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The Utility of a Common Coinage: Currency Unions and the Integration of Money Markets in Late Medieval Central Europe

Lars Boerner
&
Oliver Volckart

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Department of Economic History
London School of Economics
Houghton Street
London, WC2A 2AE

Tel: +44 (0) 20 7955 7860
Fax: +44 (0) 20 7955 7730

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Abstract
This paper employs a new method and dataset to estimate the effect of currency unions on the integration of financial markets in late medieval Central Europe. The analysis reveals that membership in a union was significantly correlated with well-integrated markets. We also examine whether currency unions were endogenous. Our results indicate that where unions were established, markets had been significantly better integrated already in the preceding period. In addition, we show that currency unions created by autonomous merchant towns were better integrated than unions implemented by territorial rulers. The overall implication is that monetary diversity was a corollary of weakly integrated markets in late medieval Central Europe.

1. Introduction

In the eighteenth century, the law lecturer and enlightened publicist Johann Stephan Pütter (1788: 451) claimed that Germany alone had more currencies than all the rest of Europe together. If this was true in the early modern period, it was all the more true in the late Middle Ages. In the fifteenth-century Holy Roman Empire, around 500 mints were in operation (Sprenger, 2002, p. 81); the number of currencies was smaller but still large. How large it was is something that we cannot determine with any degree of precision, in particular as over time some currencies fell out of use while others emerged. However, an attempt to provide a rough estimate would produce, at least, approx. 70 different currencies, many of which were used only in a few cities and their environs, while some had at least regional importance.[1]

In this paper, we consider how currency unions that were formed in Central Europe between the middle of the fourteenth and the middle of the sixteenth centuries affected the integration of money markets. Specifically, we ask if markets were better-integrated where consumers used the same silver currency, or if well-integrated markets were a precondition of the harmonisation of currencies supplied by several political authorities.

There are several reasons why these issues are important and interesting. For one thing, given the generally low level of investment and the slow pace of technological progress before industrialisation, we can expect most growth that there was to have been Smithian growth (cf. Epstein, 2000, pp. 38 ff.; 2001, p. 34). This is why the economy of pre-modern Europe is increasingly being studied in the context of a 'commercialist' framework (e.g. Unger, 1983; Aloisio, 2007; Unger, 2007; Hatcher and Bailey, 2001, pp. 121 ff.; Persson, 1999). Many scholars working in this field focus on grain markets for the simple reason that

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[1] There is as yet no comprehensive list that shows which currency was used where and at what time. However, within the fourteenth- and fifteenth-century Holy Roman Empire (excluding Italy), at least the following were used: the Marks of Aachen and of Bremen, the Mark Finkenaugen, the Marks of Holstein, Hildesheim, Cologne, Lübeck, Lingen, Lüneburg, Osnabrück, Münster, Mecklenburg, the Mark Sundisch, Mark Wendisch and the Mark of Tyrol, the Pounds of Austria, Altshausen, Arnheim, Augsburg, Brabant, Brandenburg, Basel, Bern, Bamberg, Brunswick, Bavaria, Constance, Deventer, Franconia, Freiburg im Breisgau, Guelders, the Pound grote, the Pounds of Goslar, Göttingen, Groningen, Hanover, Hall i.S., Hildesheim, Holland, Isny, Lucerne, Maastricht, Metz, Mainz, Nuremberg (old and new), the Oberland Pound, the Pounds of Passau, the Palatinate, Peine, the Pound Rappenmünze, the Pounds of Ravensburg, Regensburg, Schaffhausen, Strassburg, St. Gallen, Trier, Utrecht, Vienna, Würzburg, Württemberg, Worms and Zürich. Moreover, Bohemia and Meissen had currencies based on their respective Schocks of Groschen, and in parts of West-Germany the French gros tournois and the English penny (Sterling) were used. If the area outside the Empire but influenced by the Hanseatic League is also considered, the the Marks of Denmark, Gotland, Prussia, Poland, Norway, Riga, Skåne and Sweden can be included.

grain prices are relatively well documented. However, there are drawbacks to this approach. Grain prices were subject to violent seasonal fluctuations, and where at best a few price-observations per year exist – as is the case for most places before the sixteenth century – their informational content is limited. Also, as grain was a good with a high weight-value ratio, grain market integration was strongly affected by transport costs. To be sure, under a commodity money system transport costs of money were positive, too, but the weight-value ratio of money was still more favourable than that of almost any other good. Consequently, money markets integrated more easily than other markets; they show the optimum that could be reached in the field of market integration at any given place and period of time.

The question of how Central Europe's monetary fragmentation and efforts to overcome it by forming currency unions affected trade and market integration has hitherto not been discussed in detail. Most economic historians – even those who examine integration issues (e.g. Persson, 1999; Bateman, 2007; Unger, 2007) – ignore the issue, being understandably reluctant to venture into the jungle of pre-modern and in particular late medieval German monetary affairs. Some scholars do argue that monetary diversity impeded trade (Šimek, 1971, p. 235; Walter, 1992, p. 30 f.; Sprenger, 2002, p. 61). Epstein (2000, p. 58; 2001, p. 38) even went so far to suggest that it was the reduction of monetary diversity due to the creation of currency unions which favoured market integration and growth in the late Middle Ages. This proposition is in line with the findings of economists such as Rose (2000; 2001), who claim that trade within unified currency areas is considerably – by about a factor of 3 – larger than what gravity models predict under monetary diversity. However, neither Epstein nor any of the other economic historians mentioned above provides any quantitative evidence for the alleged correlation between monetary diversity and weak integration, or conversely between monetary unification and increasing integration.

What is more, there are two arguments which suggest that the multiplicity of late medieval currencies may have had few adverse effects. First, while the gold and silver on which monetary systems were based could be exchanged for each other, they were only imperfectly substitutable. The two precious metals fulfilled different economic functions, with silver dominating local trade and small-scale transactions and gold long distance commerce (Spufford, 1991, pp. 321 ff.). Thus, while in principle any type of money was, due to its material value, acceptable everywhere, in practice this applied mainly to gold coins. Some types of these were particularly popular. For example, in the late fourteenth and early fifteenth century, the English Noble penetrated the Baltic, while the Florin of Florence and its numerous imitations was the favourite gold coin of Italian, French and Western German merchants. In the fifteenth century, much of Germany was dominated by the Rhinegulden that was issued by the Archbishops of Cologne, Trier and Mainz and the Count-Palatine on the Rhine, while further east the Hungarian gulden or Ducat played a similar role (Berghaus, 1965; Giard, 1967; Huszár, 1970-72; Klüßendorf, 2002). What this implies is that long distance trade used a limited number of de facto international gold currencies, whose near-universal acceptance, while not being sufficiently documented to be used in quantitative analyses, in itself indicates a certain degree of integration. Hence, monetary diversity at the lower level – the localised use of a large number of silver currencies – should not have been a serious obstacle to integration.

There is a second argument, which suggests that monetary fragmentation may have been of little importance for late medieval market integration. This is inspired by the modern literature on optimal currency areas.[2] In contrast to authors such as Rose, who stress the positive effects of monetary harmonisation on integration, this literature argues that trade integration may give rise to monetary integration, in other words that currencies are unified only once markets have integrated. Eichengreen and Irwin (1995; cf. Ritschl and Wolf, 2003) found evidence of such an effect in the twentieth-century inter-war period, when commercial and financial policies followed the lead taken by trade in the period before the formal constitution of trade blocs in the 1930s. With regard to the pre-modern period, no-one has ever discussed the issue of the endogeneity of currency areas. However, it seems all the more relevant as under a commodity money system, monetary authorities wanting to form a union needed to agree on a common standard, and if local bullion prices diverged, as they were bound to do between weakly integrated markets, this was difficult. The members of the planned currency union would have to buy the raw material for their coinage at different prices, in which case arguments about rates of seignorage and mint charges would likely derail attempts at unification (see e.g. Volckart, 1996, pp. 256 ff.). Thus, monetary diversity could be overcome by constituting a currency union only once markets had reached a minimal degree of integration. This argument, too, implies therefore that at least initially, integration advanced regardless of monetary fragmentation.

The analysis presented here is based on a new approach to estimating the integration of money markets, and on a new dataset compiled in order to make it possible to apply this method. Both method and data are described more fully later in the paper. Here, it is sufficient to indicate that under the conditions of a commodity money system such as that existing in fourteenth to sixteenth century Europe, combining data

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[2] This literature originated with studies by Mundell (1961) and McKinnon (1963). More recent contributions have been made by scholars such as Frankel and Rose (1998), Dixit (2000) and Alesina and Barro (2002).

on exchange rates between currencies based on gold and silver with data on the bullion content of the coinage allows us to calculate local gold-silver ratios. Interpreting such ratios as prices paid on money markets, we can use the approach most common in integration studies: that based on the Law of One Price (Kindleberger, 1989, pp. 67 ff.). The basic idea is that in a world with perfect monetary integration, prices, i.e. gold-silver ratios, between localities converge to identity. Spreads between prices may therefore indicate weaknesses in integration. The main advantage of this method is that it allows us to take the quantitative analysis of the integration of money markets back from the modern age (cf. e.g. Canjels et al., 2004) to the fifteenth and even the fourteenth centuries.

The rest of the paper proceeds as follows. In section 2, the monetary history of the region under investigation is surveyed, with special attention being paid to the formation of the several currency unions that we analyse. Section 3 describes our method, briefly sketched above, in more detail. Both the problems the approach involves and their solutions are discussed. Section 4 contains the analysis of the data and presents the results. Section 5 concludes by summarising the main findings of the paper.

2. Money and Money Markets in Late Medieval Germany

In the main, German monetary fragmentation was the outcome of the inability or unwillingness of the emperors of the Holy Roman Empire to prevent an increasing number of secular and ecclesiastical rulers from exercising their own rights of coinage.[3] From the tenth century onward, the interest in increasing revenues from seigneurage, and probably locally

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[3] This, in turn, seems to have been the consequence of costs of control and information that in Germany were higher than in e.g. France or England (Volckart, 2006).

diverging prices of silver, too, quickly gave rise to the development of a large number of monetary standards (Sprenger, 2002, p. 60). The later thirteenth and fourteenth centuries were characterised by two developments. On the one hand, a growing number of towns began to acquire their own rights of coinage (Volckart, 2009). This increased the number of currencies used in the Holy Roman Empire and the neighbouring regions still further. On the other hand, larger denominations in both silver and gold supplemented the simple monetary system of the high Middle Ages, where the penny had been the only coin in circulation: by the second half of the fourteenth century, a bewildering array of small and large coins in gold and silver that belonged to different currencies were brought into circulation. This is the monetary background of the formation of currency unions within the Empire.

Several of these unions are included in the analysis presented below, but we should stress from the outset that there were many more, some of which were very short-lived. Also, before discussing the unions to be considered in more detail, it is necessary to point out three peculiarities. First, while studies of modern monetary unions use the nation state as the unit of analysis (cf. Ritschl and Wolf, 2003), the present article focuses on cities. This is necessary because in the late medieval Holy Roman Empire, territorial states were only beginning to emerge toward the end of the period covered here. Many cities still had their own currencies, which they sometimes issued in competition with the coinage produced by their feudal overlords. Territories with clearly defined borders that were identical with currency areas did not yet exist.

Second, for the purpose of analysis, the term monetary union is here loosely defined. It does not only cover unions between political organisations or actors who were autonomous as far as their supply of money was concerned, and who decided to harmonise their currencies. We also apply the term union to cities whose common currency was supplied by their feudal overlord. For example, we treat Bruges and Ghent as forming a currency union, regardless of the fact that neither city had the authority to pursue its own monetary policies, their coinage being supplied by their common lord, the count of Flanders.

Finally, it is important to note that in the late Middle Ages, there were not only formal currency unions in the sense of the word used above, but that foreign monetary units could be used informally and integrated into the domestic currency. For example, until the 1430s the county of Holland did have a currency of its own. However, already by the late fourteenth century the scribes of the count’s treasury in The Hague used the Flemish Pound Groote for accounting purposes (cf. de Boer et al., 1997). In parts of fifteenth-century South Germany Bohemian groats circulated as legal tender with a fixed face value, supplementing the domestic array of denominations (cf. Binder and Ebner, 1910-15, p. 35). In many such cases, it is impossible to decide whether an informal or de facto currency union existed. This implies that we can not expect the data to deliver perfectly clear-cut and unambiguous results – a certain fuzziness needs to be accepted.

As for the unions in the strict sense of the word, that is those which were formed by actors able to pursue their own monetary policies, two were exceptionally stable: the Wendish Monetary Union and the Rappenmünz-Union. As less stable organisations were structured in a similar way, introducing these two unions is sufficient to give an idea of what kind of policies late medieval currency unions pursued. The Wendish Union had its roots in an agreement concerning a common standard of the coinage reached between Hamburg and Lübeck in the thirteenth century (the units of account continued to differ, with Hamburg using the pound of 240 and Lübeck the mark of 192 pennies). In 1379, the cities of Lüneburg and Wismar joined, and these four cities continued to cooperate until the middle of the sixteenth century (Stefke, 2002). The union regulated the weight and fineness of the common coinage. Importantly, the members also agreed on regular tests of samples of their coins to prevent individual cities from reducing the standard of the coinage, thereby making an extra profit from seignorage and from the effects of Gresham’s law. One issue that the treaties did not include was the minting of gold. Lübeck struck gold coins from the 1340s, and Hamburg and Lüneburg followed suit in the 1430s, but the definition of the standard of the coins was left to the councils of the individual cities. The Rappenmünz-Union was some decades younger than the Wendish Union (Cahn, 1901). It had some antecedents in the late fourteenth century, but was definitely agreed on only in 1403. The partners were the duke of Austria, who held some scattered territories in South-West Germany, and the cities of Basle, Breisach, Colmar and Freiburg in Breisgau. Like the Wendish Union, the Rappenmünz-Union – it took its name from the head of a raven (rappen) shown on the principal denomination of its first years – regulated the weight and the fineness of its coins, which like in its North German counterpart were silver only. The Rappenmünz-Union dominated Northern Switzerland, Alsace and parts of South-West Germany until the second half of the sixteenth century.

Its formation was neither the first nor the only attempt to reduce the multiplicity of currencies used in the Holy Roman Empire. Already in 1344, one of its later members, the city of Basle, had concluded a treaty with Zürich and the Duke of Austria (Altherr, 1910, p. 25). In the fifteenth century, however, the monetary policy of Zürich was oriented rather toward the north-east, with St. Gallen, Constance and Schaffhausen being the city’s partners in a union that was established in 1418 and fell apart five years later (Wielandt, 1969, p. 24). From then on, Zürich cooperated with Lucerne, while Constance and Schaffhausen formed a more stable union with a number of cities in the area of Württemberg (Cahn, 1911, p. 246). There were many smaller and less important unions, for example one that linked the cities on the North-German coast of the Baltic. Finally, as mentioned above, there were cities that did not form currency unions based on treaties among the members, but whose common currency was supplied by their feudal overlord. The present study covers cities in Flanders, Holland, Prussia, Bohemia and Austria, where this was the case.

The late fifteenth and sixteenth centuries saw a remarkable increase in the organizational efficiency of the Holy Roman Empire that, though far from developing into anything remotely resembling a modern state, implemented a number of constitutional reforms. Since the 1520s, unifying the currencies issued by the various political authorities within the Empire's borders was on the agenda (Blaich, 1970; Christmann, 2002). In the long run, some progress in this direction was made, in particular as far as the higher denominations were concerned: From 1551, the taler was minted with some regularity by almost all major estates of the Empire. Smaller denominations, however, continued to be issued in the traditional way, the only change being the fact that state-building territorial princes were increasingly successful in eliminating urban rights of coinage.

In the period considered here, many consumers were well aware of the fact that the multiplicity of currencies offered opportunities to profit from arbitrage – opportunities, though, that required familiarity with local exchange rates and with the fine gold and fine silver content of the many coins circulating at the time (cf. Klüßendorf, 1976, pp. 432 f.). Transactions based on this kind of information are at the core of the money market that we analyse here. A telling description of this market is given in a treatise written by the late fifteenth-century annalist Hermen Bote from Brunswick. According to Bote (1880, p. 416 f.), in about the middle of the fifteenth century the exchange rate of the Rhinegulden stood at 21 shillings in Brunswick and Hildesheim,

> ‘and in the cities by the sea [i.e. in Hamburg, Lübeck and Wismar] the gulden was to be had for 24 shillings. Now here was a bargain that allowed people to look to their advantage and self-interest, because with every gulden 3 shillings could be won, so that in these cities all shillings were bought up and brought here to Brunswick and Hildesheim. And many people got rich through this trade…’.

Commercial correspondence shows how this worked at the micro-level. Thus, in December 1487 William Cely, an apprentice merchant at the staple in Calais, wrote to his superior in London, advising that

> ‘if the new groats of Malines will go into England, me thinks it were best to purvey them to you, for I think I shall get them at under 32 shillings per pound. If they will go into England, sir, send me word and I shall get as many for your mastership as I can’ (Hanham, 1975, p. 240).

The question of how this kind of arbitrage affected the integration of Central European money markets in the late Middle Ages has recently been examined in detail by Chilosi and Volckart (2009). The authors used largely the same data as those utilised in the present study, focusing on the period between c. 1400 and 1520 and on the coefficient of variation – i.e. the standard deviation divided by the mean – that is the most useful measure of integration when a region as a whole rather than a pair of markets is studied. Chilosi and Volckart find that overall the fifteenth and early sixteenth centuries were a period of monetary integration, with expected spreads in 1400-1410 being about 70 percent larger than in 1510-1520. As for regional developments, the authors found the strongest evidence of between initially weakly integrated places in the Rhineland. Integration also advanced more strongly across than within the states forming in the Holy Roman Empire; a development that they trace to the increasing effectiveness of the Empire and particularly the Imperial diet, which in the late fifteenth century became a forum where territorial policies were coordinated. Thus, developments that we discuss in the subsequent sections of this paper took place before the background of an increasing integration of local and regional money markets. However, before we can turn to the analysis of which role currency unions played in this context, we need to present the data that we used.

3. Exchange Rates, Monetary Standards and Gold-Silver Ratios

The introduction gave a brief sketch of our approach to estimating late medieval and early modern money markets, indicating that we use exchange rate notations and information on the bullion content of the coinage in order to compute local gold-silver ratios. Interpreting such ratios as prices paid on the money market allows us making use of the Law of One Price, that is, to treat spreads between them as indicators weak market integration. To do that, we need to relate the weight and fineness of the gold coins to their exchange rates in silver currencies, and in order to make them comparable internationally, we must reduce these rates to their content of fine silver.

Let us demonstrate this with the help of an example. In 1456, the treasury of the city of Hamburg exchanged 20 Venetian Ducats for the sum of £32.12s.0d. (Koppmann, 1873, p. 94). A Ducat contained 3.5596 grams of fine gold (Lane and Mueller, 1985, p. 175), while the Pound used in Hamburg was the sum of 20 shillings, each of which had a fine silver content of 1.507 grams (Ropp, 1881, p. 515). The 71.2 grams of gold contained in the 20 Ducats were therefore exchanged for 982.6 grams of silver, which gives us a gold-silver ratio of 1:13.8. In the same year, the treasury of Basel exchanged 5 Rhineguldens for £5.16s.8d. (Harms, 1910, p. 284). Considering the fine gold content of the Rhinegulden (2.723 grams, Weisenstein, 2002, pp. 106, 138), the silver equivalent of the Rappenmünz-Pound used in Basel (27.896 grams, Cahn, 1901, p. 78) and this exchange rate, we arrive at a gold-silver ratio of 1:11.9. This gives us a spread between Hamburg and Basel of 1.9. In principle we calculated all local ratios and the spreads between them in this way, using, however, yearly local averages instead of individual observations.

Table 1: Observations by Source Type and Type of Exchange Rate

Source type Exchange rate type	Merchant account book	Commercial correspondence	Non-merchant account book	Non-commercial correspondence	Notarial register	Historian
Bill of exchange	12	26	4	0	7	106
Loan	2	1	99	1	47	0
Manual exchange	17	0	8	0	0	1
Unknown	692	53	7236	79	33	850
Total	723	80	7347	80	87	957

The example given above already indicates where we found the majority of the data: Almost 79% are from urban, princely and ecclesiastic account books that are comparatively well preserved. Exchange rate notations appear almost on every single page of these sources. Merchant account books would probably be equally fertile sources, if more of them were preserved. As it is, only about 8% of the exchange rates used here are from commercial accounts. Commercial and non-commercial correspondence each yielded another c. 2% of the data, and c. 1% was found in notarial registers and similar sources. We also use rates mentioned by historians. Including material from Spufford's (1986) 'Handbook of Medieval Exchange', which provides only sketchy coverage of Central Europe but contains a wealth of information on places in Western European such as London, Bruges and Antwerp, they amount to c. 9% of the total dataset (see the appendix for a comprehensive list of our sources). Exchange rate notations are also found in political ordinances and official valuations. There is a broad literature that uses such rates as a basis for calculating gold-silver ratios (e.g. Watson, 1967; Lane and Mueller, 1985, pp. 324 f.). However, Miskimin (1985/89, pp. 148-51) argued that late medieval rulers were rarely able to enforce the circulation of their gold at its nominal par value, and this argument is in fact borne out by sources from our area and period.[4] Hence, we exclude politically imposed exchange rates from our analysis, whose focus is on market rates only. This, admittedly, takes care only of the most obvious form of intervention into the money market. The bare existence of political rates, as well as restrictions on the export of bullion or on the number of money changers, must have influenced rates paid on the open market. We are aware of the problem and must, at present, accept that it constitutes a source of imprecision for which we can not yet control. However, it is offset by an important advantage that our focus on market rates offers: Official rates mirrored differential local seigniorage charges and refining costs (cf. Gould, 1970: pp. 7 ff.), thereby influencing the position of the bullion points and opportunities for arbitrage between currencies. Where market rates are concerned, we can disregard seigniorage rates and costs borne by the local mint (if a mint existed at the location where the exchange took place).

Fig. 1 shows the geographical distribution of our exchange rate observations. The sample clearly is uneven, with some areas being much better represented than others. The map shows that a majority of our observations are from places situated in what today is Switzerland, West-

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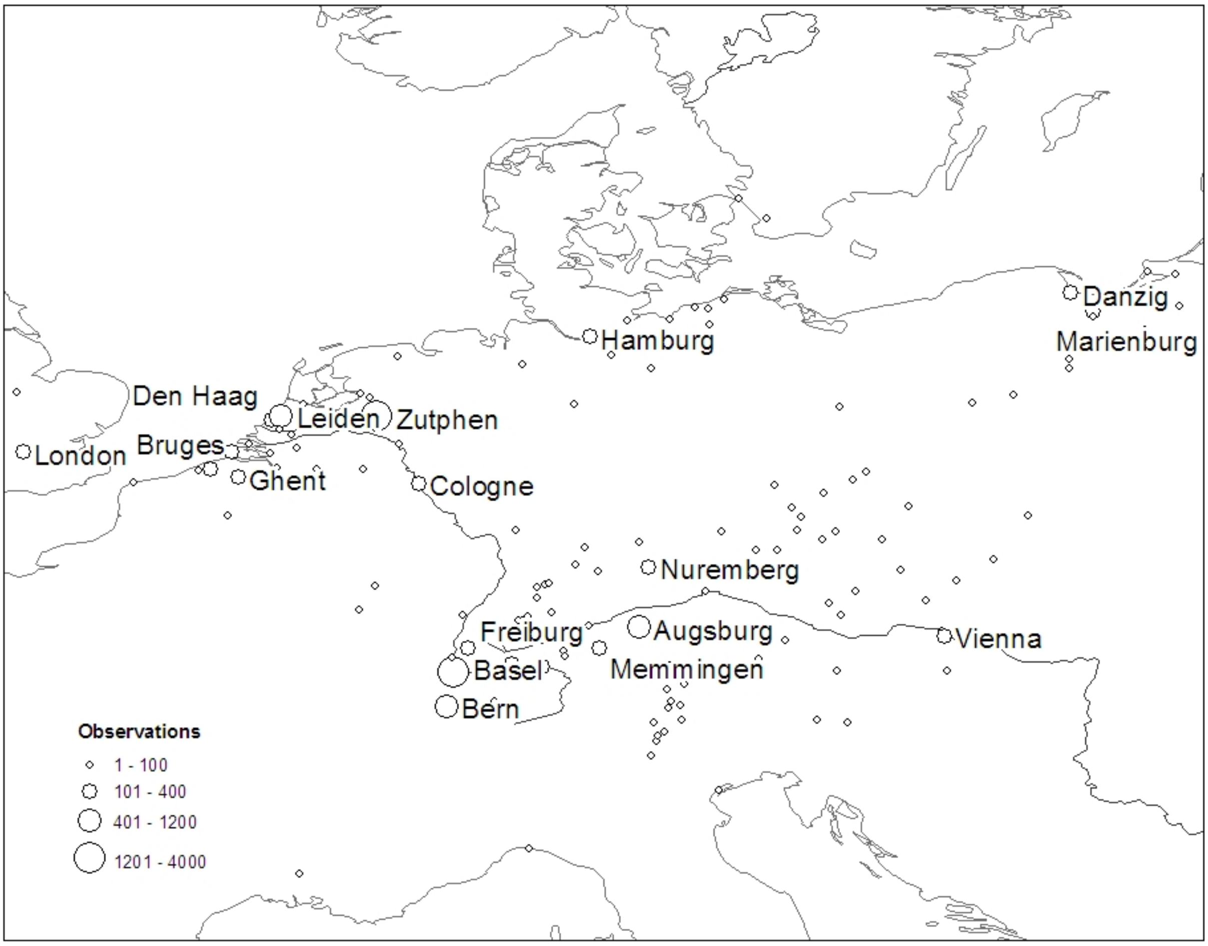
[4] Thus, in 1490 the official exchange rate of the Rhinegulden was 22 shillings. In the same year, the revenue office of the city of Hamburg used a rate of 24 shillings (Bollandt, 1960, p. 197; Koppmann, 1880, p. 209). In Nijmegen in 1545, the Couronne de soleil was officially reckoned at 36 stuivers while in non-official sources, a rate of 38 stuivers is recorded (van der Chijs, 1852: p. 327). Altogether, our dataset yields c. 1200 observations of yearly means of local gold-silver ratios. 58 of these can be directly compared to ratios from the same locality, which are based on official exchange rates. The absolute value of the difference is 0 in 2 cases, and smaller than 1 in 26 cases. The mean difference is 1.63. The conclusion that official rates were ineffectively enforced is therefore warranted.

Germany and the Netherlands – in other words, from cities that lay on or near the large late medieval transcontinental trade route that linked Northern Italy and South-East England. The assumption that most of the places we are considering were actually trading with each other is therefore not too far-fetched. The following up question to be answered then is if we have a selection bias in our sample. The composition of the sample reflects the survival and accessibility of the sources; thus it is a pure random sample. The variety of characteristics in the city-pairs with respect to distance, transport routes in form of waterways and other characteristics, which can be found in table 2 (appendix 1) support this argument. We discuss these and other descriptive statistics at the end of this section. There is a potential bias in not taking into account city-pairs where no spread has been found, and it could be beneficial to treat such city-pairs as an additional control group. However, the fragmented source material and related information preserved for the period of investigation, make the costs of creating such a control group, and using these data in an empirically meaningful, way prohibitive.

Figure 1: Exchange Rate Observations by Place[5]



Using these data in order to calculate gold-silver ratios involves a number of problems and assumptions that need to be briefly discussed (for an extensive discussion see Chilosi and Volckart, 2009; for another application of this approach, Rosen, 1981). Exchange rates were based on several types of transactions, three of which are relevant here (cf. Spufford, 1986, pp. I f.). First, there was the most elementary one called manual exchange, that is, the simultaneous and on the spot exchange of

[5] We also considered exchange rates from Livonia, i.e. Riga and Reval, but restricted the map to the core area under study in order to increase clarity.

coins of different currencies. Second, some exchange rate notations appear in loans where the creditor agreed to repay the sum he borrowed in a different currency. And finally, there was the most sophisticated kind of exchange, which made use of bills. In our dataset, only about 2% of the observations are based on rates found in bills of exchange. Loans account for another 2% and manual exchange transactions for less than 1%. In the rest of the cases, the sources just translate a sum of money in one currency into another without indicating the underlying kind of contract. This is unfortunate because rates mentioned in bills contained a hidden interest rate, at least if bills were primarily used as credit instruments and not as a means to transfer money between localities (de Roover, 1948, p. 62; Mueller, 1995; cf. Munro, 2003, pp. 543 ff.). Loans, at any rate, did certainly conceal such an interest rate. Accordingly, there must have been a systematic difference between them and the rates paid in manual exchange. In order to be able to assess how relevant this problem actually is, we need some idea of how many of the observations, where the source does not indicate the kind of transaction, were also based on loans or bills. As shown above, the most important type of source is account books. Like merchant accounts, those of urban, princely or ecclesiastic institutions occasionally refer to loans, but in contrast to merchant ledgers, they never mention bills of exchange. Bills were often employed in some Western European markets such as Bruges, but, though they were known in Central and Northern Europe, merchants rarely made use of them there (de Roover, 1948, pp. 55, 60; Spufford, 1991, pp. 254 ff.). Even in Flanders, bills made an overall negligible contribution to monetary circulation (Blockmans, 1990, p. 26; cf. Murray, 2005, p. 123). We can therefore assume that most exchange rates found in the sources ultimately reflect rates that developed in manual exchange. As for the interest rate that was a component of the exchange rates mentioned in bills, too few such documents are preserved to allow us to identify a systematic difference between these rates and those based on manual exchange. At present we are therefore forced to use all quotations indiscriminately.[6]

The ambiguity and lack of clarity of the sources pose problems that are more serious. Often the author of the document where we found the quotation did not clearly define the type of gold coin to which the exchange rate applied. Moreover, even if we know the type, determining its content of specie can be difficult. The principal class of sources that contain the relevant information are mint ordinances and contracts between the authority that issued the coins and mint masters. Usually, such documents defined 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. We could interpret them straightforwardly if it were not for several obstacles. For one thing, in some cases there is no clarity about the metric equivalents of the units of weight in use 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 (Miskimin, 1963, p. 31; Jesse, 1928, p. 160). This latter problem is important because in some cases it is not clear whether the fineness prescribed in an ordinance applied to the finished coin that was alloyed with some quantity of base metal, or to the specie which was to be used in manufacturing the coin before the base metal was added (van der Wee and Aerts, 1979, pp. 61 f.; 1980, pp. 234 ff.). The assumption made in this study is that the ordinances and contracts determined the fineness of the finished coins. This approach is

[6] The dataset contains c. 600 observations from merchant account books from areas outside England and Flanders. Only one of these observations refers to a bill of exchange (from Cologne to Bruges: Lesnikov, 1973, p. 13). Altogether, 15 of our c. 1200 yearly means of local gold silver ratios are based on rates found in bills and loans. In 7 out of the 10 cases where a direct comparison to ratios based on other transactions is possible, the difference is smaller than 0.5. Including exchange rates found in bills and loans therefore does not bias our analysis.

acceptable because no mint master of the fourteenth to sixteenth centuries could be sure of being able to manufacture coins that exactly met the prescribed standard. The pieces were struck ‘al marco’, that is, mint officials checked that a random sample held the prescribed total 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 related problem is posed by the fact that usually the bullion content of different denominations belonging to the same currency was not proportional: Small denominations contained proportionally less silver than larger ones (de Roover, 1948, p. 222). Here, we assume that most people did not pay for high-purchasing-power gold coins with small change, but used the largest silver denominations available. We also assume that after a change in the monetary standards, new coins would quickly replace the old ones in the place where they were being minted. Abroad, old coins would continue in circulation for a longer period (cf. Volckart and Wolf, 2006).

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 been variously estimated at between 2 and 2.75% per decade (Mayhew, 1974, p. 3) and between 0.25 and 0.87% per year (North, 1990, p. 108; cf. Patterson, 1972). Still, this factor influenced the amount of specie in circulation, and therefore probably the level of prices, but where exchange rates are concerned, it was less important. Presumably, coins made of both metals suffered alike from defacement,[7] so that its effects on gold and silver cancelled each other out.

[7] The higher purchasing power of gold suggests that its velocity of circulation was lower than that of silver, so that gold coins may have been exposed to less wear and tear. However, silver was more often alloyed to a higher degree with base metals; a process that increased its hardness.

Nevertheless, we must accept that these factors, too, create noise in the dataset. To reduce the noise, we rely on the results of chemical tests conducted on the coins either by late medieval political authorities, who had foreign money assayed, or by modern researchers (cf. e.g. Munro, 1972, pp. 212 ff.; Grierson, 1981; Kubiak, 1986). In this way, it is possible to derive a sufficiently clear picture of how much gold and silver changed hands when money was exchanged.

The data analysed in the next section are from altogether 69 cities, most of which were in the Holy Roman Empire. Some were in neighbouring countries, but were linked by strongly frequented trade routes or intensive exchange relations to cities within the empire. In modern terms, the geographic area covered by our study roughly corresponds to eastern France, south-eastern Great Britain, Belgium, the Netherlands, Germany, Switzerland, Austria, the Czech Republic and western and northern Poland (cf. figure 1). Theoretically, 69 cities form 2414 city-pairs in which we can measure spreads between gold-silver ratios. As the analysis covers 210 years, the earliest observation being from 1352 and the latest from 1562, there should be a total of 506,940 observations. However, there are only a few cities where the sources yield so many exchange rate notations that the time series are more or less unbroken: Cologne, Basle, Hamburg, and a few other places where the series extend at least over a couple of decades, such as Schaffhausen and Nuremberg. This reduces the number of city-pairs to 650 and the number of yearly observations of exchange rate spreads to 4156, c. 3800 of which can be used for the estimation (depending on the empirical technique used). Table 2 shows the descriptive statistics of the spreads for the different samples of the data set, which we will use as the dependent variables later in our estimation. In addition, the table depicts other characteristics of these city-pairs, which we use as explanatory and control variables. We elaborate causalities and expected potential effects of these variables in the next section.

The mean of the spreads is 2.27 with a minimum of 0 and a maximum of 16.9. For the subsamples of unions, the mean of the spreads is clearly lower, being 1.36. The minimum is again 0 and the maximum 13.31. Furthermore, the statistics of the spreads for the individual unions are reported. With the exception of the currency union of Holland (SPREAD_HOLL) – i.e. the group of Dutch cities that up to c. 1430 were supplied with a common currency by the count of Holland – all spreads are lower than the overall average spread. In another sub-sample, we investigate the spreads of city-pairs such as the Dutch ones just mentioned, i.e. city-pairs who belonged to a common territorial state (TERR_STATE). Here the mean is slightly above that of the union but clearly below the mean of the overall spread. In addition, we report the mean of the spreads for city-pairs, which did not belong to a currency union at the point of time when we observe the spread, but which joined the same union later on (LATER_UNION). Here, we find a mean slightly below the overall mean. Finally, we check the mean of city-pairs where both cities belonged to the Hansa (HANSA), or where at least one of the towns was a member of this league (HANSA_MIN). In case both towns belong to the Hansa we find a low spread with 0.86; otherwise the mean is slightly below the overall average (2.12). However, in the first case we only have two observations.

The average distance between cities that form a pair is 576 kilometres, with the minimum being 15 and the maximum 1734 kilometres. If we take the subsample of all city-pairs, which belong to a union, the number of observations falls to 218, which is about 5% of all observations. In this case the average distance is 74, the minimum 74 und the maximum 336 kilometres. About 29% of all city-pairs have a common waterway (WATERWAY), whereas only 36% of all cities are located on a river and 9% have a sea port. The share of city-pairs, where at least one city is involved in a war (WAR_MIN) is 8%. Finally, in about 39% of the city-pairs the same dialect is spoken (DIALECT).

4. Local ratios and market integration

In order to test the hypothesis that currency unions had a negative impact on the size of the spreads between the yearly means of local gold-silver ratios, we examine the dependent variable (LOG_SPREAD) and potential explanatory variables in various regressions.[8] Among these explanatory variables, a dummy that takes the value of 1 if a city-pair formed a currency union and that is 0 in all other cases has the first place (UNION). We use a similar dummy to represent city-pairs whose common currency was supplied by their common feudal overlord (TERR_STATE). In order to determine if city-pairs were already better integrated before they joined a union, we introduce the LATER_UNION dummy explained in the last section. This allows us to exploit information on the integration of the money markets of the city-pairs before they merged into a union, helping us to decide if they were already at that time better integrated than cities that never formed a union. This dummy is motivated by the work by Ritschl and Wolf (2003) who found that in the interwar period of the twentieth century, market integration preceded the formation of currency unions or blocks.

In addition to these variables, which refer directly to currency unions, we control for a number of other influences. Thus, we expect that spreads should be smaller between cities that intensively traded with each other. Lacking any data on interurban trade flows, we make two assumptions. First, we assume that the volume of trade was negatively correlated with the distance between cities that were neither seaports nor

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[8] We use the log to check for the sensitivity of small changes close to 0. We run the same regressions also for the normal spreads, but we do not receive a different result.

situated on the same navigable river (in the Middle Ages, distance was primarily relevant if no waterway was available). This fact is represented by a TRANSPORTATION interaction term. The term is constructed on the basis of the variable LOG_DISTANCE, which measures the distance between two cities, and of a WATERWAY dummy, which is 1 if both cities are connected by a waterway in the form of a river or sea (TRANSPORTATION = [(WATERWAY-1)*(-1)]*LOG_DISTANCE, where log_distance is the logarithm of the distance). Furthermore, we expect that the volume of trade was positively correlated with the size of the total populations of a city-pair; an effect which we capture by introducing a LOG_CITIES variable. Our assumptions here are in line with those made in gravity models used to predict trade between modern countries (cf. e.g. Eichengreen and Irwin, 1995; Ritschl and Wolf, 2003; Bussière and Schnatz, 2006, for the application of gravity models in integration studies). The difference is that given the lack of data on late medieval urban GDP, we use population sizes as a proxy.

We control for four further factors that may have influenced integration. The HANSA dummy mentioned above represents shared membership in the Hanseatic League. To determine this is not unproblematic as the League never compiled a comprehensive list of its members. In the present case, we regard cities that sent representatives to the Hanseatic assemblies as Hansa towns, taking into account cases when individual cities were temporarily excluded (Dollinger, 1981, pp. 155 ff., 570 f.).[9] A PERIOD-variable controls for time, allowing us to take into account a time-trend, while DIALECT represents the use of a common idiom, which may have encouraged integration. Here, we disregard most modern language borders, instead assuming e.g. that the Low German

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[9] We also checked for the case that only one of the cities was in the Hanseatic League. However, we could not find any significant results or influences of this variable.

dialect was closer to the language spoken in the Netherlands than to Upper German, from which modern German is derived. Finally, we control for war. This we do by creating the WAR_MIN dummy, which is 1 if at least one of the two cities was involved in a military conflict in the year when we observe the spread.

In our analysis, we first run an ordinary least square (OLS) regression that we can use as a benchmark, and then a two-stage least square (TSLS) variant (cf. Greene, 2007, ch. 16). We do this in order to capture the potential endogeneity between the dependent variable LOG_SPREAD and the independent variable UNION. On the grounds of an OLS-regression only, we would be unable to exclude the possibility that the estimators might be biased; after all, the assumption that currency unions promote market integration is not necessarily true. As shown in the introduction, the causality may also work the other way round, with currency unions coming into existence only where markets were already well integrated. Therefore, in the TSLS variant of our model, LOG_SPREAD and UNION are both endogenous variables and jointly and simultaneously determined. In a further step, we use a static panel data analysis (cf. Baltagi, 1995; Wooldridge, 2002). We pool the data over space and time and test for omitted cross-sectional effects, based on city-pairs. Again, we take into account a potential endogeneity between the spread and currency unions, running a two-stage least square panel data regression.

The OLS model takes the form

(1) $$y_{it} = x'_{it}ß + \varepsilon_{it}, \qquad \varepsilon_{it} \sim IID(0, \sigma^2_{\varepsilon})$$

where y_{it} stands for the dependent variable LOG_SPREAD, x_{it} for the exogenous variables UNION, TERR_STATE, HANSA, LATER_UNION, LOG_CITIES, DIALECT, PERIOD, WAR_MIN and TRANSPORTATION discussed above, *ß* for the coefficient and ε_{it} for the error term.

As explained above, in the TSLS model we assume that LOG_SPREAD and UNION are both endogenous variables and are jointly simultaneously determined. To solve the problem of endogeneity, we follow two different approaches. In a first approach we use TRANSPORTATION as an instrumental variable, where we assume that this instrument is uncorrelated with the error term, but correlated with the endogenous variable UNION. We use all other exogenous variables as their own instruments. The use of the TRANSPORTATION instrument is not unproblematic. The correlation between UNION and TRANSPORTATION is -0.24 and the causality straightforward: Cities that enjoyed lower transportation costs were more likely to economically interact and therefore to create a currency union. However, we can not exclude the possibility that the instrument influences the dependent variable not only via its correlation with the existence of a union, but in some other way, too. For instance, lower transportation costs could cause a smaller spread due to better market integration within the city-pair. Furthermore, TRANSPORTATION is time-independent, but is used as an instrument for a time dependent variable. Finally, we run the regression with this instrument in a panel with cross-sectional effects. However, because of the lack of other complementary data, alternative instruments are not applicable and we can not make any tests on the strength or weakness of this instrument. Moreover, finding an appropriate instrument in the currency union literature is difficult even for periods of investigation such as the twentieth century, where the available data potential is far richer (see Smith, 2002).

To cope with this problem, we use an alternative TSLS approach. In a first stage, in order to estimate the coefficients for union, we employ a binary dependent model in the form of a probit regression.[10] HANSA, LOG_CITIES, PERIOD, TRANSPORTATION, DIALECT and WAR_MIN are explanatory variables. On the basis of the resulting coefficients, we predict a variable UNIONHAT, which we then, in a second stage, insert into our original regression where it replaces the observed variable UNION. In this way we create an alternative set of results. In the first step both methodologies differ clearly, since in the first approach we use a least square estimation, and in the second a maximum likelihood estimation technique. This does not allow us to rank the results, but we can compare the outputs and decide if they are robust. Note that this does not improve the strength of the instrument; it only checks its robustness. However, in addition, we can use the results of the first stage probit estimation to find the likelihood of the creation of a currency union between two cities and to calculate the propensity score. This allows us to create a control group, which has similar characteristics as the observations of the city-pairs with union. Next, we can compare the average treatment effect of this control group with the treatment group (the city-pairs with a common union) using Persson's (2001) stratification method. This is a robustness check to determine the effect of the union on the spread.[11]

Now let us turn to the static panel data analysis. To work with a static model, we must first test the city-pair spreads for unit roots. Since different series are pooled, we must be aware of the possibility that not all of their processes have the same characteristics or are described by the same parameters (e.g. hypothetically the city-pair Cologne-Antwerp is stationary, but Cologne-Nuremberg is not). For this purpose, we perform

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[10] The probit takes the following form: $Pr(y_i = 1 \mid x_i, \beta) = 1-\Phi(-x_i-x'\beta) = \Phi(x'\beta)$, where Φ is the cumulative distribution function of the standard normal distribution.
[11] To creat the propensity score we use the Mahalanobis matching method. Moreover we considered other types of propensity score methods which delivered the same results.

several unit root tests, running the Levin, Lin, and Chu test for common unit roots, and the Fisher-Augmented Dickey Fuller and Fisher-Phillips-Perron tests for individual unit roots. As none of the results of these tests indicates the presence of a unit root, we can apply the static model. Once having disposed of this problem, we need to discuss the selection of cross-sectional and time effects and the related choice of fixed or random effects. Since the panel is unbalanced, these effects must be analysed separately. Let us first look at the cross-sectional effects of city-pairs and come back to time effects later.

We must decide if we want to choose fixed or random cross-sectional city-pair effects. The fixed effect model takes the form

(2) $y_{it} = \alpha_i + x'_{it}ß + \varepsilon_{it}$, $\varepsilon_{it} \sim IID(0, \sigma^2_\varepsilon)$,

where the parameter α_i is assigned to each city-pair and estimated by ordinary least squares. Alternatively, we can choose a random effects model, which takes the form

(3) $y_{it} = \mu + x'_{it}ß + \alpha_i + \varepsilon_{it}$, $\varepsilon_{it} \sim IID(0, \sigma^2_\varepsilon)$; $\alpha_i \sim IID(0, \sigma^2_\varepsilon)$,

where the parameter μ stands for a common factor and α_i are random factors, independently and identically distributed over individuals. $\alpha_i + \varepsilon_{it}$ is treated as an error term consisting of two components: an individual city-pair specific component that does not vary over time, and a remainder component that is assumed to be uncorrelated over time.

The choice between fixed and random cross-sectional effects is not ambiguous. On the one hand, the underlying units are distinct city-pairs. Each stands for a cornerstone of trade in Central Europe. Thus, there may be some justification for assigning fixed effects to specific city-pairs, where the α_i's can be estimated and the distribution of the gold-silver ratios is conditional upon the values for α_i, thus $E\{y_{it} | x_{it}\} = x'_{it}\beta+\alpha_i$. By contrast, the random effects model approach is not conditional upon the individual α_i's but integrates them out, thus $E\{y_{it} | x_{it}\} = x'_{it}\beta$. Choosing random effects can therefore also be justified. If we do so, we need to check if the explanatory variables are correlated with the α_i. For this we run Hausman-tests for both the panel and the TSLS panel to check whether the (theoretically more efficient) random effects estimators are consistent. The tests indicate that they are, and that we can use them for our analysis. Finally, we introduce an alternative approach considering the fixed and random effect estimations. Using a fixed effects model can be problematic since we assume that the error terms are independently and identically distributed within the city-pairs. This can become a problem since we use many discrete regressors in our equation – a fact that can lead to clusters in error terms (Moulton, 1986; 1990; Bertrand et al., 2004; Kedzi, 2004). Instead of applying a fixed effect model, a better approach is to control for clustering in error terms of the city-pairs. This means that we do run an OLS regression, but cluster the error terms of city-pairs and allow for any kind of unconditional heteroscedasticity as well as for correlation over time within the cross-sectional unit. In this way, we are closer to the random effects model, where the composite error term $\alpha_i+\varepsilon_{it}$ is autocorreleated (Wooldridge, 2003, section 7.8 and 10.7).

5. Integrated Markets and Currency Unions

Let us consider the results of the regressions related to currency unions. The estimated coefficients for the OLS, clusters and random effect analysis are summarized in columns 1 to 3 of table 3 (appendix 1). The results of the TSLS, random-TSLS approach, and the random-TSLS analysis with the alternative instrument can be found in columns 4 to 6 of this table.[12] In all estimations, the results suggest a strong significantly negative correlation of currency unions with spreads between local gold-silver ratios. This result holds if we make the robustness check suggested by Persson (2001), combining the propensity score with the stratification method. The results of the first stage binary probit estimation with the dependent variable UNION and the average treatment effects can be found in table 5. The results of the comparison between the control and treated groups confirm that unions reduce the spread between cities. Whereas the coefficient for the treated group is negative, the coefficient for the control group is positive. The difference between these estimators is significant. Thus taking into account a representative control group does not change our findings.

At the same time, we observe a significantly positive correlation of spreads with 'unions' between cities whose currency was supplied by a common territorial ruler (TERR_STATE). Only if we apply the alternative instrument in the random-TSLS approach, we receive a weak significant negative result. In addition, we find better-integrated money markets between cities that formed a union at some later point in time, since the estimator for LATER_UNION is significantly negative in the OLS, cluster, random effect and TSLS approach. The coefficients are negative but not significant for the two random-TSLS estimatons.

Thus, the estimated coefficients related to currency unions deliver robust outcomes, where monetary unions are correlated with significantly stronger market integration. Where the union was set up by territorial rulers this effect weakens, since a significantly positive effect pushes into the opposite direction. In addition, city-pairs that created monetary unions

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[12] The reported R^2 related to these results is rather low. This is unsurprising since we cover a period of more than 300 years, where many forces could have played in we do not know of and cannot control for.

at some later point in time were already better integrated at the point in time when we observe the spread between them.

Let us in a next step consider the results for other explanatory variables. The coefficient for membership in the Hanseatic League (HANSA) is negative in all estimators, but only significant in the cluster coefficient. The results for the population size (LOG_CITIES) deliver positive coefficients. However, they are only significant in the OLS and TSLS approach. Thus the expected negative causation can not be confirmed. The coefficient for PERIOD is for all four regression techniques significantly negative (as we expected), indicating overall improving integration and thereby confirming Chilosi and Volckart's {Chilosi, 2009 #3489} result. The coefficient for the war dummy WAR_MIN indicates that city-pairs where at least one city was at war were significantly better integrated: All coefficients, except the TSLS which negative but not significant, are here significantly negative. This result contradicts conventional wisdom, according to which violence should discourage integration. However, under late medieval conditions it is not implausible. In particular in Central Europe, it is difficult to clearly distinguish all-out wars from smaller feuds and everyday violence. Feuding may in fact have had a positive impact on markets, helping agents credibly to commit to contracts (Volckart, 2004). In so far, the negative estimator of the WAR_MIN dummy can not come as a surprise.

For DIALECT and TRANSPORTATION we can only report the results for the OLS and the cluster estimators. Since both variables do not change over time, they are already incorporated in the cross-sectional effects of the panel data analysis. The coefficient for DIALECT is positive in the OLS, cluster and TSLS estimation, (suggesting that dialectal borders were irrelevant), that for transportation costs (TRANSPORTATION) significantly positive, as expected.

Before we continue to discuss the results, some remarks on the interaction term TRANSPORTATION are in order. In table 3 (appendix 1), the interaction term of the OLS regression is split up. Column 1 reproduces the OLS regression from table 1, while column 2 shows the same regression, but with the variable LOG_DISTANCE and the dummy WATERWAY instead of TRANSPORTATION. Distance has no impact on the dependent variable. However, cities that are connected by a waterway are better integrated, with the coefficient being significantly negative. All other estimators are unchanged. Since TRANSPORTATION is significantly negative we can conclude that distance only played a role for integration if cities where not connected by a waterway.

Based on this analysis and estimation of coefficients, we can derive the following interpretations: If we regard spreads of gold-silver ratios between cities as indicators of weaknesses in money market integration, currency unions had a significant impact on integration in the area and period under study. A common currency and common monetary policies must have promoted trade between cities. This was in particular true for cities that were autonomous with regard to monetary policies. Obviously, however, among non-autonomous cities, whose common currency was supplied by a territorial lord, opposing forces or at least disturbing factors were at work, which caused a weaker integration of money markets. Another of our results points to a factor that may have been responsible: The analysis shows that cities, which became members of currency unions at some later point in time, were already better integrated earlier on. Creating currency unions thus appears to have been a path-dependent and self-enforcing process. Where markets had already begun to integrate, unions could be established, which in turn encouraged further integration. Arguably, rulers who unified the currencies in the area they claimed to rule disregarded this, establishing common currencies where well-integrated bullion markets (and by implication well-integrated markets for goods with a less favourable weight-value ratio than gold and silver, too) did not yet exist. Typical territorial institutions that prohibited the export or melting of the domestic coinage point that way (cf. Munro, 1972, pp. 11 ff.), though certainly similar institutions also existed in autonomous cities, which were members of currency unions. Another interesting result is that in contrast to the unions, many other variables we controlled for – e.g. city sizes – did not deliver any significant results. The main complementary results are that money markets became better integrated over time and that transport costs mattered.

6. Conclusion

This paper employs a new method to estimate the integration of late medieval and early modern money markets in order to answer new questions regarding the effects of currency unions. The method is based on relating exchange rate notations to information on the bullion content of the money in order to calculate local gold-silver ratios, and on treating spreads between these ratios as indicators of deficiencies in integration. In the models used in the analysis, these spreads are the dependent variable. On the other side of the equation, a dummy that indicates whether a city-pair between which a spread was measured formed a currency union takes first place. The regressions control for several other variables such as the distance between the cities, their size, their autonomy with regard to monetary policies, membership in the Hanseatic League and so forth.

Briefly, the results indicate that membership in a currency union was strongly and significantly correlated with small spreads between local gold-silver ratios, that is, with well-integrated money markets. As because of the favourable weight-value ratio of money these markets were better integrated than any other markets, this allows us to infer that monetary diversity did in fact have strongly adverse effects on the trade of more bulky and less valuable goods, too. Where the same currency was used, trade links in general must have been tighter than where different currencies circulated. As the currency unions which are analysed here standardised silver money only, this hypothesis implies that merchants on their own were unable to overcome the effects of monetary diversity, for example by employing a limited number of gold-based currencies in long-distance trade. What was needed was political action.

Another important insight from our analyses indicates that, as suggested by the optimal currency area literature, late medieval currency unions were at least weakly endogenous. This result of our analysis has some interesting implications. For one thing, it indicates that the link between monetary unification and integration (and ultimately economic growth) may have been less straightforward than e.g. Epstein (2000, p. 58) assumed: Overcoming the diversity of currencies required markets that already were relatively well integrated. Moreover, this endogeneity of currency unions suggests that where such unions did not develop, their preconditions were frequently lacking. In other words, where bullion markets – and by implication markets for goods with less favourable weight-value rations – were well integrated, monetary diversity could be replaced by some measure of uniformity, thus helping further advances in integration. However, where this was not the case – where markets were fragmented – monetary diversity persisted. Put briefly, the monetary fragmentation of fourteenth to mid-sixteenth century Germany, that is, the existence of a large number of silver currencies, most of which circulated in relatively small regions only, was a corollary of weak market integration. In other words: the multiplicity of currencies used in the Holy Roman Empire north of the Alps reflected the fragmented state of markets in the area. To summarize, while currency unions did help the integration of markets, this effect could not be brought about simply by an effort of political will. Such an effort would be successful only once market integration had sufficiently advanced in the face of monetary fragmentation.

Appendix 1: Tables

Table 2: Descriptive Statistics

Variable	Observations	Mean	Std. Deviation	Min	Max
DISTANCE (km)	4156	576	294	15	1734
DISTANCE union (km)	218	74	45	25	336
WATERWAY (common=1)	4156	0.16	0.37	0	1
River	4156	0.29	0.45	0	1
Port	4156	0.09	0.29	0	1
WAR_MIN (at least one = 1)	4156	0.08	0.28	0	1
DIALECT (common=1)	4156	0.29	0.45	0	1
Spreads-ALL	4156	2.27	2.23	0	16.90
Spreads-UNION	218	1.36	1.76	0	13.31
Spreads-RMU	40	0.65	0.78	0.01	4.63
Spreads-WMU	41	1.16	2.15	0	13.31
Spreads-FLEM	18	1.62	1.95	0	6.64
Spreads-HOLL	45	2.42	2.08	0	7.00
Spreads-PRU	45	1.36	1.54	0	6.38
Spreads-LATERUNION	72	2.20	1.92	0.01	7.68
Spreads-TERR_STATE	123	1.66	1.78	0	7.00
HANSA (both=1)	2	0.86	0.01	0.83	0.85
HANSA_MIN (at least one=1)	199	2.12	1.80	0	11.11

RMU: Rappenmünz-Union; WMU: Wendish Monetary Union; FLEM: Flemish currency; HOLL: Currency of Holland; PRU: Currency of Prussia.

Table 3: Regressions with LOG_SPREAD as Dependent Variable

Dependent Variable: LOG_SPREAD

	(1) OLS	(2) Cluster	(3) Random	(4) TSLS	(5) Random-TSLS	(6) Alt. Random-TSLS
C	4.562*** (5.98)	4.563*** (4.26)	5.168*** (6.28)	4.504*** (5.897)	5.564*** (5.72)	4.930*** (5.97)
UNION	-0.907*** (6.68)	-0.907*** (7.10)	-0.936*** (4.60)	-5.370*** (4.64)	-5.396** (2.54)	-
UNIONHAT	-	-	-	-	-	-0.017*** (2.83)
TERR_STATE	0.658*** (3.60)	0.658** (2.00)	0.510** (1.24)	4.775*** (4.38)	4.616** (2.26)	-0.300* (1.85)
LATER_UNION	-0.270* (1.77)	-0.270** (2.00)	-0.241* (1.24)	-0.555*** (2.93)	-0.294 (1.05)	-0.106 (0.54)
HANSA	-0.398 (0.48)	-0.398** (2.27)	-0.401 (0.826)	-0.834 (0.84)	-0.382 (0.47)	-0.456 (0.55)
LOG_CITIES	0.059** (2.18)	0.059 (1.30)	0.026 (0.78)	0.006** (0.19)	0.010 (1.90)	0.021 (0.63)
DIALECT	0.059 (1.22)	0.059 (0.05)	-	0.354*** (3.29)	-	-
PERIOD	-0.004*** (7.29)	-0.004*** (4.90)	-0.004*** (6.84)	-0.003*** (4.21)	-0.004*** (6.32)	-0.004*** (2.10)
WAR_MIN	-0.130* (7.211)	-0.130* (1.85)	-0.137** (2.04)	-0.092 (1.15)	-0.136** (2.04)	-0.141** (2.10)
TRANSPORTATION	0.038*** (4.274)	0.038*** (2.93)	-	-	-	-
R^2	0.037	0.033	0.032			
Total observations	3776					
Periods included	202					
City-pairs included	650					

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%; absolute t-respectively z-values in parentheses.

Table 4: OLS with Interaction-Term or Individual Variables (LOG_DISTANCE, WATERWAY), No City-Pair Effects

Dependent Variable: LOG_SPREAD

	(1) **OLS**	(2) **OLS**
C	4.562*** (5.98)	4.841*** (6.08)
UNION	-0.907*** (6.68)	-0.943*** (6.16)
TERR_STATE	0.658*** (3.60)	0.631*** (3.403)
LATER_UNION	-0.270* (1.77)	-0.308** (1.90)
HANSA	-0.398 (0.48)	-0.387 (0.45)
LOG_CITIES	0.059** (2.18)	0.062** (2.26)
DIALECT	0.059 (1.22)	0.050 (0.93)
PERIOD	-0.004*** (7.29)	-0.005*** (7.36)
WAR_MIN	-0.130* (7.211)	-0.131*
TRANSPORTATION	0.038*** (4.274)	-
LOG_DISTANCE	-	-0.979 (0.03)
WATERWAY	-	-0.246*** (4.49)
R^2	0.037	0.038
Total observations	3776	
Periods included	202	
City-pairs included	650	

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%; absolute t-values in parentheses.

Appendix 2: Exchange Rate Sources

Printed sources:

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