

The Influence of Information Costs on the Integration of Financial Markets: Northern Europe, 1350-1560

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Abstract

In this paper, the influence of information costs on the integration of Northern European financial markets between ca. 1350 and 1560 is explored. The approach is based on splitting information costs into their constitutive components and on measuring one of these, i.e. the costs of transmitting information, which have particular importance for market integration. The analysis has two main results: First, under pre-industrial conditions, when transmitting information was extremely labour intensive and very little capital intensive, transmission costs can be largely identified with labour costs, and were subject to the same influences. Next, the integration of financial markets depended on the level of transmission costs, high costs being strongly and significantly correlated with weak integration, while lower costs favoured convergence.

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1. The issue: information costs and market integration

In the context of New Institutional Economics, one of the most widely used concepts is that of transaction costs. Ronald Coase, who introduced it into economic theory, defined transaction costs as the costs of using the price mechanism of the market.¹ While a standard terminology has still not evolved and many different definitions appear in the literature,² there is wide agreement that these costs are a source of friction which damages the ability of the market smoothly to provide for the optimal allocation of resources. It follows that the ability of economic actors to engage in exchange, to specialise and to realise gains from productivity advances due to specialisation also depends on the level of transaction costs, which therefore have central importance for the performance of the economy as a whole.

Research in economic history inspired by New Institutional Economics often invokes transaction costs in order to explain the behaviour of economic agents or economic developments. Douglass C. North's seminal studies stand for many others.³ Still, the approach has met with some criticism. Many scholars claim that it is impossible to operationalise the concept of transaction costs and meaningfully to use it in empirical studies. Clemens Wischermann, for example, asserts that transaction costs can hardly be measured.⁴ Proponents of the concept usually counter this criticism in two ways. On the one hand, they claim that for comparative analyses it is sufficient to establish relative levels of transaction costs. On the other hand, they point to studies where these costs have been measured, either by comparing the costs involved in specific kinds of

¹ Coase: The Nature of the Firm, in: *Economica* 4 (1937), pp. 386-405.

² Thus, Barzel defines transaction costs as "the costs associated with the transfer, capture, and protection of rights". Barzel: *Economic Analysis of Property Rights*. 2. impr., Cambridge 1997, p. 4. According to Eggertsson, they "are the costs that arise when individuals exchange ownership rights to economic assets and enforce their exclusive rights. A clear-cut definition of transaction costs does not exist, but neither are the costs of production in the neoclassical model well defined". Eggertsson: *Economic Behavior and Institutions*, Cambridge 1990, p. 14. A still wider definition is given by Furubotn and Richter, who claim that "transaction costs include the costs of resources utilized for the creation, maintenance, use, change, and so on of institutions and organizations Transaction costs consist of the costs of defining and measuring resources or claims, plus the costs of utilizing and enforcing the rights specified". Furubotn and Richter: *Institutions and Economic Theory: The Contribution of the New Institutional Economics*, Ann Arbor 1997, p. 40.

³ E.g. North: Government and the Cost of Exchange in History, in: *Journal of Economic History* 44 (1984a), pp. 255-264; North: Transaction Costs, Institutions, and Economic History, in: *Journal of Institutional and Theoretical Economics* (JITE) 140 (1984b), pp. 203-213; North: Institutions, Transaction Costs and Economic Growth, in: *Economic Inquiry* 25 (1987), pp. 419-428; North: *Transaction Costs, Institutions, and Economic Performance*, San Francisco 1992.

⁴ Wischermann: Der Property-Rights-Ansatz und die "neue" Wirtschaftsgeschichte, in: *Geschichte und Gesellschaft* 19 (1993), pp. 239-258, p. 249; cf. Bonus and Maselli: *Transaktionskostenökonomik*, in: *Gabler-Volkswirtschafts-Lexikon*, vol. 2: L-Z. Wiesbaden 1996, pp. 1082-1085, p. 1084.

transactions, or by estimating the size of the economic sector concerned with initiating and handling transactions.⁵

As far as economic history is concerned, there have not been many attempts to measure transaction costs. In particular, few attempts seem to have been made with regard to pre-industrial history: the problems posed by the lack and poor quality of the data seemed too forbidding. Using a new approach, the present paper aims at remedying this defect, at least as far as Northern and Central Europe between the middle of the fourteenth and the second half of the sixteenth centuries are concerned. The intention is neither to measure the development of the transaction sector nor to establish how the costs developed which had to be incurred in order to enter into specific transactions. Rather, the approach is to split transaction costs into components that are more manageable and about whose definitions agreement is easier to reach than about the concept as a whole, and to measure at least one of these. Additionally, in order to demonstrate the relevance of this cost component, the effects its development had on markets in late medieval and early modern Europe are estimated.

Where exactly are costs incurred when economic agents use the market to co-ordinate their activities? A good approach is to return to the origin, that is, to the discoverer of transaction costs. Coase pointed out that “[i]n order to carry out a market transaction it is necessary to discover who it is that one wishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading up to a bargain, to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on”.⁶ Obviously, in this context information costs take a central place: *ex ante*, information is needed in order to find a partner and to determine the characteristics of the good or service which is exchanged. *Ex post*, enforcing a contract against a dishonest partner is costly for many reasons, but without incurring information costs the agents cannot even begin to determine whether one of them has violated the agreement. If the issue is measuring transaction costs, it therefore makes sense to begin with measuring information costs.

⁵ E.g. Furubotn and Richter: *The New Institutional Economics: An Assessment*, in: Furubotn and Richter, eds.: *The New Institutional Economics*. Tübingen 1991, pp. 1-32, p. 11; Wallis and North: *Measuring the Transaction Sector in the American Economy, 1870-1970*, in: Engerman and Gallman, eds.: *Long-term Factors in American Economic Growth*. Chicago 1986, pp. 95-161; the research on measuring transaction costs is surveyed in Wang: *Measuring Transaction Costs: An Incomplete Survey*, Ronald Coase Institute, Working Paper 2, 2003.

⁶ Coase: *The Problem of Social Cost*, in: *Journal of Law and Economics* 3 (1960), pp. 1-44, p. 15.

Still, information costs, too, can be split into several categories.⁷ For one thing, there are the costs of encoding and decoding information, which are reduced for example when standardised writing systems and languages are introduced. Thus, without actually attempting to measure the costs involved, Ulrich Blum and Leonard Dudley showed how at the end of the Dark Ages the creation of a standardised alphabet and the spread of standard Latin contributed to economic growth by making it less costly to record contractual clauses.⁸ Apart from this, the costs of storing information depend on the price of the medium used for storage. For instance, when cheap paper replaced expensive vellum in the course of the fourteenth and fifteenth centuries, the costs of storing information fell. Finally, there are the costs of transmitting information. In spatially segmented markets, they do not only influence the chances of discovering what the relevant prices are, but also of finding a partner with whom to do business. Put differently, the costs of transmitting information determine whether economic agents are able to recognise opportunities for arbitrage. It is this cost category that is analysed in the present paper.

Such an analysis would be incomplete if the relevance of the costs of transmitting information for the performance of markets was not examined, too. The above remarks already point to where it seems promising to look. It has long been realised that arbitrage is the driving force behind market integration, which is impeded by transport costs on the one hand, and information costs on the other.⁹ Here, the costs of encoding and storing information play a minor role; what counts are the costs of transmitting it. Hence, it seems obvious to examine how their development influenced the integration of markets. Still, markets for which goods? Transport costs and information costs hamper integration, but their relative importance for different commodities differs: transport costs have a relatively stronger influence on the integration of markets for goods with a high weight-value ratio, that is, for heavy, bulky commodities which are typical mass goods. Grain comes to mind. Information costs, on the other hand, are relatively more important where goods with a low weight-value ratio are concerned: luxuries, for example. Even under commodity money conditions as those existing in late

⁷ For the following see Dudley: Communications and Economic Growth, in: *European Economic Review* 43 (1999), pp. 595-619, pp. 601 f.

⁸ Blum and Dudley: Standardised Latin and Medieval Economic Growth, in: *European Review of Economic History* 7 (2003), pp. 213-238.

⁹ Kindleberger: *Economic Laws and Economic History*, Cambridge, New York, New Rochelle, Melbourne, Sydney 1989, pp. 67 ff.

medieval and early modern Europe, there is hardly any good whose weight-value ratio is more favourable than that of money, in other words, where transport costs are relatively less and information costs relatively more important for market integration. Consequently, it is the integration of financial markets that is examined below. This is done by employing a new method that allows us to push back the analysis several centuries farther than research has succeeded in doing until now: Hitherto, the limit of quantitative analyses of financial markets has been the early eighteenth or at most the late seventeenth century;¹⁰ with the method used here, it is the fourteenth century. The hypothesis which is tested is that the integration of these markets was driven by the development of information costs, high costs being correlated with weakly integrated markets, whereas low costs favoured convergence.

The rest of the article proceeds as follows: In section 2, the data are discussed. Here, it is first explained how the development of information costs was determined for the period between the middle of the fourteenth and the middle of the sixteenth centuries. Most importantly, the principal source on which this paper is based is introduced. Subsequently, it is explained how the data base needed for the analysis of the integration of financial markets was constructed. The following section (3) concerns the analysis of the data. In a final section (4), the results are presented and discussed in their historical context, and the main hypotheses of the paper are summarised.

2. The Data

2.1. *Messenger wages*

As indicated above, this paper considers only one component of information costs in the late Middle Ages and the early modern period, namely transmission costs. That transmitting information was an important issue was realised by anybody concerned with long distance trade. In the course of their career, merchants who were active on international markets sent and received hundreds of letters each of which contained bits of information – in effect vital pieces of the puzzle they needed to put together in order to obtain a picture of what went on abroad. No wonder that they took pride in being

¹⁰ Neal: Integration of International Capital Markets: Quantitative Evidence from the Eighteenth to the Twentieth Centuries, in: *Journal of Economic History* 45 (1985), pp. 219-226; Neal: The Integration and Efficiency of the London and Amsterdam Stock Markets in the Eighteenth Century, in: *Journal of Economic History* 47 (1987), pp. 97-115; Schubert: Innovations, Debts, and Bubbles: International Integration of Financial Markets in Western Europe, 1688-1720, in: *Journal of Economic History* 48

better-informed than their competitors. Thus, in 1410 Sievert Veckinghusen, a merchant from Lübeck whose business interests were as far-flung as Livonia, Flanders and Italy, did not only point out to his brother Hildebrand in Bruges that “great profit” could be made by keeping their agent in Venice abreast of events in Flanders, but also that it would be “a great honour” for him “always to receive letters with all runners, like other people do”.¹¹

Much information may, of course, have been transmitted informally in the late Middle Ages and in the early modern period, but the quotation shows that sending messengers was the usual way of spreading knowledge which was relevant for doing business. Obviously, such messengers could carry several oral messages and more than one letter at a time, so that here the economies of scale usually involved in the transmission of information apply. Still, if a rough and ready outline of how transmission costs developed over time is needed, the wages that messengers received are a useful indicator.

How can we study such wages over extended periods of time? Many late medieval and early modern commercial sources – e.g. account books¹² – mention sums paid to messengers, but usually the data are too isolated to be easily comparable. What we need are sources that contain serialised information about messenger wages over several centuries or at least decades. Fortunately, such sources have been preserved, albeit rarely from a commercial context: most seem to be records kept by political authorities.¹³ The present study draws on the account books of the treasury of the city of Hamburg, which contain year-by-year entries of the sums paid to messengers of the council. These sums are used in order to establish how the costs of transmitting information developed. Is this approach feasible? Clearly, to be so two conditions need to be given: First, the messengers must have received wages and not just some kind of expense allowance, as it is sometimes claimed in the literature.¹⁴ Furthermore, if they

(1988), pp. 299-306; Schubert: Arbitrage in the Foreign Exchange Markets of London and Amsterdam During the 18th Century, in: *Explorations in Economic History* 26 (1989), pp. 1-20.

¹¹ Stieda, ed.: Hildebrand Veckinghusen: Briefwechsel eines deutschen Kaufmanns im 15. Jahrhundert, Leipzig 1921, p. 37.

¹² Cf. Nirnheim, ed.: *Das Handlungsbuch Vickos von Geldersen*, Hamburg, Leipzig 1895, p. 115.

¹³ Cf. Braudel: *The Mediterranean and the Mediterranean World in the Age of Philip II*, vol. 1. 5. impr., Glasgow 1949/86, pp. 365 ff.

¹⁴ Maack: *Die Anfänge hamburgischen Postwesens*, in: *Hamburg-Altonaer Verein für Briefmarkenkunde*, ed.: *Hamburg, seine Postgeschichte, Postwertzeichen und Poststempel: Festschrift zur Erinnerung an die 50jährige Wiederkehr des Gründungstages des Vereins für Briefmarkenkunde*

were paid wages, these payments must be representative of the wages granted to messengers not only by political authorities such as the council of Hamburg, but also by e.g. merchants or firms. The material used here makes it possible to confirm that both conditions do indeed hold. In order to demonstrate this, it is necessary to introduce the source on which this paper is primarily based in some more detail.

The earliest preserved account books of the city of Hamburg date from 1350. In 1563, the financial administration was reorganised and transferred to a new department.¹⁵ Between these dates, the principles according to which the records were kept did not change, the entries made in the mid-sixteenth century being organised in exactly the same way as those that are 200 years older. In the present context, the section headed “cursoribus” is of principal interest. Here, the scribes of the treasury entered the missions on which the council of Hamburg sent their messengers, first registering the messenger’s name or just “uni cursori”, “nuntio” or “tabellario”, next the destination, and finally a sum of money paid out. The exact date is usually not given. Altogether, c. 6200 missions are recorded in the “cursoribus”-section;¹⁶ additionally, there are c. 1500 entries that concern payments – apparently perquisites – made to some of the foreign messengers who arrived in Hamburg. Unfortunately, the books containing the entries for 1351-1369, 1388 to 1460, and 1501 to 1521 were lost when parts of the old town of Hamburg burned in 1842. Some of the missing material could be reconstructed with the help of notes taken by a historian of the town some years before the fire, but large lacunae remain.¹⁷ What survives is, however, sufficient to give us glimpses at developments during key periods of late medieval and early modern history: at the aftermath of the Black Death, at the beginning recovery in the second half of the fifteenth century, and at the effects of the “Price Revolution” of the sixteenth century.

Before the method used in this paper to establish the development of information costs is explained, some points of interest should be noted. First, the source shows that the vast majority of couriers travelled on foot. Mounted messengers of Hamburg are explicitly mentioned only six times.¹⁸ This does not preclude that occasionally the

zu Hamburg von 1885. Hamburg 1935, pp. 1-14, p. 1; Ahrens: Das Botenwesen der Hamburger Kaufmannschaft (1517-1821), in: Archiv für deutsche Postgeschichte 1 (1962), pp. 28-42, p. 28.

¹⁵ Koppmann, ed.: Kämmererechnungen der Stadt Hamburg 1555-1562, vol. 7, Hamburg 1894, p. XI.

¹⁶ Some very few missions were entered in other sections of the accounts.

¹⁷ Koppmann, ed.: Kämmererechnungen der Stadt Hamburg: 1350-1400, Hamburg 1869, pp. VII f.

¹⁸ Koppmann, ed.: Kämmererechnungen der Stadt Hamburg: 1471-1500, Hamburg 1878, p. 192; Koppmann, ed.: Kämmererechnungen der Stadt Hamburg: 1501-1540, vol. 5, Hamburg 1883, p. 501;

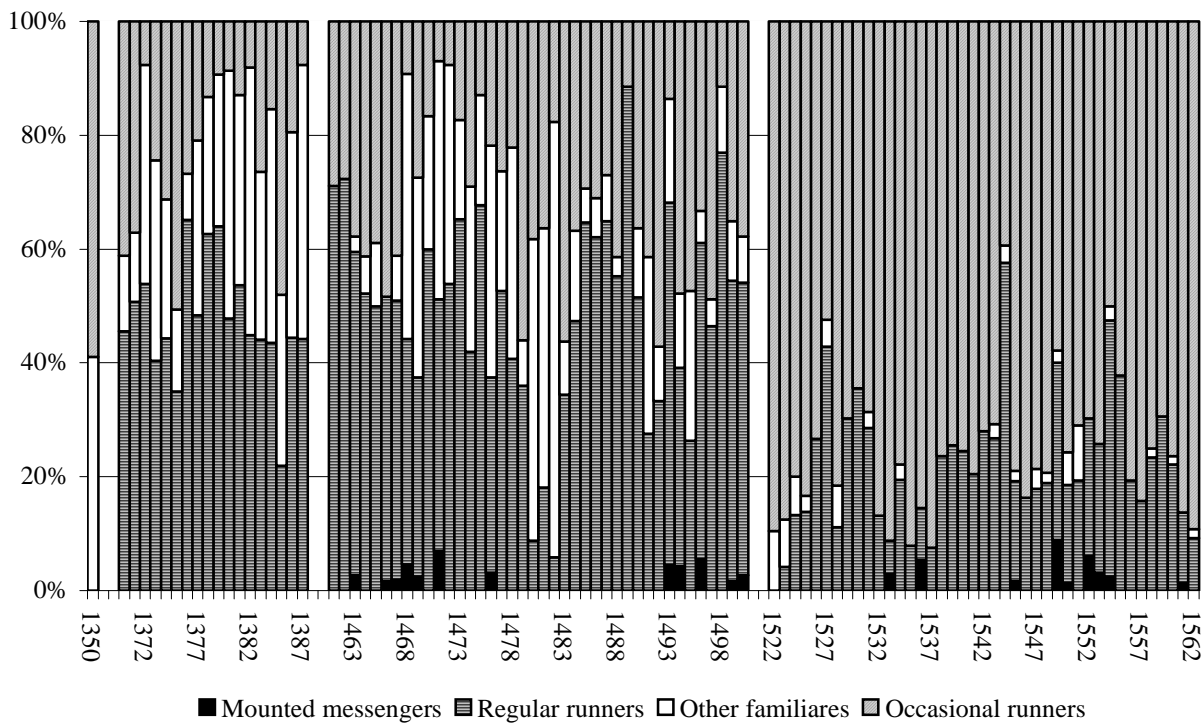
scribes just did not make a note of the means of travel; in fact, it seems likely that the number of mounted messengers was larger. An examination of another section of the civic accounts of Hamburg – headed “ad pretium familiae” – shows why this is the case. In the “ad pretium”-section, the scribes entered the basic yearly salaries paid to the civil servants of Hamburg (the members of the city’s “familia”: night watchmen, gatekeepers, officials who supervised the market etc.). Among these civil servants, a number of “famuli equestri” appears, who were usually employed as outriders. When the names in the “cursoribus”-section are compared with those in the “ad pretium”-section, it becomes evident that occasionally, the mounted servants of the city were employed as messengers, too. Taking these cases into account, 42 missions can be identified where it is either certain or very likely that the messenger travelled on horse.

A second point that is shown by a comparison of the “cursoribus”- and “ad pretium familiae”-sections is that there was not a single year when the council of Hamburg restricted themselves to employing members of the familia as messengers. They always sent other persons, too. This can be conclusively determined when names are entered that do not appear among the city’s familiares. However, for analytical purposes anonymous missions are here also attributed to such occasional messengers, the assumption being that the scribe of the treasury knew the familia, and would have entered the name if he had known it. While occasional messengers appear in all years, a trend is obvious: Whereas in 1350 practically every servant of the city could be employed as a messenger, regardless of his usual occupation, by 1371 two familiares were recorded as regular “cursores”; they rarely seem to have fulfilled any other tasks.¹⁹ In the fifteenth century, the share of other familiares fell, and by the middle of the sixteenth century, the council hardly ever sent members of the familia other than the two main messengers. At the same time, the share of non-members of the familia, who were employed as messengers, grew. Taken together, both developments (i.e. the fall in the share of other familiares and the rise in that of occasional runners) point to an increasing specialisation within the civil service of Hamburg.

Fig. 1: Types of messengers, 1350-1562

Koppmann, ed.: Kämmererechnungen der Stadt Hamburg 1541-1554, Hamburg 1892, pp. 347, 553;
Koppmann, ed.: Kämmererechnungen der Stadt Hamburg 1555-1562, vol. 7, Hamburg 1894, p. 211.

¹⁹ Koppmann, ed.: Kämmererechnungen der Stadt Hamburg: 1350-1400, Hamburg 1869, p. 142.



Finally, the source shows that the frequency with which the council of Hamburg sent messengers varied enormously. There were periods when traffic was intense, the council sending up to three messengers per week, while at other times only about twenty or thirty messengers were sent per year.

Table 1: Number of missions per year

Period	Missions	Period	Missions
1350	115	1491-95	40
1370	151	1496-1500	48
1371-75	136	1522-25	38
1376-80	92	1526-30	36
1381-85	67	1531-35	56
1386-87	60	1536-40	62
1461-65	56	1541-45	59
1466-70	74	1546-50	59
1471-75	45	1551-55	44
1476-80	39	1556-60	64
1481-85	54	1561-62	89
1486-90	47		

The cause of these variations is unclear, all the more so as falling numbers of civic messengers do not seem to have been made up by rises in the numbers of foreign envoys who arrived in Hamburg. However, since there must have been more foreign messengers than those who received a payment out of the treasury and who are mentioned in the account books (for some years, e.g. 1527, not even one is recorded), this problem must remain open.

The method used in the present paper in order to establish the development of transmission costs is to determine the geographical co-ordinates of the messengers' destinations, to calculate the distance from Hamburg and then the per-kilometre sum. Starting out from the distance as the crow flies obviously yields sums which are somewhat too high. However, the focus here is not on individual income or purchasing power but on the fluctuations of payments over time, so that this approach is acceptable. Altogether it is possible to determine the direct distance from Hamburg for about 75% of the destinations. In the rest of the cases, the scribe of the treasury did not make a note of the place, but rather of a person or of a larger region where the messenger was sent. Many of the persons were princes of neighbouring territories – the counts of Holstein, the dukes of Brunswick-Lüneburg, of Mecklenburg and so on –, who were fairly mobile and had so many residences that these entries must be neglected. Regions, such as the Alte Land opposite Hamburg on the south bank of the Elbe or Dithmarschen on the west coast of Holstein, present a problem because they are quite large and as destinations altogether too imprecise to allow the calculation of a per-kilometre sum from Hamburg.

The proponents of the hypothesis that civic messengers did not receive per-kilometre wages but rather an expense allowance do not tell, but their view seems to be based on the observation that even within the same year, sums paid for journeys to the same destinations varied widely. In 1350, for example, the messenger Arnold Sasse was twice sent to Bergedorf, a village just 18 kilometres from Hamburg. At one time he received 1s., at the other 4s.²⁰ In 1470, Johannes Bur got 16s. for his mission to Lübeck (c. 57 kilometres), while Ludekin Meiger was given just 7s. for the same distance.²¹ Even at the end of the period considered here, fixed tariffs that were paid for specific distances did not exist.²² The sums paid to messengers and the distances they went are still quite closely correlated (the mean correlation coefficient is 0.72 for the regular runners, 0.66 for occasional messengers and 0.59 for both mounted servants and other familiares), but

²⁰ Ibid., p. 12. The currency in which the accounts were kept is the Pound of Lübeck (£) that was divided into 20 shillings (s.) and 240 pennies (d.). Hamburg was a member of a currency union (the "Wendish Monetary Union") which linked it not only with Lübeck but also with the neighbouring cities of Lüneburg and Wismar. In these cities, the most common unit of account was not the Pound but the Mark (m.), which was divided into 16 shillings or 192 pennies (thus, £1 equalled 1m.4s.).

²¹ Koppmann, ed.: *Kämmereirechnungen der Stadt Hamburg: 1401-1470*, Hamburg 1873, pp. 445 f.

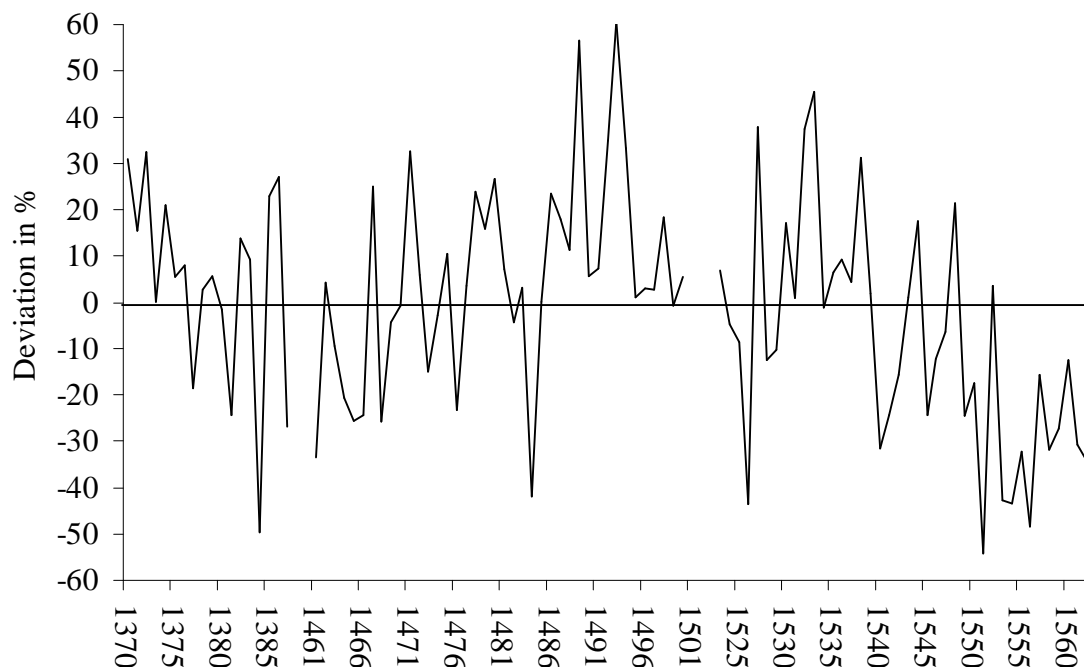
²² In 1561, for example, Georg Wolters received £1 for one mission to Lübeck, and £1.10s. for another Koppmann, ed.: *Kämmereirechnungen der Stadt Hamburg 1555-1562*, vol. 7, Hamburg 1894, p. 311; cf. Gerteis: *Reisen, Boten, Posten, Korrespondenz in Mittelalter und Früher Neuzeit*, in: Pohl, ed.: *Die Bedeutung der Kommunikation für Wirtschaft und Gesellschaft: Referate der 12. Arbeitstagung der Gesellschaft für Sozial- und Wirtschaftsgeschichte vom 22.-25.4.1987 in Siegen*. Stuttgart 1989, pp. 19-36, p. 22.

such variations might nevertheless support the view that the payments were just supposed to cover expenses incurred by the messengers. However, any number of alternative explanations comes to mind. Thus, with regard to nearby Lüneburg's messenger service Ranft suggested that the kind of mission – transmitting verbal information, carrying important documents etc. – influenced payments.²³ Just as well, the messenger's age or experience, his speed or why not the weather or the time of the year may have been decisive.

Still, there is a way to determine whether the expense-allowance view is correct. Obviously, the hypothesis can apply to civil servants only, that is to persons who received a regular basic salary. Occasional messengers must have received a wage. If the traditional hypothesis was correct, it should be possible to make out a systematic difference between the sums paid to both types of messengers: those who did not belong to the "familia" should have received more because they could not rely on a basic salary. In order to show whether this was indeed the case, it seems useful to treat the wages paid to the two regular runners whom the council employed as a benchmark; this is the only group for which data exist for every year apart from 1350. The wages that occasional runners received can then be compared to those of the council messengers.

Fig. 2: Deviation of wages of occasional runners from those of regular runners (in percent), 1370-1562

²³ Ranft: Der Basishaushalt der Stadt Lüneburg in der Mitte des 15. Jahrhunderts: Zur Struktur der städtischen Finanzen im Spätmittelalter, Göttingen 1987, p. 82.



While differences could become large, there do not seem to have been systematic deviations into one or the other direction. Perhaps it could be said that conditions favoured the occasional runners in the late 1480s and 1490s, and harmed them in the 1550s, but otherwise years when they were better paid alternated with years when they received less than the two regular runners did. Evidently, this contradicts the hypothesis that familiares received a kind of expense allowance. Members of Hamburg's familia were paid a wage that seems to have been individually negotiated between them and the city's financial administration. At the same time, the lack of a clear direction into which the wages of regular runners deviated from those of occasional messengers suggests that the data found in the account books of Hamburg are indeed representative of messenger wages in general: Merchants probably paid similar per-kilometre sums.

The question of why the wages of regular and occasional runners diverged cannot be answered on the basis of the surviving sources. However, the general development can be explained. While New Institutional Economics suggests that the level of transaction costs – and by implication that of the costs of transmitting information – is strongly influenced by institutional change, the literature which is concerned with information costs in the narrow sense of the word puts the main stress on the importance of either cultural factors (such as the spread of standardised writing systems or languages) or technology.²⁴ How about the present case? The problem becomes clearer when the

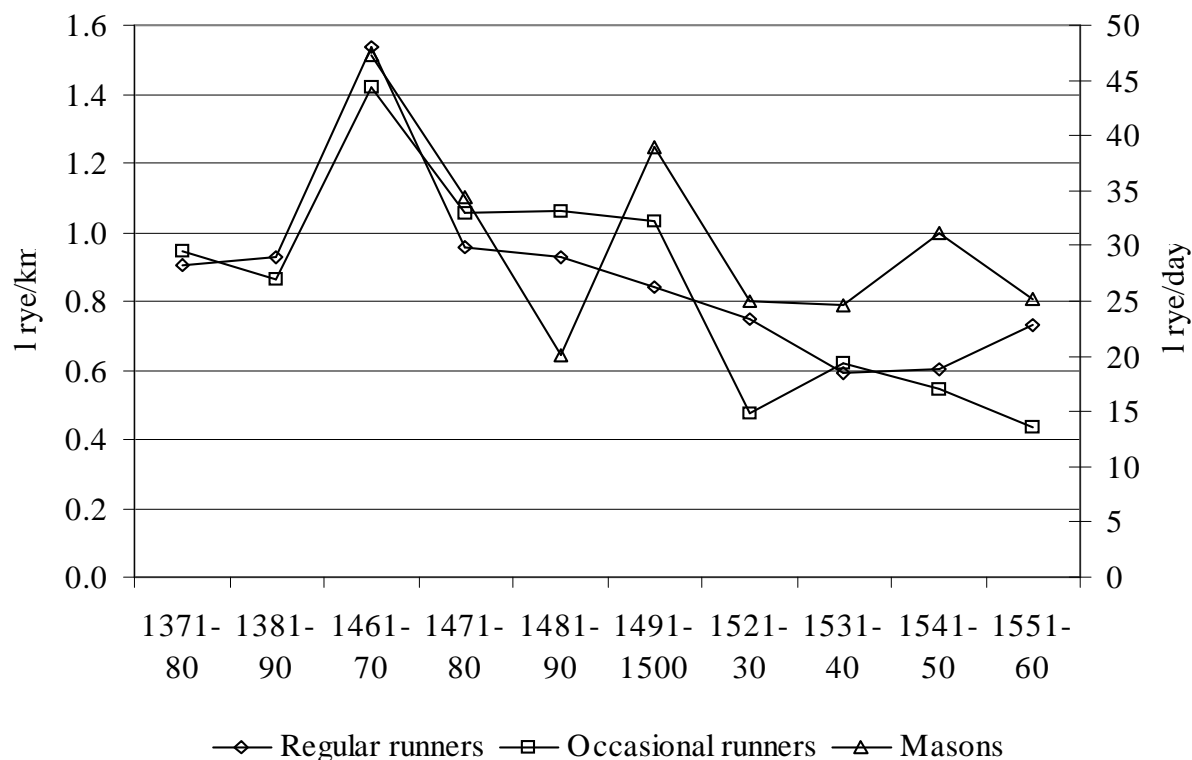
²⁴ North: Institutions, Transaction Costs and Economic Growth, in: *Economic Inquiry* 25 (1987), pp. 419-428; Blum and Dudley: Standardised Latin and Medieval Economic Growth, in: *European Review of Economic History* 7 (2003), pp. 213-238; Dudley: Communications and Economic Growth, in: *European Economic Review* 43 (1999), pp. 595-619; cf. Eggertsson: *Economic Behavior and Institutions*, Cambridge 1990, p. 16.

wages that messengers received are contrasted with those of other professions. Unfortunately, other wage series from Hamburg are not preserved, so that interregional comparisons are necessary, for example with Antwerp where the wages of craftsmen are well recorded.²⁵ As long as we do not have sufficient data to put together plausible commodity baskets, such comparisons are best based on the grain equivalents of the sums paid as wages. This can here be done because in the account books of the treasury of Hamburg prices of rye are mentioned relatively often; there are some gaps, but most of these can be filled with data from the account books of the treasury of nearby Lüneburg.²⁶ Still, as for most years there are not more than one or two observations, and as grain prices were subject to violent seasonal fluctuations, low-frequency data such as those used here can not convey more than a vague impression of the general trend. To increase clarity we will therefore use decennial means, concentrating on the wages of professional messengers, that is, of Hamburg's two regular runners and of the occasional runners which the council employed, and compare those to the wages of masons from Antwerp.

Fig. 3: Wages of messengers in Hamburg (in litre rye per kilometre) and of masons in Antwerp (in litre rye per day), decennial means 1371-1560

²⁵ At least from c. 1430, cf. van der Wee: *The Growth of the Antwerp Market and the European Economy (fourteenth-sixteenth centuries)*, vol. 1: Statistics, The Hague 1963, pp. 457-62.

²⁶ StA Lüneburg, AB 56,1.2. Supplementing data from Hamburg with those from Lüneburg is possible because the distance between the cities is barely 44 kilometres. Moreover, Hamburg and Lüneburg were linked by a much-frequented waterway (via the rivers Elbe and Ilmenau) and had, at the time discussed here, the same currency. They are therefore assumed to have been a fairly well-integrated grain market. For the price of rye in Antwerp see *Ibid.*, pp. 174-8.



Despite the considerable differences that can be observed in some decades, the overall development of messenger wages in Hamburg and masons' wages in Antwerp was remarkably similar: Comparatively high real wages in the late fourteenth and fifteenth centuries were followed by much lower wages in the sixteenth century.²⁷ The data suggest that the factor which had the strongest influence on wages was the supply of labour which shrank due to the Black Death and to recurring waves of the plague in the second half of the fourteenth and the early fifteenth centuries, began to grow again in the second half of the fifteenth century, and outran the supply of grain in the sixteenth century. The fall of real wages after c. 1460 was, in fact, a common development which has been observed all over Europe.²⁸ By contrast, institutional change is unlikely to have had a strong effect on both the wages of messengers in Hamburg and of masons in Antwerp, as it would have had to occur in both cities at the same time. As for technical change, it is hard to imagine innovations that affected messengers and masons alike. In sum: the development of transmission costs seems to have been primarily driven by the labour supply – a conclusion which is all the more plausible as, like all services before industrialisation, transmitting information was extremely labour intensive (and very little capital intensive) in the late Middle Ages and the early modern period.

²⁷ The coefficient for the correlation of the wages of regular runners and masons is 0.49, and for the wages of occasional runners and masons 0.44.

²⁸ Braudel and Spooner: Prices in Europe from 1450 to 1750, in: Rich and Wilson, eds.: The Cambridge Economic History of Europe, vol. 4: The Economy of Expanding Europe in the Sixteenth and Seventeenth Centuries. Cambridge, London, New York, Melbourne 1967, pp. 374-486, p. 428.

2.2. *Exchange rates and monetary standards*

As explained above, it is plausible to expect that transmission costs influenced market integration, and that this influence should be most obvious where a commodity with a low weight-value ratio such as money was concerned. Up to now, there has not been a lot of research on the question of how well integrated pre-modern financial markets were. The approach used in nineteenth- or twentieth-century studies is based on the examination of interest rates demanded by various banks; if rates between several localities were similar – if, in other words, the Law of One Price held –, this is interpreted as indicating a well-integrated market. Given the lack of data, this method cannot be used for the period analysed here. Alternatively, Larry Neal examined prices paid at English and Dutch stock markets.²⁹ In this way, he was able to push the analysis back to the early eighteenth century. Eric S. Schubert, who used exchange rates and fees paid for bills of exchange, managed to extend it into the late seventeenth century.³⁰ Up to now, nobody has gone further back.

However, there is a simple approach to this issue which suggests itself under a commodity money system such as that which existed in fourteenth- to sixteenth-century Northern Europe. This approach is based on the fact that at this time, merchants tended to treat money just as any other commodity. Thus, in Hanseatic sources the terms used to describe exchange transactions were “buying” and “selling” coins, and the use of bills of exchange was called “*overkof*”, which can be translated as “sale at a distance”.³¹ Moreover, in commercial correspondence the partners frequently informed each other about the development of exchange rates abroad.³² In view of these facts, it would be more than surprising if they had shunned opportunities to profit from arbitrage in money.

During the time examined here, c. 20 different types of gold coins and about 6 major silver currencies were in use between the eastern Baltic and the Netherlands; additionally, there were a number of currencies of local importance. Under conditions

²⁹ Neal: *Integration of International Capital Markets: Quantitative Evidence from the Eighteenth to the Twentieth Centuries*, in: *Journal of Economic History* 45 (1985), pp. 219-226; Neal: *The Integration and Efficiency of the London and Amsterdam Stock Markets in the Eighteenth Century*, in: *Journal of Economic History* 47 (1987), pp. 97-115.

³⁰ Schubert: *Innovations, Debts, and Bubbles: International Integration of Financial Markets in Western Europe, 1688-1720*, in: *Journal of Economic History* 48 (1988), pp. 299-306.

³¹ E.g. Mollwo, ed.: *Das Handlungsbuch von Hermann und Johann Wittenborg*, Leipzig 1901, pp. 30, 33; Lesnikov, ed.: *Die Handelsbücher des hansischen Kaufmanns Veckinghusen*, Berlin 1973, p. 39.

like these, how can we use exchange rates in order to analyse the integration of financial markets? We need to relate the weight and fineness of gold coins to their exchange rates in silver currencies, and in order to become internationally comparable, we need to reduce these exchange rates to their content of fine silver. Put briefly, exchange rates of gold coins must be used to determine the gold-silver ratios in Hamburg and in several places with which the city traded. When these ratios are interpreted as prices paid on local financial markets, the approach based on the Law of One Price can be used: Gold-silver ratios that were similar between several localities indicate well-integrated financial markets, whereas differences between local ratios show that opportunities for arbitrage existed – opportunities that were not used due to high transport- and, presumably, prohibitive information costs.

Despite its overall simplicity, the approach sketched above is beset with a number of difficulties. To be sure, there is a relative abundance of data.³³ As accounts were kept in units based on silver coins (such as the mark or the pound), merchants and others who handled sums in gold were used to calculating the exchange rates, and it is from their account books that most of our information about these rates stems. In most cases, the person who kept the account simply translated a sum in gold into another sum in a silver currency. The same applies to many exchange rates found in commercial letters and similar papers. However, how did the authors of such documents arrive at the exchange rates? There were, in fact, several ways:³⁴ The most elementary one was based on manual exchange, that is, on the simultaneous and on the spot exchange of coins of one currency for that of another. A more sophisticated kind of exchange made use of bills, which developed during the high Middle Ages. Sometimes, rates based on them are recorded in account books, too. Finally, there were official rates that were determined or imposed by political authorities not only for domestic, but occasionally even for foreign gold. A broad literature exists where such rates, particularly those based on the nominal values of domestic gold coins, are used as a basis for calculating gold-silver ratios.³⁵ Harry Miskimin forcefully argued against this approach, claiming that Renaissance princes were seldom able to enforce the circulation of their gold at its nominal par

³² E.g. Stieda, ed.: Hildebrand Veckinghusen: Briefwechsel eines deutschen Kaufmanns im 15. Jahrhundert, Leipzig 1921, pp. 83, 94-97.

³³ The data are accessible at http://www.wiwi.hu-berlin.de/wg/volckart/hist_data.html.

³⁴ Cf. Spufford: Handbook of Medieval Exchange, London 1986, pp. 1 f.

value.³⁶ Hence, in the present study politically imposed exchange rates are excluded from the start; here, the focus is on market rates only.

As for the two other ways exchange rates could develop – i.e. manual exchange and bills –, it is under dispute which was more important at the time considered here. The traditional assumption is that Hanseatic merchants made little use of bills of exchange has been challenged by Jenks,³⁷ and the sources show, in fact, that by the early fifteenth century bills were employed quite frequently in monetary transfers at least between Bruges and Lübeck.³⁸ In this context, two points should be noted. On the one hand, exchange rates found in bills may contain a hidden interest rate; hence, there may be a systematic difference between them and the rates paid in manual exchange.³⁹ On the other hand, if bills had constituted an important part of the money supply,⁴⁰ their bare existence would have influenced rates of exchange. Still, as long as they were not freely negotiable, they were no fully-fledged substitutes for hard money – and this does not seem to have been the case before the seventeenth century.⁴¹ Even in Flanders, credit instruments made a negligible contribution to monetary circulation.⁴² Most exchange rates found in the sources, even those mentioned in account books and commercial letters, therefore ultimately reflect rates that developed in manual exchange. As for bills, too few are preserved to make it possible to make out a systematic difference between

³⁵ E.g. Watson: Back to Gold - and Silver, in: *Economic History Review* 20 (1967), pp. 1-34; Lane and Mueller: *Money and Banking in Medieval and Renaissance Venice*, vol. 1: *Coins and Moneys of Account*, Baltimore, London 1985, pp. 324 f.

³⁶ Miskimin: The Enforcement of Gresham's Law, in: Miskimin, ed.: *Cash, Credit and Crisis in Europe, 1300-1600*. London 1985/89, pp. IX, 147-161, pp. 148-51; cf. Luschin von Ebengreuth: *Das Werthverhältnis der Edelmetalle in Deutschland während des Mittelalters*, Bruxelles 1892, pp. 7 f.

³⁷ Dollinger: La Hanse (XII^e-XVII^e siècles), Paris 1964/88, pp. 252 ff.; Jenks: War die Hanse kreditfeindlich? in: *Vierteljahrschrift für Sozial- und Wirtschaftsgeschichte* 69 (1982), pp. 305-338.

³⁸ Stieda: Ein Geldgeschäft Kaiser Sigismunds mit hansischen Kaufleuten, in: *Hansische Geschichtsblätter* 6 (1887), pp. 61-82; Stieda: *Hansisch-venetianische Handelsbeziehungen im 15. Jahrhundert: Festschrift der Landes-Universität Rostock*, Rostock 1894; Stieda, ed.: *Hildebrand Veckinghusen: Briefwechsel eines deutschen Kaufmanns im 15. Jahrhundert*, Leipzig 1921; Lesnikov, ed.: *Die Handelsbücher des hansischen Kaufmanns Veckinghusen*, Berlin 1973.

³⁹ Cf. de Roover: *The Bruges Money Market Around 1400*, Brussel 1968, pp. 32 ff.

⁴⁰ As claimed by Henning: *Zahlungsusancen und Nichtmetallgeld im ausgehenden Mittelalter: Ein Beitrag zur Entwicklung von Buch- und Papiergeld*, in: Kellenbenz, ed.: *Weltwirtschaftliche und währungspolitische Probleme seit dem Ausgang des Mittelalters: Bericht über die 7. Arbeitstagung der Gesellschaft für Sozial- und Wirtschaftsgeschichte*. Stuttgart, New York 1981, pp. 39-60.

⁴¹ Munro: *Die Anfänge der Übertragbarkeit: Einige Kreditinnovationen im englisch-flämischen Handel des Spätmittelalters (1360-1540)*, in: North, ed.: *Kredit im spätmittelalterlichen und frühneuzeitlichen Europa*. Köln, Wien 1991, pp. 39-69.

⁴² Blockmans: *Handelstechniken in Flandern und Brabant im Vergleich mit denjenigen der Hanse, 14. - 15. Jahrhundert*, in: Friedland, ed.: *Brügge-Kolloquium des Hansischen Geschichtsvereins 26.-29. Mai 1988: Referate und Diskussionen*. Köln, Wien 1990, pp. 25-32, p. 26.

the rates mentioned in them and those based on manual exchange. Hence, it seems acceptable to use all quotations indiscriminately.

A more serious problem is posed by the ambiguity and lack of clarity of the sources. Often enough, the merchant or official or whoever authored the document where the quotation is found did not bother clearly to define which kind of gold coin the exchange rate actually applied to. In some of these cases, it is possible to make a plausible guess, but others cannot be decided and must be left out of account. A related problem is posed by changes of the standard of the gold or silver coinage. If an exchange took place shortly after such a change, it is often impossible to make sure whether the coins that changed hands were newly minted or had already circulated for some time. Here, the same assumptions were made as in Nikolaus Wolf's and the author's recent paper about silver exchange rates.⁴³ Debased coins dominated circulation more quickly than re-enforced ones, and older coins continued to circulate abroad for a longer time than at home, where they had been minted.

Even if it is known which types of coins were exchanged, the problem remains of determining their content of specie. The principal class of sources that contain the relevant information are mint ordinances and contracts concluded between the authority who issued the coins and the mint master. Usually, such documents define the fineness of the alloy from which the coins were to be made, and the number of coins to be drawn from a specified quantity of that alloy. They could be straightforwardly interpreted if it were not for several obstacles. For one thing, in some cases there is no clarity about the exact metric equivalents of the units of weight used between the fourteenth and sixteenth centuries. For another, the ability of medieval and early modern mint technicians to make chemically pure gold and silver has been questioned.⁴⁴ Lest the reader think these matters unduly arcane, the example of the Flemish écu of 1349 will suffice to show that they could become quite important. According to the ordinance, 54 écus were to be drawn from a Marc de Troyes of gold of a fineness of 23¼ carats.⁴⁵ Suppose that the metric equivalent of the Marc de Troyes, as used in the Netherlands,

⁴³ Volckart and Wolf: Estimating Financial Integration in the Middle Ages: What can we learn from a TAR-model? in: *Journal of Economic History* (forthcoming) (2006).

⁴⁴ Miskimin: *Money, Prices, and Foreign Exchange in Fourteenth-Century France*, New Haven, London 1963, p. 31; Jesse: *Der Wendische Münzverein*, Lübeck 1928, p. 160.

⁴⁵ Blockmans and Blockmans: Devaluation, Coinage and Seignorage under Louis de Nevers and Louis de Male, Counts of Flanders, 1330-84, in: Mayhew, ed.: *Coinage in the Low Countries (880-1500): The Third Oxford Symposium on Coinage and Monetary History*. Oxford 1979, pp. 69-94, p. 86.

was 298.587 grams,⁴⁶ and that 23¼ carats defined the fineness of the finished coin. Its content of fine gold would then have been 5.357 grams. Suppose, on the other hand, that the Marc de Troyes had only 244.753 grams (as at the time of conversion to the metric system) and that the stipulation of 23¼ carats meant that the mint official had to add 0.75 units of base metal to 23.25 units of the best fine gold he could make, i.e. gold of a purity of say 980/1000. In this case, the finished écu would have contained only 4.303 grams of fine gold, that is, almost 20% less than if the first assumptions apply.

In the present analysis, the weight of the Marc de Troyes as established by Munro is used.⁴⁷ For the Mark of Cologne, we follow Witthöft's arguments and assume that in the period of time considered here, it was slightly heavier than in the early nineteenth century.⁴⁸ Other units used in Central and Eastern Europe were, according to Witthöft, linked to this Mark of Cologne by simple relations based on whole numbers.⁴⁹ Finally, for Italy, i.e. Florence and Venice, we use the metric equivalents of the local marks and pounds given in the recent relevant literature.⁵⁰ As for the purity of fine gold and silver, the assumption made here is that the ordinances and contracts determined the fineness of the finished coins. This approach is acceptable because no mint master of the fourteenth to sixteenth centuries could rely on being able to manufacture coins exactly to the prescribed standard anyway. The pieces were struck "al marco", that is, mint officials checked that the prescribed number of them held a prescribed weight, regardless of variations among the individual coins. This alone makes it impossible to exclude a margin of error when the bullion content of late medieval and early modern coins is determined.

A final problem is posed by the fact that once in circulation money became worn down and defaced. For silver, losses due to wear and tear have variously been estimated at

⁴⁶ Miskimin, quoted by Munro: *The Maze of Medieval Mint Metrology in Flanders, France and England: Determining the Weight of the Marc de Troyes and the Tower Pound from the Economics of Counterfeiting, 1388-1469*, Department of Economics and Institute for Policy Analysis, University of Toronto, Working Paper No. UT-ECIPA-MUNRO5-98-01, 1998, p. 8.

⁴⁷ Ibid..

⁴⁸ Witthöft: *Die Markgewichte von Köln und Troyes im Spiegel der Regional- und Reichsgeschichte vom 11. bis ins 19. Jahrhundert*, in: *Historische Zeitschrift* 253 (1991), pp. 51-100.

⁴⁹ Witthöft: *Mark I.*, in: North, ed.: *Von Aktie bis Zoll: Ein historisches Lexikon des Geldes*. München 1995, pp. 234-235, p. 234.

⁵⁰ Bernocchi: *Le monete della Repubblica Fiorentina*, vol. 3: *Documentazione*, Firenze 1976; Lane and Mueller: *Money and Banking in Medieval and Renaissance Venice*, vol. 1: *Coins and Moneys of Account*, Baltimore, London 1985.

between 2 and 2.75% per decade and between 0.25 and 0.87% per year.⁵¹ Still, losses and wear and tear influenced the amount of specie in circulation, and therefore probably affected the level of prices, but as far as exchange rates are concerned, their effects were less important. Presumably, coins made of both metals suffered alike from defacement, so that its effects on gold and silver cancelled each other out.⁵² Still, for this reason, too, a margin of error is unavoidable.

Fortunately, there is a group of sources that helps us to reduce such errors to an acceptable minimum. Many late medieval and early modern authorities had foreign money assayed more or less regularly.⁵³ The interpretation of contemporary assays is, of course, problematic due to our imperfect knowledge of the metric equivalents of ancient units of weight, but if these sources are checked against the results of modern chemical tests,⁵⁴ it is possible to derive a clear enough picture of how much gold and silver really changed hands when money was exchanged.

When all problems involved in determining the specie content of the coins in circulation have been solved, it is necessary once again to turn to the way the prices of gold and silver coins developed. These pieces of precious metal were not valued against some benchmark price that had been independently determined, but were solely subject to local supply and demand. Some of them were more popular than others, so that buyers were prepared to pay a premium. Thus, for a large part of the fourteenth century the florin of Florence was the most popular and widely used gold coin of Western Europe. In the fifteenth century, the Hungarian florin played a similar role further east, in Poland and Prussia. What follows from this is that gold-silver ratios that are determined for one place, but on the basis of different types of coins are not necessarily alike. For example, in 1378 the treasury of Hamburg reckoned 132 ducats at £84.13s.4d. and 48 francs at

⁵¹ Mayhew: Numismatic Evidence and Falling Prices in the Fourteenth Century, in: *Economic History Review* 27 (1974), pp. 1-15, p. 3; North: Geldumlauf und Wirtschaftskonjunktur im südlichen Ostseeraum an der Wende zur Neuzeit (1440-1570): Untersuchungen zur Wirtschaftsgeschichte am Beispiel des Großen Lübecker Münzschatzes, der norddeutschen Münzfunde und der schriftlichen Überlieferung, Sigmaringen 1990, p. 108.

⁵² Gold may have suffered less from wear and tear than silver. The hardness of both metals is about the same (2.5-3), but as the purchasing power of gold was higher, gold coins circulated slower. On the other hand, silver was more often alloyed to a higher degree with base metals, a practice which increased the hardness of silver money.

⁵³ Cf. Ropp, ed.: *Hanserecesse von 1431-1476*, vol. 2 (2. Abt.), Leipzig 1878, pp. 223 f.; Cahn: *Münz- und Geldgeschichte der Stadt Strassburg im Mittelalter*, Strassburg 1895, pp. 169 ff.; Munro: *Wool, Cloth, and Gold: The Struggle for Bullion in Anglo-Burgundian Trade, 1340-1478*, Brussels, Toronto 1972, p. 212 ff.

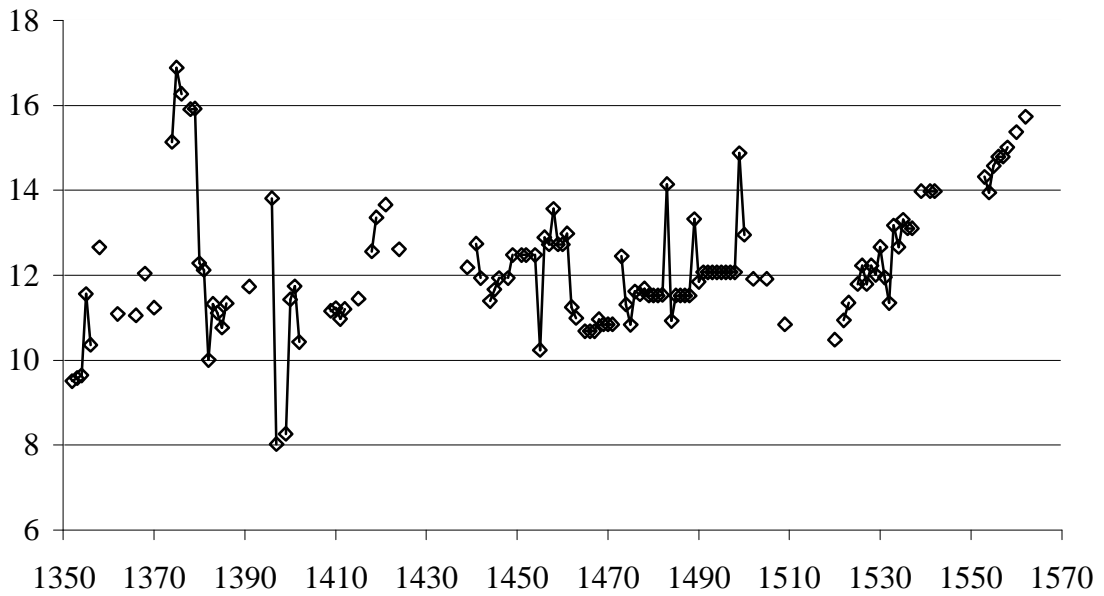
£28.16s.⁵⁵ The first exchange rate gives a gold-silver ratio of 1:17.01, the second of 1:14.81. There are two ways out of this problem: Either, and this applies to the fourteenth century, the mean value of all ratios that can be found is established. Alternatively, when circulation was dominated by a single type of gold coin, as in Hamburg since the middle of the fifteenth century when the Rheingulden was the most popular type of gold, the ratios based on this are used and all others are ignored.

Using this approach, and aggregating the gold-silver ratios that correspond to individual exchange rate quotations on a yearly level, it is possible to construct an almost unbroken time series that represents the development of the ratio in Hamburg. The following graph shows this.

Fig. 4: The gold-silver ratio in Hamburg, 1350-1562

⁵⁴ Cf. Grierson: The Weight of the Gold Florin in the Fifteenth Century, in: Quaderni Ticinesi: Numismatica e Antichità Classiche 10 (1981), pp. 421-431; Kubiak: Monety i stosunki monetarne w Prusach Królewskich w 2 połowie XV wieku, Wrocław, Warszawa, Kraków, Gdansk, Łódź 1986.

⁵⁵ Koppmann, ed.: Kämmererechnungen der Stadt Hamburg: 1350-1400, Hamburg 1869.



These data are contrasted with gold silver ratios from nineteen other places that had commercial links with Hamburg.⁵⁶ The data for most of these are more scattered, the only comparable time series being from Cologne where the relevant material has been prepared by Rainer Metz.⁵⁷ However, the following section shows that this does not impede the analysis.

3. Analysing the data

It is now time to analyse both sets of data introduced above – transmission costs as well as gold-silver ratios – in context. In order to do so, it is useful briefly to consider the approach used here from a more formal point of view. Thus, the exchange rate of some type of gold coin sold in Hamburg for domestic silver money can be defined as

$$E_H = \frac{kC_H}{C_G}, \text{ where } k \text{ represents the sum in Hamburg's currency } (C_H) \text{ which equalled}$$

one gold coin (C_G). The par ratio between these currencies is given by $R_H = \frac{kC_H S}{C_G G}$.

Here, S is the silver equivalent of the unit of account used in Hamburg, that is, of the Mark of Lübeck, and G is the fine gold content of the gold coin. Hamburg's gold-silver ratio is the average of the par ratios found per year (i.e. R_H'), subject to the restrictions

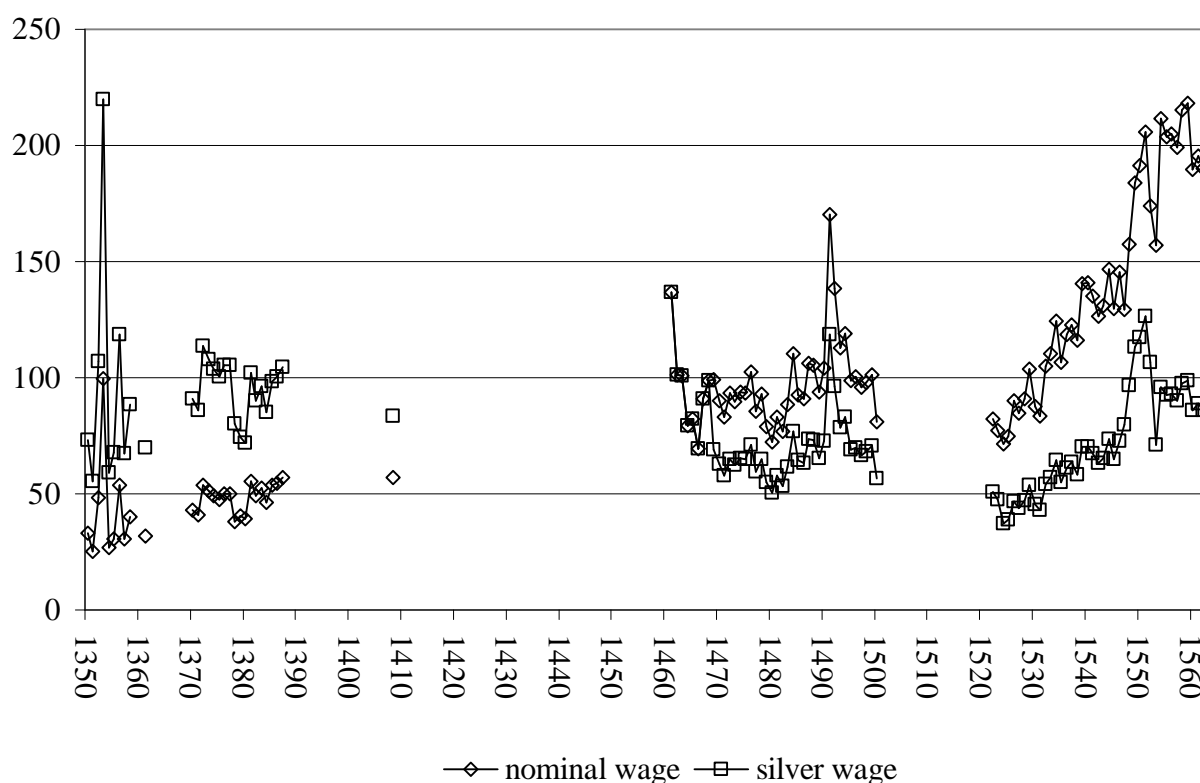
⁵⁶ Amsterdam, Antwerp, Bruges, Cologne, Danzig, Deventer, Dordrecht, Elbing, Gnesen, Königsberg, London, Lübeck, Lüneburg, Lund, Marienburg, Middelburg, Posen, Stuhm and Thorn.

described in the previous section. Ratios valid at the other places here considered (R_L) are defined analogously and are, like those from Hamburg, aggregated on a yearly level. Deviations between both aggregates are therefore given by $\Delta = |R_H - R_L|$.

These deviations are treated as the dependent variable that is to be explained by a number of independent ones, among whom information costs – that is, messenger wages per kilometre – are most important. To give an impression of how these wages developed between 1350 and 1562, figure 5 charts their yearly average values. Because the dependent variable refers to gold-silver ratios, and because a common standard of measurement is needed, silver instead of nominal wages are used in the analysis. Silver wages have the additional advantage of eliminating inflationary or deflationary effects due to changes in the standard of the coinage. Moreover, in contrast to nominal wages that rose practically over the whole period, they do not show any clear trend: In the middle of the sixteenth century, they were not higher than 200 years before. Detrending the data is therefore unnecessary.

⁵⁷ Metz: Geld, Währung und Preisentwicklung: Der Niederrheinraum im europäischen Vergleich 1350-1800, Frankfurt 1990, pp. 366 ff.

Fig. 5: Messenger wages per kilometre, 1350-1562 (Index, 1461-65 = 100)



While the basic assumption of this study – i.e. that information costs impeded market integration – is plausible enough, it is obvious that the level of these costs was not the only relevant influence. Hence, it is necessary to control for a number of other variables. Integration studies usually stress the importance of transport costs, and though coins may have been inexpensive to ship, costs were certainly positive. Transport cost data do not exist, but given the lack of much progress in transport technology,⁵⁸ the distance between Hamburg and the place where a gold-silver ratio was observed seems to be a good proxy: it should be positively correlated with differences between the ratios. However, transport costs have a wage component, and given the similarity of the development of the wages of messengers in Hamburg and masons in Antwerp, this component may have behaved in a comparable way. Testing for multicollinearity is therefore necessary.

Further, what about the influence of infrastructure? Important differences in the quality of the roads linking Hamburg and her several trading partners probably did not exist,

⁵⁸ Menard: Transport Costs and Long-Range Trade, 1300-1800: Was there a European 'Transport Revolution' in the Early Modern Era? in: Tracy, ed.: The Political Economy of Merchant Empires: State Power and World Trade, 1350-1750. Cambridge, New York 1991, pp. .

but it is well known that using roads was usually more expensive than sea transport. However, just making a distinction between places that could be reached by sea and those that were landlocked is still unsatisfactory. Hamburg had much better communications with the west, i.e. the Netherlands or England, than with the east, that is, Prussia or Poland. Eastern European ports could be reached only by first travelling overland to a place like Lübeck or Wismar and then continuing by sea, or by rounding the northern tip of Denmark and entering the Baltic via the Oeresund. Hence, it is possible to define three dummies in order to capture the infrastructure effect: one for Hamburg's trading partners in the west, i.e. for those which could be reached via the North Sea, another for the cities on the coast of the Baltic, and a third one for inland places which were linked to Hamburg by road. Price differences between Hamburg and the western cities should be smaller than those between Hamburg and her Baltic partners, which in turn should be smaller than differences between Hamburg and cities which were landlocked. The coefficients for the dummies should show this.

Another factor is the currency union formed by Hamburg and Lübeck in 1255, and extended to Lüneburg and Wismar in 1379.⁵⁹ Such a union can be expected to have reduced transaction costs, thereby favouring market integration, so that prices should differ less among member cities than between Hamburg and places that had a different currency. Here, this effect is captured by a dummy that takes the value 1 if a city where a gold-silver ratio was observed was a member of this currency union in the given year, and 0 if this was not the case. To link the dependent variable Δ to these independent variables, a simple OLS regression model is used:

$$\log(\Delta) = \alpha \log(wage) + \beta \log(distance) + \gamma(west) + \varepsilon(inland) + \zeta(union) + c,$$

⁵⁹ Stefke: Der "Wendische Münzverein" als spätmittelalterliche Währungsunion und andere norddeutsche Münzkonventionen des 13./14.-16. Jahrhunderts, in: Cunz, ed.: Währungsunionen: Beiträge zur Geschichte überregionaler Münz- und Geldpolitik. Hamburg 2002, pp. 145-195.

The result is given in the following table:

Dependent variable = $\log(\Delta)$	
$\log(wage)$	0.646
	(5.02)**
$\log(dist)$	0.067
	(0.49)
west	-0.335
	(2.15)*
inland	0.041
	(0.28)
union	-1.008
	(3.68)**
Constant	1.015
	(1.15)

Observations 500 Absolute value of t statistics in parentheses
R-sq 0.13 * significant at 5%; ** significant at 1%

The result does look quite promising: As expected, the influence of the costs of transmitting information (the *wage*-variable) comes out strongly and is highly significant. The weaker and in fact insignificant influence of transport costs is no surprise either. This result supports a central hypothesis of the present study: Information costs were relevant for the integration of financial markets, and given the favourable weight-value ratio which coins had, they were much more relevant than transport costs. Higher information costs significantly impeded the integration of financial markets, while lower costs obviously favoured exchange rate convergence. Another important insight is that even where a high-value and lightweight good like money was concerned, being landlocked was a drawback for economic integration. Markets with access to the sea integrated more easily, even if the sea-lanes were indirect or rather long, like those linking Hamburg and the Baltic. Also in line with what was expected, the influence of Hamburg's currency union with Lübeck, Lüneburg and Wismar comes out clearly and highly significantly. For the integration of financial markets, having the same currency was the single most important factor. And finally, the F-test shows that jointly, the independent variables do explain the dependent one. However, two problems remain: The R-sq is rather unsatisfactory, and there is still the possibility of multicollinearity between the variables.

As for the second problem, we can solve it by attempting to explain the messenger wages (as the dependent variable), using the others as independent variables. If there is indeed a strong relationship between the wages and the distance (as a proxy for

transport costs), this should show up in the data. In fact, however, the regression yields a coefficient for $\log(dist)$ of barely 0.045 which is not even significant at 10%, and an R-sq of just 0.06. This is so small that the possibility of a strong linear relationship between the variables can be excluded; hence, the distance-variable can be safely retained.

What then can be done to improve the quality of the regression? The integration of financial markets was, of course, influenced by more factors than those included above. Thus, in the period discussed here, wars and urban unrest were frequent occurrences that disrupted trade and influenced exchange rates. Accordingly, it is possible to define several more dummies: on the one hand one for Hamburg itself, which indicates whether the city was affected by wars or internal unrest, and on the other hand similar dummies for all other cities analysed here.⁶⁰ These dummies take the value of 1 if there were local disturbances in the years for which we have observations about gold-silver ratio differences; otherwise they have the value of 0. Two remarks about them are in order. First, because the dummies apply to years from which we have observations about ratio differences, they designate not individual cities but city pairs. Hence, they overlap with the union and infrastructure dummies used above, and cannot be employed in the same regression. Second, it is important to point out that while unrest and war certainly affected financial markets, the direction of this influence is not evident without further information. In other words, we do not *prima facie* know whether such disturbances caused a local rise in the price of gold or in that of silver, thereby increasing or reducing the difference to the ratio valid in Hamburg. Despite the plausibility of the assumption that wars and unrest affected integration, we therefore cannot tell whether the coefficients will be positive or negative.

Apart from introducing disturbance-dummies, it is possible to improve the regression by using panel data. After all, we have wage-data for four types of messengers (mounted

⁶⁰ The relevant information is taken from Blockmans and Prevenier: *The Promised Lands: The Low Countries under Burgundian Rule, 1369-1530*, Philadelphia 1999, Boockmann: *Ostpreußen und Westpreußen*, Berlin 1992, Dollinger: *La Hanse (XII^e-XVII^e siècles)*, Paris 1964/88, Ennen: *Geschichte der Stadt Köln*, vol. 3, Köln, Neuß 1865; Ennen: *Geschichte der Stadt Köln*, vol. 4, Köln, Neuß 1875, Gabrielsson: *Die Zeit der Hanse*, in: Loose, ed.: *Hamburg: Geschichte der Stadt und ihrer Bewohner*, vol. 1: *Von den Anfängen bis zur Reichsgründung*, Hamburg 1982, pp. 101-190; Hoffmann, ed.: *Lübeck im Hoch- und Spätmittelalter: Die große Zeit Lübecks*, Lübeck 1988, Nicholas: *Medieval Flanders*, London, New York 1992, Postel: *Reformation und Gegenreformation 1517-1618*, in: Loose, ed.: *Hamburg: Geschichte der Stadt und ihrer Bewohner*, vol. 1: *Von den Anfängen bis zur Reichsgründung*, Hamburg 1982, pp. 191-258 and Reinecke: *Geschichte der Stadt Lüneburg*, vol. 1, Lüneburg 1933.

messengers, regular runners, other familiars and occasional runners) from the years between 1350 and 1562. A hausman-test having indicated that a random-effects regression is appropriate, we use the following equation:

$$\log(\Delta) = \alpha \log(wage) + \beta \log(dist) + \gamma \dots k(disturbance_citypair) + c$$

The result is given in this table:

Dependent variable = $\log(\Delta)$			
$\log(wage)$	0.618	koenigsberg	0.122
	(4.88)**		(0.16)
$\log(dist)$	0.200	london	0.104
	(2.40)*		(0.50)
hamburg	0.164	luebeck	-3.776
	(0.85)		(5.55)**
amsterdam	-0.685	lueneburg	0.000
	(1.49)		(.)
antwerp	0.000	lund	0.000
	(.)		(.)
bruges	0.750	marienburg	0.198
	(2.53)*		(0.31)
cologne	-0.818	middelburg	0.000
	(4.55)**		(.)
danzig	0.000	posen	0.000
	(.)		(.)
deventer	0.000	stuhm	0.000
	(.)		(.)
dordrecht	-2.133	thorn	-0.149
	(3.89)**		(0.19)
elbing	0.000	Constant	0.052
	(.)		(0.09)
gnesen	0.000		
	(.)		

Observations 500

Number of groups 4

Absolute value of z statistics in parentheses

* significant at 5%; ** significant at 1%

Interestingly, the relevant variables, that is, those in which we are principally interested, have not changed very much. The influence of information costs still comes out strongly and highly significantly, while that of transport costs is much weaker and less significant. The most important difference between this regression and the simpler variant shown above is the higher R-sq: In this case, it is 0.21.

Still, almost 80% of the differences between the exchange rates at Hamburg and at the other places here considered remain unaccounted for. This is probably due to the low quality and number of data and variables. Defining dummies for war and urban unrest

can never give more than a vague impression of conditions during the time analysed here. In particular during the fourteenth and fifteenth century, being at peace or war was not really a question of either – or, but rather one of more or less. Some major wars can, of course, be identified, for example the one which devastated Prussia between 1454 and 1466, or that waged by Charles the Bold in the vicinity of Cologne in 1473-74. However, on the whole it is difficult to make a clear-cut distinction between all-out wars and everyday low-level violence of the type of feuds. Particularly in Germany feuding was going on practically continuously.⁶¹ Any war-dummy defined for specific places and years has therefore a strong element of arbitrariness. This probably accounts for much of the low R-sq in the regression shown above.

With regard to the quality of the data, it should be remembered that transmitting information involved economies of scale, so that messenger wages can never be more than a rough indicator for transmission costs. Moreover, it has been shown above that while there was quite a strong correlation between the distances messengers covered and the sums they received, it was far from unambiguous. This may have been caused by a large number of influences that are impossible to analyse, such as the age and experience of the messenger, his speed, the type of document he carried etc. Finally, it should be kept in mind that in determining fourteenth- to sixteenth-century gold-silver ratios a margin of error cannot be avoided. As a rule, not too much should be read into or expected from the few surviving data from the late Middle Ages and the early modern period. However, all this does not detract from the main result of the above analysis: The wages of messengers are a useful proxy for the costs of transmitting information, and had a strong and highly significant influence on the integration of the gold market.

4. Conclusion

This article is motivated by the desire to give more substance to the concept of transaction costs that is frequently invoked by economic historians inspired by New Institutional Economics. The approach is to isolate information costs as a component of transaction costs which has central importance, then to split information costs into their constitutive components, and finally to measure one of these, namely transmission costs, i.e. the costs of transmitting information between different localities.

⁶¹ Cf. Volckart: The Economics of Feuding in Late Medieval Germany, in: *Explorations in Economic History* 41 (2004), pp. 282-299.

Additionally, the effects these costs had on the integration of financial markets in fourteenth- to sixteenth-century Northern Europe are explored. The underlying assumption is that arbitrage on the money market was relatively little impeded by transport costs, whereas transmission costs had a comparatively strong influence. Briefly, the paper aims at testing the hypothesis that the integration financial markets depended on the level of the costs which were involved in transmitting information, high costs being correlated with weakly integrated markets, while low costs favoured convergence.

In order to measure transmission costs, the article draws on the account books of the treasury of Hamburg. There, the sums paid to messengers whom the council of the city sent are recorded in a way that makes it possible to calculate how much they received per kilometre. A comparison of the sums paid to regular and occasional messengers shows that the payments did not have the character of expense allowances, as has sometimes been claimed in the literature, but were indeed wages that were probably individually negotiated between the messengers and the financial administration of Hamburg. At the same time, the comparison suggests that the sums recorded in the accounts are representative of messenger wages in general, i.e. of those wages which messengers sent by merchants were paid, too. Hence, it is possible to treat the per-kilometre wages as general indicators of how the costs of transmitting information developed.

The integration of financial markets is examined on the basis of exchange rates of gold coins for silver, and of the specie content of the coins which changed hands. These data are used to construct local gold-silver ratio series which can then be compared; differences between them are treated as indicators of opportunities for arbitrage which were forgone. While the exchange rate quotations found in the sources are relatively unambiguous (leaving aside the problem of rates based on bills of exchange, which cannot be decided on the basis of the surviving material), it is more difficult to determine the fineness of gold and silver coins. For one thing, a number of exchange rate quotations are so vague that the types of the coins involved cannot be established, and for another, it is sometimes difficult to reach a definite conclusion with regard to their fineness. Even if the information gleaned from the sources is checked against the results of modern chemical tests, a margin of error remains. In the present study, the ratio valid in Hamburg is contrasted with that of nineteen other places. Differences

between both ratios are related to the yearly averages of the wages of several groups of messengers.

The analysis yields three major results: First, in contrast to hypotheses hitherto advanced with regard to transaction costs in general and information costs in particular, it has become evident that neither institutional nor technical change had a strong influence on the development of transmission costs. This does not mean that such influences did not exist; it just means that the relevance of such factors cannot be estimated and anyway pales in comparison to the one dominant influence: the supply of labour. Under pre-industrial conditions, transmitting information was extremely labour intensive; in fact, most of Hamburg's messengers went on foot, so that not even the prices of horses and oats or similar factors played a role. Transmission costs were essentially labour costs, and hence dependent on the labour supply. The recurring waves of the plague in the late fourteenth and fifteenth century reduced the supply of labour; therefore, the real wages of messengers in Hamburg peaked in about 1460-70. From then on, population began to recover; the supply of labour grew, and wages fell. In real terms, the per-kilometre costs of transmitting information in the mid-sixteenth century were less than half of what they had been about 100 years before. Despite being reached on the basis of sources from just one city, this result probably applies to all Western and Northern Europe. After all, a comparison with wages paid in other professions and at other places shows a roughly parallel development. Consequently, there is no reason to suppose that messenger wages – and therefore the costs of transmitting information – in for example Antwerp or Paris behaved any different than in Hamburg. The important point is that in the late Middle Ages and at the beginning of the early modern period, this component of information- and transaction costs can be closely identified with the costs of labour.

The second important result of the analysis presented above is that transmission costs had a clear and positive influence on the integration of financial markets. In other words, the hypothesis which this study set out to test – i.e. that the integration of these markets was inversely correlated with the development of the costs of transmitting information – has been fully confirmed: When messenger wages – expressed in grams of silver – were high, differences between local exchange rates of gold for silver – likewise expressed in grams of silver – were large. The regressions presented above show that this correlation was strong and highly significant. They also show that the

influence of information costs was much stronger and more significant than that of transport costs. This is as it should be, given the favourable weight value ratio of commodity money: Transport was cheap, and profiting from arbitrage on financial markets required paying for information about exchange rate differences.

Is it possible to draw any conclusions with regard to the integration of other markets? While the importance of transport costs obviously depended on the weight-value ratio of the good, this was not true for information costs. Information costs had a similar influence on the integration of all markets. In order to profit from an opportunity for arbitrage, a merchant had first to acquire the necessary information, regardless of whether he planned to sell grain or money. Before he had found out or had at least developed rational expectations about potential buyers and about the relevant prices, transport was not even an issue. Hence, when markets became better integrated in the course of the late fifteenth and sixteenth centuries, this was not due to technical advances in transport – which were anyway negligible – but to the reduction in information costs due to the fall of messenger wages.

The third result is of a more general nature. The present paper aims at contributing to an estimation of how transaction costs developed in the pre-statistical age. Hitherto, attempts to capture these costs and their effects either aimed at determining the size of the transaction sector or the costs involved in concluding specific types of transactions. By contrast, the approach used here is based on splitting transaction costs into their components and measuring one of these. This method has been shown to be viable: it is not only possible to measure how this cost-component developed, but also how it influenced market performance. Altogether, this suggests that with the help of further studies that focus on those components of transaction costs not analysed here it should be possible to derive a relatively comprehensive picture of the development of transaction costs and of their importance over time.

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