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Central Europe from the Fourteenth to the Sixteenth Centuries

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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 of a union strongly and significantly correlated with well-integrated markets. We also examine whether currency unions were endogenous. Our results indicate that markets were significantly better integrated prior to the formation of a union. In addition, we show that currency unions established by autonomous merchant towns were better integrated than unions implemented by territorial rulers. The overall implication is that late medieval Central European monetary diversity was a corollary of weakly integrated markets.

Keywords
Financial market integration, currency unions, Late Medieval Europe

JEL classification F33, G15, N23

Currency Unions, Optimal Currency Areas and the Integration of Financial Markets: Central Europe from the Fourteenth to the Sixteenth Centuries♣

LARS BOERNER♦ and OLIVER VOLCKART♠

1. Introduction

After the last Grandmaster of the Teutonic Order, Albert of Brandenburg (1490-1568), had turned the Prussian state of the Order into a secular duchy and done homage to King Sigmund of Poland (1467-1548) in 1525, Polish demands for the harmonisation of the currencies used in both countries placed him in a difficult position. While on the one hand, Duke Albert feared a loss of autonomy, on the other hand, he found it hard to counter the Polish argument that after the creation of a currency union, 'the utility of a common coinage would become apparent in manifold ways' (Volckart, 1996, p. 259): the advantages for commerce seemed only too obvious. He found himself in a dilemma in a way that was far from unusual for political authorities acting under the conditions of monetary fragmentation in late medieval Central Europe.

Did this dilemma exist? Were currency unions really as advantageous as the King of Poland, the Duke of Prussia and their councillors assumed? How did efficiency and integration of markets develop under their influence? The answers given here to these questions are based on a new approach to estimating financial market integration 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 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 proxies for prices paid on financial 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 zero transport and transaction costs and perfect monetary integration, prices, i.e. gold-silver ratios, between localities would converge to identity. With positive transport and transaction costs, spreads between prices indicate that

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♦ Max Weber Post-Doctoral Fellow (2007-2008) and Economics Department, European University Institute, Florence, Italy

♠ Economic History Department, London School of Economics and Political Science

opportunities for arbitrage remained unexploited, making it possible to estimate how integration developed. The main advantage of this method is that it allows us to take the quantitative analysis of financial market integration back from the late seventeenth century, which is the earliest period research has so far been able to reach (Neal, 1985; 1987; Schubert, 1988; 1989), to the fifteenth and even the fourteenth centuries.

There are several reasons why the issues analysed here are important and interesting. For one thing, given the generally low level of investment and the slow pace of technological progress before industrialisation, it makes sense to look for the preconditions of growth in the commercial sphere. After all, growing and better-integrated markets not only allowed for a more efficient allocation of resources, but also for a more intensive division of labour, for specialisation and for concurrent increases in per-capita output. This is why the economy of pre-modern Europe is increasingly being studied in the context of a 'commercialist' framework (e.g. Aloisio, 2007; Unger, 2007; Hatcher and Bailey, 2001, pp. 121 ff.; Persson, 1999). Most scholars working in this field focus on grain markets for the simple reason that 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, grain being a good with a high weight-value ratio that was expensive to transport, the integration of grain markets allows few inferences about markets for other commodities. The late medieval money market, by contrast, can be assumed to provide a nearly ideal benchmark for the study of other markets. To be sure, under a commodity money system transport costs were positive, but the weight-value ratio of money was still more favourable than that of almost any other good. The money market therefore shows the optimum that could be reached in the field of market integration at any given place and period of time.

Why study currency unions? Monetary conditions in late medieval and early modern Europe were characterised by a diversity that defies modern imagination. The large monarchies of Western Europe, i.e. France and above all England, had monopolised their currencies at a comparatively early date, but no one has ever attempted to count how many different currencies were used further east. In the Holy Roman Empire alone, around 500 mints were in operation in the fifteenth century (Sprenger, 2002, p. 81). The number of currencies was smaller but still huge. The question of how this diversity – and efforts to overcome it by forming currency unions – affected market performance has hitherto not been discussed in any detail. Some economic historians claim that monetary diversity impeded trade (Šimek, 1971, p. 235; Walter, 1992, pp. 30 f.; Sprenger, 2002, p. 61), but most, even those who discuss integration issues (e.g. Persson, 1999), seem implicitly to assume that money was neutral. Economists, by contrast, point to the advantages of unitary currencies, specifically to the reduction of uncertainty about prices paid in other places that allows economic agents to exploit the opportunities offered by a growing market (Grubel, 1970, p. 320). The core of the argument is that currency unions foster trade by reducing transaction costs and exchange rate volatility. Empirical analyses made under present conditions (e.g. Rose, 2000; 2001) claim that trade within unions is considerably – by about a factor of 3 – larger than what gravity models predict under monetary diversity.

As for the period under discussion here, there are a number of arguments which suggest that monetary diversity cannot have been a serious impediment to commercial integration. After all, the gold and silver on which late medieval currencies were based could be exchanged for each other, but were still 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. Gold coins were more or less indiscriminately used in all countries, regardless of where they had been minted and of which silver currency was locally issued or favoured. To be sure, some types of gold coins were more popular than others. 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, West 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). What this implies is that long distance trade used a limited number of de facto international gold currencies. 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 market integration.

There is another argument in the modern literature on currency unions. In contrast to authors such as Rose, who stress the positive effects of monetary harmonisation on integration, other scholars, who argue from the point of view of the theory of optimal currency areas, point out that trade integration may give rise to monetary integration, in other words that currencies are unified only once markets have integrated.[1] Ritschl and Wolf (2003) found such an effect in the early twentieth-century inter-war period, when currency blocs formed in areas where markets had already been well-integrated.

The issue of the endogeneity of currency areas has never been discussed with regard to the pre-modern period. 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. Either the members of a planned currency union would have to buy the raw material for their coinage at different prices, in which case it is easy to imagine that arguments about rates of seignorage and mint charges would prevent unification; or the members of the union would try to avoid these issues by producing the coinage centrally and distributing the seignorage among themselves. Under these conditions, agents in outlying regions far from the mint faced incentives to melt down the money and sell the bullion or export it to somewhere where they would receive more raw gold or silver in exchange. Which option they chose depended on whether their local bullion price was higher or lower than the mint price, but for the stability of the currency union, this did not matter: both alternatives were equally fatal. This argument, too, implies that market integration advanced regardless of monetary diversity, which could, in fact, only be overcome when at least the bullion market had reached a minimal degree of integration. Thus, the question needs to be

[1] 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).

asked anew: how important was a common currency for the integration of pre-modern markets?

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. Monetary conditions in late medieval Germany

Like all medieval currencies, those used in the Holy Roman Empire of the fourteenth to sixteenth centuries were ultimately derived from the monetary system Charlemagne introduced in the Frankish kingdom shortly before the year 800 (Grierson, 1965/79). With few exceptions, only one monetary unit – the silver denarius or penny – was issued. While uniformity was largely preserved in the ninth century, it began to fall apart under the last Carolingians in the western Frankish kingdom, and under the Saxon rulers in Germany. There, the kings and emperors transferred the right to issue coins to an ever-increasing number of ecclesiastical and secular rulers. The process culminated under Emperor Frederick II (1194-1250) (Sprenger, 2002, p. 60). Given the strong incentives to increase the profits from seignorage, and probably also the differing local prices of the raw materials needed for minting – most importantly silver – it is no surprise that standards began to diverge. By the middle of the thirteenth century, a large number of localised silver currencies had replaced the former monetary uniformity.

The later thirteenth and fourteenth centuries were characterised by two developments. On the one hand, an increasing number of towns began to acquire their own rights of coinage (Nau, 1964; Berghaus, 1964; Volckart, 2007). This increased the number of currencies in use in the Holy Roman Empire and the neighbouring regions. 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. This development began in mid-thirteenth-century Italy, spread from there to France, and began to affect Germany from about the turn of the fourteenth century. First, Italian and French gold and larger silver coins were imported and used alongside the various domestic types of pennies, but soon German princes and cities began to issue their own multiples of silver pennies and various types of gold coins, most of which initially imitated the florin of Florence (Berghaus, 1971-72). From the second half of the fourteenth century, the link to Italy was severed, and the emperor, many princes and an increasing number of cities determined both the standard and appearance of their coins for themselves. 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 introducing the unions to be considered in more detail, it is necessary to point out three peculiarities. First, while studies of modern monetary unions, such as that by Ritschl and Wolf (2003) cited above, use the nation state as the unit of analysis, 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, who decided to harmonise their currencies. We also apply the term monetary 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. Still, our method of analysis allows us to make a distinction between both types of unions.

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 Groat 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. When analysing the data, this needs to be kept in mind.

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 Rappenmuenz-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 currency reached between Hamburg and Luebeck in the thirteenth century. In 1379, the cities of Lueneburg and Wismar joined, and these four cities continued to cooperate until the middle of the sixteenth century (for the following, see Stefke, 2002). The union was based on treaties between the partners that contained detailed articles regulating the weight and fineness of the common coinage. Importantly, the members also agreed on regular inspections, so-called assays, of samples of their coins. They did this in order 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. Luebeck struck gold coins from the 1340s, and Hamburg and Lueneburg followed suit in the 1430s, but the definition of the standard of the coins was left to the councils of the individual cities. What was regulated was the nominal value of these guldens in the union's silver coinage. Whether it was possible to enforce these politically imposed rates is doubtful, not least because when the rates of other types of gold coins were fixed, not even the city fiscal administrations always paid heed.[2]

The Rappenmuenz-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 Rappenmuenz-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 the silver coins issued by its members. Also like its North German counterpart, it repeatedly (and ultimately unsuccessfully) tried to fix the exchange rate of gold coins circulating in its member cities and territories. In spite of this, the Rappenmuenz-Union remained stable, dominating Northern Switzerland, Alsace and parts of South-West Germany until the second half of the sixteenth century.

The Rappenmuenz-Union's 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 Zuerich and the Duke of Austria (Altherr, 1910, p. 25). In the fifteenth century, however, the monetary policy of Zuerich 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, Zuerich cooperated with Lucerne, while Constance and Schaffhausen formed a more stable union with a number of cities in the area of Wuerttemberg (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, 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 (such as Bruges and Ghent mentioned above), Holland, Prussia, Bohemia and Austria, where this was the case.

The sixteenth century saw a remarkable increase in the organizational efficiency of the Holy Roman Empire, which, 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 had been on the agenda (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 measure of 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.

3. Method and data

The introduction gave a brief sketch of our approach to estimating late medieval and early modern financial markets, indicating that we use exchange rate notations and information on the bullion content of the coinage in order to compute local gold-silver

[2] 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).

ratios. Studies of exchange rates between currencies based on the same precious metal, e.g. silver, show that while the rates frequently diverged from parity, arbitrage always brought them back to within the band between the bullion points, and indeed to parity (Volckart and Wolf, 2006). As arbitrage must have affected exchange rates for gold and silver in a similar way, we can interpret local gold-silver ratios as prices paid on financial markets. This allows us to make use of the Law of One Price, that is, to treat spreads between local ratios as indicators of market inefficiencies. Taking such an approach is eminently plausible; after all, many late medieval consumers were well aware of the fine gold and silver content of the coinage and eager to exploit opportunities for arbitrage offered by spreads such as those that we have discovered (Klüßendorf, 1976, pp. 432 f.). A telling description of how people tried to make a profit on the money market is given in a treatise written by the late fifteenth-century annalist Hermen Bote from Brunswick. According to Bote (1880, pp. 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, Luebeck 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 Mechelen 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 the 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)'.

Such commercial letters and account books kept by merchants or political authorities and other sources contain an abundance of exchange rate notations, which we can use in order to examine how efficient financial markets were. 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. In short, we use exchange rates to determine the gold-silver ratios for the cities here considered, and treat these ratios as proxies for prices paid on financial markets.

We employ a dataset of c. 9,000 exchange rate notations compiled for this purpose. The data are supplemented with c. 150 notations from Spufford's (1986) Handbook of Medieval Exchange, which provides only sketchy coverage of Central and Northern Europe but contains a wealth of information on places in Western European such as London, Bruges and Antwerp. The majority of the data (almost 79%) were found in urban, princely and ecclesiastic account books that are comparatively well preserved (e.g. Harms, 1909; 1910). Exchange rate notations appear almost on every single page of these sources – a fact that is not surprising considering the multiplicity of currencies used in late medieval Central Europe. 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 (e.g. Lesnikov, 1973). Commercial and non-commercial correspondence yielded another c. 2% of the data (e.g. Stieda, 1921; Hanham, 1975), and c. 1% was found in notarial registers and similar sources (e.g. Simon, 2006). We also use rates mentioned by historians. Including the material provided by Spufford (1986), they amount to c. 9% of the total dataset.[3]

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 Volckart, 2006; 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. l f.). First, there was the most elementary one called manual exchange, that is, the simultaneous and on the spot exchange of 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 not only rates found in loans, but also those in bills of exchange contained a hidden interest rate; hence, there was a systematic difference between them and the rates paid in manual exchange (de Roover, 1948, p. 62). 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.).[4] 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. Hence, it seems acceptable to use all quotations indiscriminately.

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 bother to clearly define to which kind of gold coin the exchange rate applied. Moreover, even if we know the types of coins, determining their 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

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[3] Rates from political ordinances were excluded from the analysis.

[4] 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).

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 (cf. van der Wee and Aerts, 1979, pp. 61 f.; 1980, pp. 234 f.). The assumption made in this study 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 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). Still, 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, p. 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 this study roughly corresponds to eastern France, south-eastern Great Britain, Belgium, the Netherlands, Germany, Switzerland, Austria, the Czech Republic and western and northern Poland. Theoretically, 69 cities form 2415 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 507,150 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 625 and the number of yearly observations of exchange rate spreads to c. 3300.

4. Analysis

The hypothesis tested in this section is that currency unions had a negative impact of the size of the spreads between the yearly means of local gold-silver ratios, which we use as proxies for prices paid in financial markets. Before beginning the analysis, it may be helpful to summarise the way in which we constructed the dependent variable in a slightly more formal manner. Let us define the exchange rate of some type of gold coin sold for silver money in a specific location as

(1) $$E_L = \frac{kC_{S1}}{C_G},$$

where k represents the sum in a silver currency (C_{S1}) which equalled one gold coin (C_G). The par ratio between these currencies is given by

(2) $$R_L = \frac{kC_{S1}Ag}{C_G Au}.$$

Here, *Ag* is the silver equivalent of the unit of account of the silver currency, and *Au* is the fine gold content of the gold coin. The local gold-silver ratio is the average of the par ratios found per year (i.e. R_{L1}'). We define ratios valid at the other places here considered in the same way and aggregate them on a yearly level ($R_{L2\ldots n}$). Spreads between the aggregates are therefore given by

(3) $$\Delta = \left| R_L' - R_n' \right|.$$

As shown above, large spreads indicate weakly integrated markets, while small or shrinking spreads show that the markets where the ratios were measured were well integrated or that integration was improving.

To test our hypothesis, we examine the dependent variable (LOG_SPREAD) and the potential explanatory variables in various regressions. Among the 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). To measure if city-pairs were already better integrated before they joined a union, we introduce a LATER_UNION dummy. This dummy allows us to exploit extra information on the integration of the financial markets of these city-pairs before they merged into a union, helping us to answer the question of whether they were already at that time better integrated than those city-pairs that never formed a union.

In addition to these variables, which refer directly to currency unions, we control for a number of other influences. Most importantly, we expect that spreads should be smaller between cities that traded intensively 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 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. This 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 and 0 otherwise. Furthermore, we assume 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. 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 three further factors that may have influenced financial market integration. First, a HANSA dummy represents shared membership in the Hanseatic League, second, PERIOD controls for time, and finally DIALECT represents the use of a common idiom. Here, we disregard most modern language borders, instead assuming e.g. that the Low German dialect was closer to the language spoken in the Netherlands than to Upper German, from which modern German is derived.

In our analysis, we first run an ordinary least square regression that we can use as a benchmark, and then a two-stage least square variant (cf. Greene, 2007, ch. 16). We do this in order to take into account a potential endogeneity between the dependent variable (the spread of gold-silver ratios between city-pairs, 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 suggested by the optimal currency area literature (e.g. Frankel and Rose, 1998; Dixit, 2000; Alesina and Barro, 2002), 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 two-stage least square variant of our model, LOG_SPREAD and UNION are 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 ordinary least square model (OLS) takes the form

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

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 and TRANSPORTATION discussed above, *ß* for the coefficient and ε_{it} for the error term.

As explained above, in the two-stage least square model (TSLS) we assume that LOG_SPREAD and UNION are endogenous variables and are jointly simultaneously determined in the model. To solve this problem of endogeneity, 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 since we cannot completely exclude the possibility that it influences the dependent variable not only via its correlation with the existence of a union, but in some other way, too. However, because of the lack of other complementary data, alternative instruments are not applicable. Thus, testing market integration with a TSLS approach must be weighted carefully, and discussed in the context of the other OLS and panel-regression results.

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. For example, the city-pair Cologne-Antwerp is stationary, but Cologne-Nuremberg is not. For this purpose, we perform 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.

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

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

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

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

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. On the other hand, we do not have a complete picture of these pairs: our sources are fragmentary. Neither the number of cities nor the observations over time are complete. Therefore, the observations are a random sample from an underlying population of city-pairs. In this way, choosing random effects may be justified. In addition, depending on the different independent variables discussed earlier, effects can be assigned to distinct city-pairs or to an underlying common population effect. Thus, we estimate coefficients for both models. We also 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.

The results of both the benchmark and the cross-sectional panel data estimations are summarised in table 1 (see appendix).[5] Column one depicts the OLS and column two the TSLS coefficients. They suggest a significantly negative correlation of currency unions with spreads between local gold-silver ratios over the period of observation in the OLS-estimator. This also holds if we take a potential endogeneity of the spreads and

[5] We also run these regressions from table 1 and later from table 3 with White cross-section and White period robust coefficient variance estimators, but the results do not change.

the unions into account. At the same time, we observe a significantly positive correlation with 'unions' between cities whose currency was supplied by a common territorial ruler (TERR_STATE). In addition, we find better-integrated financial markets between cities that formed a union at some later point in time, since the estimator for LATER_UNION is significantly negative. The coefficient for membership in the Hanseatic League (HANSA) is positive in the OLS regression and significantly negative in the TSLS approach. As expected, the coefficient for the distance in case no waterway is available between the city-pairs (TRANSPORTATION) is significantly positive, suggesting that spreads increased with increasing distance between cities. Since we need the TRANSPORTATION-variable as an instrument for the TSLS approach, we unfortunately loose this information.

Before we continue to discuss the results shown in table 1, some remarks on the interaction term are in order. In table 2 (in the appendix) the interaction term of the OLS regression is split up. Column 1 reproduces the OLS regression from table 1, while column 2 runs the same regression, but with the variable LOG_DISTANCE and the dummy WATERWAY. The distance has no impact on the dependent variable. However, cities which are connected by a waterway are better integrated. The coefficient is significantly negative. All other estimators are unchanged.

Returning to the main results in table 1, results for the population size of the city-pairs (LOG_CITIES) are inconclusive. The output of the OLS regression is significantly positive; in the TSLS regression the estimator is negative but not significant. The coefficient for PERIOD is significantly negative (as we expected) and the one for similar language between similar city-pairs (DIALECT) significantly positive. Accordingly, financial markets between cities with similar dialects were significantly better integrated than others. Altogether, our preliminary benchmark results confirm our expectations only in part.

Columns three and four present the results of the cross-sectional panel data analysis. Note that we reduce the number of exogenous variables to UNION, TERR_STATE, LATER_UNION, LOG_CITIES and PERIOD, as all the other exogenous variables take the form of dummies that do not change over time. Hence, they are already incorporated in the cross-sectional effect. The last two columns show the results for the fixed and random effects of the TSLS approach.

The more efficient random effects estimators confirm the earlier results. The coefficient for currency unions (UNION) is significantly negative in the panel as well as in the TSLS panel. In the random effects model, the coefficients for TERR_STATE are significantly positive in both the panel and the TSLS panel. The estimator for LATER_UNION is significantly negative. If we argue that while this model is more efficient, the fixed effects model is intuitively more appropriate, the results become weaker, with the coefficients being no longer significant. However, as explained above, there are good reasons (missing data) for using the random effects model, which is therefore the appropriate choice. Thus, we can conclude that there are no other hidden city-pair effects which change the significance and the algebraic sign of the estimators.

The results for the population sizes of the city-pairs (LOG_CITIES) do not deliver clearer estimators than in the earlier regression. All estimators are positive, but only the fixed effect estimator is significant. The PERIOD coefficient is significantly negative for all estimators, as expected. We will return to this issue below. For the moment, let us go back to the role of the TERR_STATE dummy in the model (in appendix table 3 we skip this variable).

Here, the estimator for UNION is still negative and significant, but the coefficient is smaller. This indicates that establishing a currency union did in general promote market integration, even if it were set up by feudal rulers. Obviously, however, among non-autonomous cities, whose common currency was supplied by a territorial lord, an opposing force was at work which led to a weaker integration of financial markets. Arguably, rulers established such ‘currency unions’ in disregard of market conditions, creating unified currencies for areas that were still lacking well-integrated bullion markets (and by implication well-integrated markets for goods with a less favourable weight-value ratio than gold and silver, too). 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.

5. Conclusion

This paper employs a new method to estimate the integration of late medieval and early modern financial 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 model 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 financial markets. This is also true for ‘unions’ which were formed by cities that were not autonomous with regard to monetary policies, but that used a common currency supplied by their common feudal overlord. Here, though, the effect was weaker. As, due to the favourable weight-value ratio of money, financial 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. When Duke Albert of Prussia eventually, in 1528, gave in to the Polish argument that harmonising the currencies of both countries would help commerce and agreed to a formal currency union, he lost part of his political autonomy and, most painfully, the chance to arbitrarily increase his revenues from the seignorage. However, the population of his territory – in particular the merchants of his only major city, Koenigsberg – benefited from his decision. Money was, as the duke had to admit, definitely not neutral.

Another important insight from our analyses indicates that, as suggested by the optimal currency area literature, late medieval currency unions were endogenous, being formed on the basis of already well-integrated markets. This result of our analysis has far-reaching implications. It not only indicates that unions could emerge only where the necessary preconditions existed, but moreover suggests that where they did not develop, these 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, while 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 huge number of silver currencies, most of which circulated in relatively small regions only, was actually a corollary of the weak state of Central European market integration. In fact, given the state of development of markets in Germany, the multiplicity of currencies used in that country seems to have been optimal. 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.

A final remark seems in order. One of the aims of this paper was to present a new method for analysing financial market integration during a period of European history that quantitative research has hitherto been unable to reach. The results that we have achieved seem altogether plausible and match the expectations that we formed on the basis of modern economic theory. This in itself, it should be pointed out, strongly supports our claim that our method is a valuable and useful tool for research that can be applied with regard to other geographical regions, and perhaps even to earlier periods than those analysed here.

Appendix

Table 1: Panel data analysis with city-pair effects

Dependent Variable: LOG_SPREAD

	(1) OLS	(2) TSLS	(3) Fixed	(4) Random	(5) Fixed-TSLS	(6) Random-TSLS
C	4.504*** (5.897)	3.635*** (3.759)	2.952* (1.617)	5.166*** (6.080)	7.043 (0.570)	5.572*** (8.737)
UNION	-0.907*** (6.614)	-6.454*** (4.176)	-0.365 (0.454)	-0.912*** (3.990)	-36.776 (0.340)	-5.876*** (3.626)
TERR_STATE	0.652*** (3.541)	5.800*** 3.985)	-1.162 (1.049)	0.453*** (1.625)	21.708 (0.320)	5.000*** (3.232)
LATER_UNION	-0.272** (1.770)	-0.540*** (2.724)	-0.850 (1.047)	-0.230* (1.105)	-7.619 (0.379)	-0.315* (1.625)
HANSA	-0.015 (0.170)	0.465** (2.539)	-	-	-	-
LOG_CITIES	0.060** (2.195)	-0.034 (0.863)	0.352** (2.003)	0.025 0.682)	0.068 (0.078)	0.015 (0.396)
DIALECT	0.060 (1.209)	0.366** (3.148)	-	-	-	-
PERIOD	-0.003*** (7.211)	-0.002*** (2.950)	-0.004* (6.185)	-0.004*** (6.659)	-0.004*** (4.417)	-0.004*** (10.010)
TRANSPORTATION	0.038*** (4.274)	-	-	-	-	-
Total observations	3776					
Periods included	202					
City-pairs included	650					

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 2: OLS with interaction-term or individual variables (LOG_DISTANCE, WATERWAY)

Dependent Variable: LOG_SPREAD

	(1) OLS	(2) OLS
C	4.504*** (5.897)	4.776*** (5.994)
UNION	-0.907*** (6.614)	-0.944*** (6.109
TERR_STATE	0.652*** (3.541)	0.627*** (3.403)
LATER_UNION	-0.272** (1.770)	-0.308** (1.892)
HANSA	-0.015 (0.170)	-0.007 (0.082)
LOG_CITIES	0.060** (2.195)	0.063** (2.270)
DIALECT	0.060 (1.209)	0.046 (0.914)
PERIOD	-0.003*** (7.211)	-0.004*** (7.274)
TRANSPORTATION	0.038*** (4.274)	-
LOG_DISTANCE	-	-0.000 (0.009)
WATERWAY	-	-0.246*** (4.424)
Total observations	3776	
Periods included	202	
City-pairs included	650	

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3: Panel data analysis with city-pair effects, without TERR_STATE

Dependent Variable: LOG_SPREAD

	(1) fixed	(2) random	(3) fixed-TSLS	(4) random-TSLS
C	2.875 (1.576)	5.204*** (6.112)	6.813 (0.671)	5.636*** (7.682)
UNION	-0.749 (1.047)	-0.619*** (4.380)	-21.003 (0.411)	-2.501*** (3.909)
LATER_UNION	-0.458 (-0.636)	-0.238 (1.1374)	-10.626 (0.414)	-0.475** (2.137)
LOG_CITIES	0.359** (2.043)	0.027 (0.720)	0.066 (0.086)	0.020 (0.526)
PERIOD	-0.004*** (6.195)	-0.004*** (6.722)	-0.004*** (4.659)	-0.004*** (8.645)
Total observations	3776			
Periods included	202			
City-pairs included	650			

* significant at 10%; ** significant at 5%; *** significant at 1%

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