu-Arabic numerals first appeared in accounts of the so-called mercantile groups whose members were active in international trade and had direct contacts with Italian merchants and financiers. Bruges broker and “hosteller” Wouter Ameyde was among the first to use the numerals in his accounts, albeit it cau-

³² O. Mus, “De Brugse compagnie Despars op het einde van de 15e eeuw”, in *Handelingen van het Genootschap voor Geschiedenis “Société d’Emulation” te Brugge*, vol. 101, no. 1, 1964, p. 10.

³³ J.A. Goris, *Étude sur les colonies marchandes méridionales (Portugais, Espagnols, Italiens) à Anvers de 1488 à 1567. Contribution à l’histoire des débuts du capitalisme moderne*, Leuven, 1925, plates III and IV on pp. 120-121.

³⁴ W. Brulez, *De Firma della Faille en de internationale handel van Vlaamse firma’s in de 16e eeuw*, Brussels, 1959, p. 442.

³⁵ A. Meskens, *Wiskunde tussen Renaissance en Barok. Aspecten van wiskunde-beoefening te Antwerpen 1550-1620*, Antwerp, 1994, p. 55.

³⁶ A. Meskens, “Antwerpen en cultuur in de zestiende en vroege zeventiende eeuw”, in *Scientiarum Historia*, vol. 32, 2006, p. 4; Kool, *Die conste vanden getale*, p. 36.

tiously and not yet fully. Ameyde numbered many Italian merchants among his customers and it is highly likely that this Italian network acted as a source of inspiration, not only for the introduction of the new accounting system, but also for the novel numerals.³⁷

6. Reasons for Delay

Pending the results of a more systematic and large-scale study, all these examples illustrate that, even for accounts of private individuals, many decades and even centuries separate the introduction of Hindu-Arabic numerals from their practical application. The reason for this considerable time lag has nothing to do with ignorance, but mainly with distrust and suspicion towards this new form of numeration coming from the East. For centuries, it appears that amounts in Roman characters offered greater legal certainty throughout Europe.³⁸ This was even true in Italy, the country that had first welcomed the oriental innovation into its practice. Indeed, from 1299 both Florence and Venice took a number of measures to prevent the use of the numerals, and in 1348 the University of Padua demanded that all book lists should include Roman characters.³⁹ In Germany, in 1494 reckoning masters in Frankfurt were forbidden from making use of the new numerals in the accounts of the city.⁴⁰ Throughout the Holy Roman Empire, urban magistrates called the Roman characters “*kaiserlich*” (or “imperial”, referring to the great tradition of the Roman Empire) and decreed that they were the only figures that could be used.⁴¹ People were genuinely afraid that amounts expressed in the new numerals could easily be falsified.⁴²

³⁷ Verbist, *Traditie of innovatie*, pp. 345–346 and 353.

³⁸ O. Landolt, *Der Finanzhaushalt der Stadt Schaffhausen im Spätmittelalter*, Ostfildern, 2004, p. 81; E.I. Strubbe and L. Voet, *De chronologie van de middeleeuwen en de moderne tijden in de Nederlanden*, Antwerp, Amsterdam, 1960, pp. 89, 118 and 130.

³⁹ Kool, *Die conste vanden getale*, p. 36.

⁴⁰ K. Bjarnadóttir, “History of Teaching Arithmetic”, in A. Karp and G. Schubring (eds.), *Handbook on the History of Mathematics Education*, New York, 2014, p. 433.

⁴¹ Braunstein, *Les Allemands à Venise*, p. 445, note 131.

⁴² R. de Roover, “Aux origines d’une technique intellectuelle: La formation et l’expansion

As the new numerals were closely linked to Italian business affairs and accounting practices, it is very possible that tensions and difficulties between Italian financiers and native merchants or domestic administrations also had a negative influence on the spread of the new arithmetic culture among public administrations.⁴³ Despite some periods of xenophobia, hostilities and even open conflict towards Italian residents in a number of countries such as England and the Low Countries,⁴⁴ this sometimes troubled relationship did not prevent a series of other Italian innovations (double-entry bookkeeping, the bill of exchange, deposit and transfer banking) from being quite easily accepted. Perhaps the long time lag was needed to allow useful knowledge to leave the rather restricted scholarly area of mathematics and trickle down to practical application among accountants, architects, bankers, bookkeepers, cartographers, engineers, land surveyors, money-changers, and other professions?

The concern about easy arithmetic falsifications and the general context of distrust that enveloped the new numerals may explain why they were first used to display dates and to number pages in non-official documents such as preliminary records, or in the narrative items accompanying and explaining the amounts on the right side of each page or folio. Even when people used the numerals for their preliminary calculations, in preparatory documents or draft notes, and in the narrative sections of their accounts, they would

sion de la comptabilité à partie double", in *Annales d'histoire économique et sociale*, vol. 9, no. 44, 1937, p. 191; Endrei, *De l'abaque*, p. 288; Kool, *Die conste vanden getale*, p. 35; A. Sangster, "The Genesis of Double Entry Bookkeeping", in *The Accounting Review*, vol. 91, no. 1, 2016, p. 305.

⁴³ This was suggested by Danna, "The Spread of Hindu-Arabic", pp. 69-70. For difficulties between the English king, the barons and the Italians, see M. Allen, "Italians in English mints and exchanges", in C. Given-Wilson (ed.), *Fourteenth Century England*, vol. 2, Woolbridge, 2002, p. 53 or M. Prestwich, "Italian Merchants in Late Thirteenth and Early Fourteenth Century England", in *The Dawn of Modern Banking*, New Haven, London, 1979, pp. 80-81 and 95.

⁴⁴ E. Aerts, "Italian presence in the late medieval Bruges stock market", in L. Brunori, S. Dauchy, O. Descamps and X. Prévost (eds.), *Le droit face à l'économie sans travail. Finance, investissement et spéculation de l'Antiquité à nos jours. Tome II: L'approche internationale*, Paris, 2020, p. 215.

convert these figures into Roman characters for the final amounts in the official version of the accounts. Accounts from the southern Low Countries have left many traces of this deeply rooted mistrust. In some cases, specialist auditors from the Chambers of Accounts – the official central government audit offices – used the Hindu-Arabic numerals in their annotation while the accounting officers continued to work with the familiar Roman characters.⁴⁵ The receivers-general of all finances clearly knew about these numerals and used them in their notes and correspondence with the Council of Finance, but they still preferred to wait many decades before giving them a place in their official accounts.⁴⁶ They were not alone. The power of the Roman tradition was so firmly embedded in the urban financial administrations that during the second half of the seventeenth century the Antwerp town receivers carefully converted the Hindu-Arabic figures from the preparatory accounts into Roman numerals for the final grand account.⁴⁷ This long-held view of the superiority of the Roman notation may explain why in the Bruges city accounts, even after the introduction of the Hindu-Arabic numerals, the *summae* or totals under the chapters as well as the closing balances at the end of the account continued to be presented in Roman characters.⁴⁸ A similar practice can be observed in the accounts of the receivers-gen-

⁴⁵ For example, in the demesne accounts of Lier for the years 1612-1613 and 1660-1661 (Brussels, General State Archives, Chambers of Accounts, reg., nos. 5020 and 5028). There is another example in West Flanders in 1690, where the specialist auditor used the Hindu-Arabic numerals while the receiver himself continued to use the traditional Roman characters (Brussels, General State Archives, Chambers of Accounts, reg., no. 2991/3).

⁴⁶ Compare, for example, Brussels, General State Archives, Chambers of Accounts, reg., no. 1946 with no. 2022.

⁴⁷ M. Van Lerberghe, *De Antwerpse stedelijke financiën onder Filips II* (unpublished master's thesis University of Gent, History Department), Gent, 2012-2013, p. 31. The same phenomenon can be noticed in the town accounts of Konstanz around 1440 (B. Kirchgässner, "Studien zur Geschichte des kommunalen Rechnungswesen der Reichs städte Südwestdeutschlands vom 13. bis zum 16. Jahrhundert", in *Finances et comptabilité urbaines du XIIIe au XVIe siècle*, Colloque international Blankenberge 6-9-IX-1962. Actes, Brussels, 1964, p. 243).

⁴⁸ Brussels, General State Archives, Chambers of Accounts, reg., no. 32,805, fol. 26.

eral of all finances,⁴⁹ the provincial receivers-general of the county of Flanders⁵⁰ and the local demesne receivers of Antwerp and Brussels.⁵¹ Here too, the receivers expressed their subtotals and closing balance in Roman characters even when they had used the new numerals for the current amounts in their receipts and expenses. In Tournai, the town receivers preferred to follow the opposite path: they expressed the totals or *summae* and the *summa summarum* in Hindu-Arabic numerals many decades before they were willing to take the risk of writing down the amounts on the right side of the current line items in the same way.⁵²

While distrust of the numerical innovation may have been the principal explanation for its late adoption by public institutions, another motive may have played a secondary role. Against a background of a duodecimal-vicesimal currency and the widespread and sophisticated use of handy calculating tools such as the abacus or counting board, the novelty of decimal Hindu-Arabic numerals was considered superfluous for a very long time. Already in the late fourteenth century, the officers of the Chambers of Accounts demonstrated “an excellent level” in the fine art of “throwing” tokens or chips (*jetons*) onto an abacus. In mastering arithmetic operations, they demonstrated their ability to avoid errors even when checking large series of amounts in major accounts. Staff of the chambers detected accounting errors with great precision and easily performed calculations such as the arithmetic mean and the rule of three.⁵³ Calculating with an abacus and with tokens remained popular well into the seventeenth and even eighteenth centuries. All this time, finan-

⁴⁹ Brussels, General State Archives, Chambers of Accounts, reg., nos. 2022-2036.

⁵⁰ Brussels, General State Archives, Chambers of Accounts, reg., no. 2842, fol. 473-474 and no. 2992.

⁵¹ For Brussels: Brussels, General State Archives, Chambers of Accounts, reg., nos. 4420-4422; for Antwerp: nos. 5167-5169.

⁵² Brussels, General State Archives, Chambers of Accounts, reg., nos. 40,121, 40,133 and 40,139.

⁵³ J.-B. Santamaria, “Savoirs, techniques et pratiques comptables dans l’administration des Pays-Bas bourguignons, fin XIV^e-début XV^e siècle”, in *Comptabilités, Revue d’histoire des comptabilités*, vol. 7, 2015, [online], accessed on 20 July 2022.

cial and accounting experts in public administrations simply did not see any added value associated with the use of the new numerals.⁵⁴ As suggested in the introductory section, public finance officers were not that interested in profit and loss, but rather in personally justifying public funds. Such a different aim required less sophisticated accounting procedures, tools and calculations.

7. The Driving Force Behind the New Practices

Based on current research, it is difficult to identify the individuals who were the prime movers behind the dissemination of Hindu-Arabic numerals in public accounts. The little evidence available appears to support the hypothesis that lower-level financial staff, and even subordinate personnel such as clerks, introduced the new numerals into the accounts. For example, in the small Brabant town of Lier, Roman numerals were still used for monetary amounts in the official accounts in 1652, while Hindu-Arabic numerals appeared the next year.⁵⁵ Both accounting years had the same receivers, but the different handwriting indicates that the accounts were prepared by different clerks.⁵⁶ A similar observation can be made for the accounts of the provincial government of East Flanders where the receiver-general Gilles Dons used Roman characters in 1702 and suddenly introduced Arabic numerals the year after.⁵⁷ Here, too, the

⁵⁴ Endrei, *De l'abaque*, p. 289; J.-B. Santamaria, "Comptabilité publique et innovation à la fin du Moyen Âge: les institutions princières et l'émergence d'une culture numérique dans un ordre conservateur", in *Médiévales. Langues, Textes, Histoire*, vol. 76, 2019, p. 126.

⁵⁵ For Lier, see note 16.

⁵⁶ This was also the case in other small towns and in large(r) towns (V. Neckebroeck, *De Leuvense stadsfinanciën (1642-1661)*, unpublished master's thesis University of Leuven, History Department, Leuven, 2008, p. 31; W. Prevenier, "Quelques aspects des comptes communaux en Flandre au Moyen Âge", in *Finances et comptabilité urbaines du XIII^e au XVI^e siècle*, Colloque international Blankenberge 6-9-IX-1962. Actes, Brussels, 1964, p. 145; P. Vandepitte, *De stadsfinanciën van Tielt vanaf de regering van Filips II tot het begin van de Oostenrijkse periode 1557-1718*, Tielt, 1966, pp. 26, 30 and 76).

⁵⁷ Brussels, General State Archives, Chambers of Accounts, reg., nos. 2841 and 2842.

handwriting in the two accounts of the same receiver is different and the two sets of accounts were presented to the Chamber of Accounts by different people. It is of course perfectly possible that the same receiver simply changed his mind from one day to the next, or more likely from one accounting year to the next, but it is more probable that his collaborators introduced the new numerals. After all, the receiver was in charge of the general financial management, leaving the painstaking daily keeping of the accounts to one of his subordinate collaborators.⁵⁸ So it seems that these professional categories were at the forefront when it came to practical numeracy. From their position within the financial field, they were responsible for the slow but steady advance of technical, prescriptive knowledge in society.

The accounts provide no answer to the question of where and how these lower-ranked office workers in public financial administrations familiarized themselves with the new way of performing calculations. In a number of cases, clerks, *greffiers* and other lower staff members must have learned the art from a more experienced or senior colleague within the administration itself. This process of learning “on the job” was widespread and typical not only for the transmission of technical skills within craft guilds but also for the commercial and financial training of apprentices and junior employees in private companies.⁵⁹ We know, for example, that the workplace was very important for the training of accountants in late medieval Tuscany.⁶⁰ In Antwerp, such training was often arranged

⁵⁸ M. van der Heijden, “Stadsrekeningen, stedelijke financiën en historisch onderzoek”, in *NEHA. Bulletin voor de economische geschiedenis*, vol. 13, no. 2, 1999, pp. 132-133. See also the interesting observations on “la position des clerks” in the diffusion of financial knowledge in Santamaria, *Comptabilité publique et innovation*, pp. 116 and 129. Some towns had two receivers, one of whom was sometimes called the “bookkeeper” (for example in Lier).

⁵⁹ B. De Munck and H. Soly, “Learning on the Shop Floor in Historical Perspective”, in B. De Munck, H. Soly and S.L. Kaplan (eds.), *Learning on the Shop Floor. Historical Perspectives on Apprenticeship*, New York, Oxford, 2007, pp. 3-30; J. Puttevils, *The Ascent of Merchants from the Southern Low Countries. From Antwerp to Europe 1480-1585* (unpublished doctoral dissertation University of Antwerp), Antwerp, 2012, pp. 163-171.

⁶⁰ A. Orlandi, “The emergence of double-entry bookkeeping in Tuscan firms of the thirteenth and fourteenth centuries”, in *Accounting History*, vol. 26, no. 4, 2021, p. 537.

by senior merchants during formal or less formal apprenticeships. Obviously, these orally based practical learning processes needed a more formal start in an institutional context, an infrastructure that had existed in Italian cities since the thirteenth century. In the so-called *scuole d'abaco*, pupils were trained not only in traditional reckoning techniques (such as the abacus), but also in the use of the Hindu-Arabic numerals.⁶¹ According to Florentine banker, diplomat and chronicler Giovanni Villani, in Florence between 1336 and 1338 no fewer than six such schools offered practical training courses to between 1,000 and 1,200 pupils.⁶² The arithmetic manuals (*libri d'abaco*) that circulated in these vernacular lay schools became more numerous throughout Europe as of the fifteenth century and became available in printed form in the last quarter of the century.⁶³

In the southern Low Countries, there was a flourishing circulation of handbooks (*artes* literature) in manuscript form among urban citizens, supplemented from 1470 with professional and scientific literature marketed by a large number of printers and publishers.⁶⁴ From the second quarter of the sixteenth century, Antwerp, the great commercial metropolis of western Europe, counted a large number of arithmetic schools within its walls. The usually well-informed Florentine merchant and historian Lodovico Guicciardini, who lived in the city, estimated their number at about 150.⁶⁵ In these “distant de-

⁶¹ Danna, “The Spread of Hindu-Arabic”, p. 64; Id., *Elaboration and Diffusion*, pp. 63 and 64.

⁶² R. Black, *Education and Society in Florentine Tuscany*, vol. 1, Leiden, Boston, 2007, pp. 1 and 222; F.G. Dragomann (ed.), *Cronica di Giovanni Villani a miglior lezione ridotta coll'ajuto de' testi a penna con note filologiche di I. Moutier e con appendici storico-geografiche*, vol. 3, Florence, 1845, p. 324.

⁶³ P. Benoît, “La formation mathématique des marchands français à la fin du Moyen Age: l'exemple du Kadran aux marchands (1485)”, in *Annales de l'Est*, 5th series, vol. 34, nos. 1-2, 1982, p. 221; Danna, *Elaboration and Diffusion*, pp. 64 and 72.

⁶⁴ Kool, *Die conste vanden getale*, p. 24; B. De Munck and H. de Ridder-Symoens, “Education and Knowledge: Theory and Practice in an Urban Context”, in B. Blondé, M. Boone and A.-L. Van Bruaene (eds.), *City and Society in the Low Countries 1100-1600*, Cambridge, 2018, pp. 220, 225, 234, 238 and 251-252.

⁶⁵ A. Meskens, *Practical mathematics in a commercial metropolis: mathematical life in late 16th century Antwerp*, Dordrecht, Heidelberg, London, New York, 2013, p. 36.

scendants”⁶⁶ of the Italian prototypes, specialized schoolmasters, also called “cypher masters” (*cyfermeesters*) or “reckoning masters” (*rekenmeesters*),⁶⁷ used printed treatises and manuals, which they sometimes wrote themselves.⁶⁸

8. Conclusion

Hindu-Arabic numerals were quite common in private (company) accounts of the Low Countries before the end of the sixteenth century. By contrast, public accounts administered by central, provincial, local and urban governments only began to use the new numeral forms in the late seventeenth or even eighteenth centuries. A similar pattern can be seen elsewhere. In England the new numerals were present in some private accounts in the fifteenth century but only started to appear in public accounts in the course of the seventeenth and eighteenth centuries.⁶⁹ If we assume that this divergent chronology can be considered a proxy for financial progress or even, to use bold words, “modernity” and “rationality”,⁷⁰ we could conclude that public accounts were more conservative than their private equivalents. However, an important caveat is necessary here. The very long absence of the new numerals in public accounts does not imply a kind of intellectual blindness or a state of mental isolation, or even a resistance to any form of numerical or arithmetic innovation. It could also be an indication that the existing techniques and practices were satisfactory and adequately met all needs. In the case of public administrations, these expectations were less high and rig-

⁶⁶ Danna, “The Spread of Hindu Arabic”, p. 77.

⁶⁷ H.L.V. de Groote, “Zestiende-eeuwse boekhoudkundigen en cijfermeesters in betrekking met Antwerpen”, in *Scientiarum Historia*, vol. 3, no. 3, 1961, pp. 142-156; Kool, *Die conste vanden getale*, p. 48.

⁶⁸ Danna, *Elaboration and Diffusion*, pp. 61 (table 1), 74 and 76; Kool, *Die conste vanden getale*, p. 51.

⁶⁹ Danna, “The Spread of Hindu-Arabic”, p. 71; Jenkinson, *The Use of Arabic*, pp. 264 and 266.

⁷⁰ Braunstein, *Les Allemands à Venise*, pp. 445 and 447.

orous than with merchants or bankers who in their daily contacts with Italian colleagues felt the need to adapt sooner. As for the transmission of this practical knowledge, it took place both in an informal and a formal way, on the work floor with experienced senior colleagues and in special arithmetic schools with qualified reckoning masters.

One conclusion seems certain: the adoption of the new numerals in the accounts of the southern Low Countries did not occur suddenly or through a series of revolutionary external shocks, but represented, as so aptly observed by Richard Goldthwaite and Angela Orlandi for the financial documentation of Renaissance Florence, “nothing more than an internal dynamic, however slow, toward refinement”, driven “by means of small, barely perceptible changes”.⁷¹ Their conclusion of a slow, endogenous process is confirmed by Paul Bertrand who, at least for the long thirteenth century, stressed the pragmatic and even spontaneous character of the introduction of new writing practices “in a more or less improvised way”.⁷² Such statements substantiate the more general idea that commercial and financial innovative practices in general followed a cumulative path rather than a revolutionary trajectory.⁷³

⁷¹ Quotations from Goldthwaite, *The Practice and Culture*, p. 633 and Orlandi, *The emergence of double-entry bookkeeping*, p. 535.

⁷² Bertrand, *Les écritures ordinaires*, p. 388 even uses the expression “pratiques de bricolage” or “do-it-yourself practices”. An English translation of this impressive study is available as *Documenting the Everyday in Medieval Europe. The Social Dimensions of a Writing Revolution, 1250-1350*, Turnhout, 2019.

⁷³ Danna, *Elaboration and Diffusion*, p. 58.