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Rules, Discretion or Reputation? Monetary Policies and the Efficiency of Financial Markets in Germany, 14th to 16th Centuries

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Abstract

This paper examines the questions of whether and how feudal rulers were able to credibly commit to preserving monetary stability, and of which consequences their decisions had for the efficiency of financial markets. The study reveals that princes were usually only able to commit to issuing a stable coinage in gold, but not in silver. As for silver currencies, the hypothesis is that transferring the right of coinage to an autonomous city was the functional equivalent to establishing an independent central bank. An analysis of market performance indicates that financial markets between cities that were autonomous with regard to their monetary policies were significantly better integrated and more efficient than markets between cities whose currencies were supplied by a feudal ruler.

Keywords : Financial markets, integration, monetary policy, Middle Ages

JEL classification: G15, N13, N23, N43

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1. Introduction

On March 1, 1412, the joint rulers of the small North German duchy of Brunswick-Lueneburg, dukes Otto and Bernard, concluded a contract with their city of Brunswick. Neither the cause nor the content of that treaty were at all unusual at this time. The dukes had followed a tradition common in many parts of late thirteenth and fourteenth century Germany (cf. Hävernick, 1931): They had held yearly recoinages, withdrawing the old money from circulation to exchange it at a heavy discount – in their case of 25 percent – for newly minted coins. In effect, they had pursued a rather drastic policy of capital taxation. Now, in 1412, they agreed to abolish this practice. Henceforth, the burghers and magistrates of Brunswick would have the exclusive right "to make and manufacture coins at which time and in whatever quantity they deem to be fit, and with whatever mark and sign may seem convenient to them, which coins shall be current and acceptable in all our lands of Brunswick… The mint shall for ever be and remain to be in the free ownership of our faithful subjects, the council and burghers of our city of Brunswick". A little later it transpired that the city had paid almost 4000 marks of silver – that is, nearly 1 ton – for this privilege (Jesse, 1924, pp. 35 f.).

The contract between the dukes and the city of Brunswick highlights a problem that occupied practically all rulers in the Holy Roman Empire at the close of the Middle Ages and at the beginning of the early modern era: whether, and if so, how to preserve monetary stability.[1] On the one hand, there were strong motives for discretionary behaviour, that is, for tolerating no restraints on the princely right to debase the coinage. Given a limited supply of bullion (which in the late fourteenth and early fifteenth century actually may have been shrinking, c.f. e.g. Day, 1980/87; Munro, 1983; but see Sussman, 1998, for a dissenting view), such debasements – i.e., reductions of the gold or silver content of the coinage – were the only way of how the nominal quantity of money could be extended. Modern governments may pursue comparable policies, hoping to reduce unemployment or trying to depreciate the real value of government debts (Barro and Gordon, 1983, pp.102 f.). In late medieval Germany, rulers had other motives. Due to the stickiness of nominal prices, they were able to make a short term profit from seignorage, which they might need for any number of political or personal reasons (such as wars or marriages, which actually were both political) (cf. Cipolla,

[1] At this time, there were about 500 mints in operation in Germany (Sprenger, 2002, p. 81). The number of currencies was somewhat smaller but still large.

1963, p. 414). Nominal prices would only begin to rise in the medium term, when consumers noticed that the currency was being debased (Sussman, 1993; Sussman and Zeira, 2003). On the other hand, rulers were aware of the fact that monetary instability was harmful, or, as the dukes of Brunswick-Lueneburg put it, they realised "the manifold, lamentable and great damages that we, our subjects … and people … suffered and continue to suffer due to the aforementioned recoinages, and because there is no stable and lasting penny current and usual in our land of Brunswick". In particular, the dukes noticed "that many merchants avoid our lands with their merchandise, because of the loss which they must bear and suffer due to those selfsame pennies [i.e. those hitherto minted], which does great damage to our customs revenues and also to our other affairs" (Jesse, 1924, p. 35). Hence, there were also incentives to accept restrictions and to follow some rule that would help to establish long-term confidence in the coinage.[2]

The starting point of the analysis below is that fundamentally, the problem that late medieval rulers had to solve was one of credibility: If they wanted to prevent revenue losses due to the exit of the owners of mobile factors of production such as merchants, they had to convince consumers that they would not only for the moment supply a stable currency, but would also continue to do so in future. The passage from the contract between the dukes of Brunswick-Lueneburg and the city of Brunswick, which was quoted above, shows that they realised that being able credibly to commit to safeguarding monetary stability would in the long run increase their income, at the same time helping economic performance.

There are, of course, several ways of how money affects the economy. Having a standardised unit to measure the value of commodities and using a general means of exchange saves transaction costs. This, in turn, is in itself important for the size of the market, the division of labour and for productivity gains due to specialisation. However, money can fulfil this function only if its purchasing power is secured (Kasper and Streit, 1999, p. 211). Consumer expectations with regard to the future value of the monetary units they hold affect the demand for money, the willingness to spend and to invest.

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[2] The vast literature on the "rules versus discretion" issue originated with an article by Kydland and Prescott (1977), who showed that due to time inconsistencies, it is unlikely that an optimal policy can be implemented. Some years later (1980), they extended their model with the aim of making it possible to define a benchmark optimal policy with which to compare the time consistent but almost necessary suboptimal actual policy. The literature is surveyed by Ireland (2002).

Studies on the influence of central bank independence on economic performance show that in particular in less-developed countries, there is a close correlation between monetary stability and economic performance (Cukiermanet al., 1993). Hence, the creation of stable price expectations can be seen as a long-term investment by politicians involved in the supply of money. However, as Klein (1974, p. 449) pointed out, particularly politicians whose positions are not secure and whose time horizon is comparatively short face strong incentives not to undertake this investment.

The present article examines the question of if and how late medieval rulers managed to solve this problem, that is, of whether and by which means they were able to commit to preserving monetary stability. The study follows Shepsle's (1991, pp. 247 ff.) distinction between motivational and imperative credibility. A commitment is motivationally credible when subsequently, that is, at the time of performance, the person who committed himself wants to honour that commitment. Put differently, it is credible in the motivational sense because it is incentive-compatible and therefore self-enforcing. On the other hand, a commitment is imperatively credible if the committee is unable to act otherwise. In this case, credibility is given not because of contemporaneous preferences but rather because there is a regular and predictable mechanism that is used to sanction non-performance. Shepsle's distinction is useful as a heuristic means that makes it possible to ask the appropriate questions and to structure the historical material. In actual fact, however, there was a fluid transition between both forms of commitment. It is one of the hypotheses of the present paper that the alternative was not just rules versus discretion, but that under certain circumstances, which need to be examined, even formally unconstrained authorities had an incentive to preserve monetary stability (cf. Barro and Gordon, 1983).

The paper proceeds in two steps. First, in section 2, the mechanisms of credible commitment available to late medieval rulers are examined. Here, motivational credibility is examined first. Where and in how far imperative credibility really differed from it will become obvious when it is discussed subsequently. In the second step (section 3), the analysis explores the consequences of credible commitment to monetary stability for the efficiency of financial markets. Here, a new approach to estimating financial market efficiency in general and financial market integration in particular is used. The final section (4) contains a summary of the findings of this study.

2. Committing to stable money

2.1. Motivational credibility

Commitment situations are fundamentally instances of exchange based on explicit or implicit contracts. In today's models, the exchange takes place between a policy maker who is responsible for the supply of money, and consumers who demand it and who pay taxes in return. For the supplier, reneging on the contract means setting an inflation rate that exceeds the consumers' expectations. For the consumers, it means evading taxes or simply exiting the policy maker's jurisdiction. The situation is structured like a prisoners' dilemma, and as it is repeated and the time horizon is infinite, the actors' interest in their reputation is sufficient to allow a cooperative equilibrium to emerge, if the policy maker's discount factor is high enough (Barro and Gordon, 1983, pp. 108 ff.; Lohmann, 1998, pp. 9 f.).

Medieval conditions differed in a number of important respects from modern ones. As mentioned above, feudal rulers could reap short-term windfalls from increasing the seignorage, their incentive to renege being thus more direct and personal than that of policy makers today. Medieval consumers, on the other hand, had in principle more options than their modern counterparts if they wanted to defect or to put pressure on a ruler whose defection they had observed. Apart from evading taxes, they could attempt to evade customs or simply refuse to accept the currency that was locally provided, which in effect meant to exit to a different supplier (cf. Hirschman, 1970). In order to examine how viable these alternatives were, it is useful to briefly turn to the position of the rulers, which was summarised by Schumpeter (1991, p. 102):

> "The fourteenth- and fifteenth-century prince … was confronted by the solid position of the estates, that is primarily the nobility of various degrees, to a lesser extent the clergy, still less the burghers of the towns, and finally and least important, the remains of free peasantry…. The position of the prince … consisted merely of a sum of the rights of dukes, counts, various feudal officials, land-owners, etc., as did the rights of all other land- and relatively independent allodial lords…. The prince owned his sum of rights and positions of power for his own benefit…. So far as the economy of the prince was concerned, it followed that he had to meet all the expenses of any policy which was his private affair…."

Given these conditions, any feudal ruler who wanted to raise taxes, which they increasingly tried in the fifteenth century, needed not only the consent of his estates, but also their cooperation that had to make up for the lack of an administrative apparatus of his own. Consequently, raising taxes was so expensive that they played a minor role in the budget of most late medieval territorial lords. Customs revenues were more important, in particular in the western regions of the Empire that straddled the great axis of European trade between Italy and the Netherlands (Droege, 1966, pp. 153, 157). Evading customs, however, was difficult: Usually customs posts were not positioned on the vaguely defined borders between territories but at places that were costly to circumvent, such as river crossings, mountain passes or ports. Whether customs evasion was possible depended on geographical and political conditions; other things being equal, trade would find it the easier to avoid a territory the smaller it was (the duchy of Brunswick-Lueneburg was evidently small enough).

The third option, the refusal to accept a ruler's money, gives a different picture. Because of the transaction costs savings that the use of money involved, consumers would not have been willing to give up using money altogether, but would have looked for substitutes for their local currency. If their actual or threatened exit to some other supplier of money was to enable the local ruler credibly to commit himself to preserving monetary stability, a number of preconditions needed to be given. In the first place, substitutes had to exist, that is, there had to be competition in the money supply.

The competitive supply of money has been extensively discussed in the literature on monetary theory (Klein, 1974; Hayek, 1976). While older analyses claimed that money can not be supplied under conditions of unregulated laissez-faire without leading to an infinite price level, i.e. to hyperinflation, Klein (1974, pp. 426 f.) showed that this view was based on the implicit assumption that firms would produce identical and undistinguishable forms of money. If each supplier would instead produce a distinct and distinguishable currency, and if these circulated side by side at flexible market exchange rates, there would not be one general price level but rather several levels in terms of the particular currencies. Conditions in fourteenth- and fifteenth-century Central Europe closely corresponded to Klein's model. At that time, any kind of bullion-based money was in principle acceptable anywhere, at the discretion of the consumers. For example,

Bohemian silver groats were widely used all over Poland and Prussia,[3] while coins jointly minted by the Hanseatic cities of Luebeck, Hamburg, Lueneburg and Wismar were current not only in their home towns and in the region in between, but in all North-Western Germany (Stefke, 1995, p. 126). Gold, in particular, often circulated far from home. Thus, in the fourteenth century, the Florentine florin was used all over Western Europe (Berghaus, 1965), while the Hungarian ducat played a similar role in East-Central Europe (Huszár, 1970-72). In the fifteenth century, the rhinegulden, struck by the archbishops of Cologne, Mainz and Trier and by the Count-Palatine on the Rhine, was current in practically all Germany (Weisenstein, 2002).

The production and side-by-side circulation of distinct types of money is a necessary but not a sufficient condition for competition between currencies to allow rulers credibly to commit to monetary stability. As Hayek (1976, pp. 58 ff.) pointed out, consumers must be well-informed about the purchasing power of the monetary units of the various currencies that circulate at the same time. If this is not the case, they are unable to choose between currencies and to select the one with the highest purchasing power for their day-to-day transactions. Under modern conditions, where information costs are low and fiat money dominates, this requirement may arguably be fulfilled by e.g. placing different and easily distinguishable price tags on the goods consumers demand. However, under late medieval conditions – characterised not only by the use of commodity money, but also by high information costs – matters were more complicated. Under such conditions, the costs consumers had to bear in order to acquire information about their alternatives were often prohibitive, and most importantly, they were not the same for all agents on the market.

In models that capture modern conditions, consumers are usually assumed to be homogeneous, meaning that all are equally able to assess the value of the money supplied by the policy maker and to detect his defection (cf. Barro and Gordon, 1983). A similar assumption is often made with regard to the Middle Ages. Rolnick et al. (1996), for example, claim that consumers were aware of the intrinsic value of money, which they used by weight. However, late medieval conditions rather suggest a rough distinction between two groups of agents (cf. Sussman and Zeira, 2003, pp. 175 f.). On the one hand, there was the majority of the population: people who were illiterate and

[3] An early fifteenth-century source from Prussia states that "according to the [Bohemian] groat, any merchant determines the price of his commodities in gold and silver" (Töppen, 1878, p. 266).

probably did not handle money on a day-to-day basis. As coins circulating at that time were not marked with their nominal values, and as even those belonging to the same currency and having the same nominal value were not exactly identical, these consumers tended to value all monetary units at 1:1 that looked superficially similar and had roughly the same weight. Put differently, they used money by tale. On the other hand, there was a small group of agents, not only professional moneychangers, but also merchants, who went by weight, that is, who had the specialised knowledge to distinguish those units whose content of bullion was higher and to withdraw them from circulation. In 1539, the council of Hamburg gave a vivid description of how such practices endangered the local currency. Here, it was Danish small change that was difficult to distinguish from the money jointly issued by the cities of Luebeck, Lueneburg, Wismar and Hamburg, whose council complained that

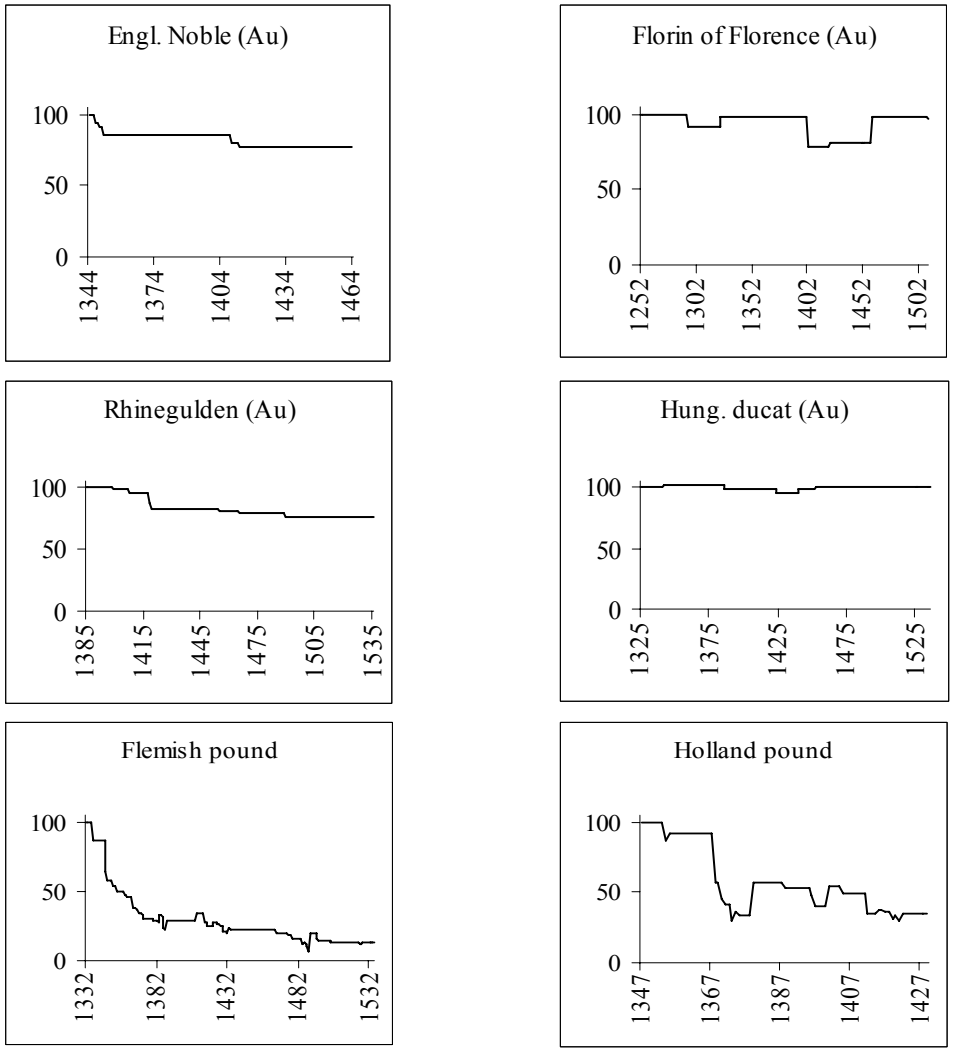
> "several burghers and inhabitants of this city bring whole tons and sacks of underweight three- and sixpenny pieces and other coins from outside into this city, and use these to buy up and export the cities' good shillings, talers, mark pieces and other good coins, thereby looking for their own advantage and acting against the common weal, to the detriment of all good money" (Bollandt, 1960, p. 322).

Gresham's law, that is frequently claimed only to hold for monetary units whose exchange rates are legally fixed (Hayek, 1976, p. 35), could therefore operate on the late medieval money market even when no political authority tried to impose exchange relations. Consequently, despite the side-by-side circulation of different currencies, suppliers of money could behave *as if* they had a monopoly and *as if* consumers had no exit option. Under these conditions, rulers could hardly credibly commit to monetary stability.

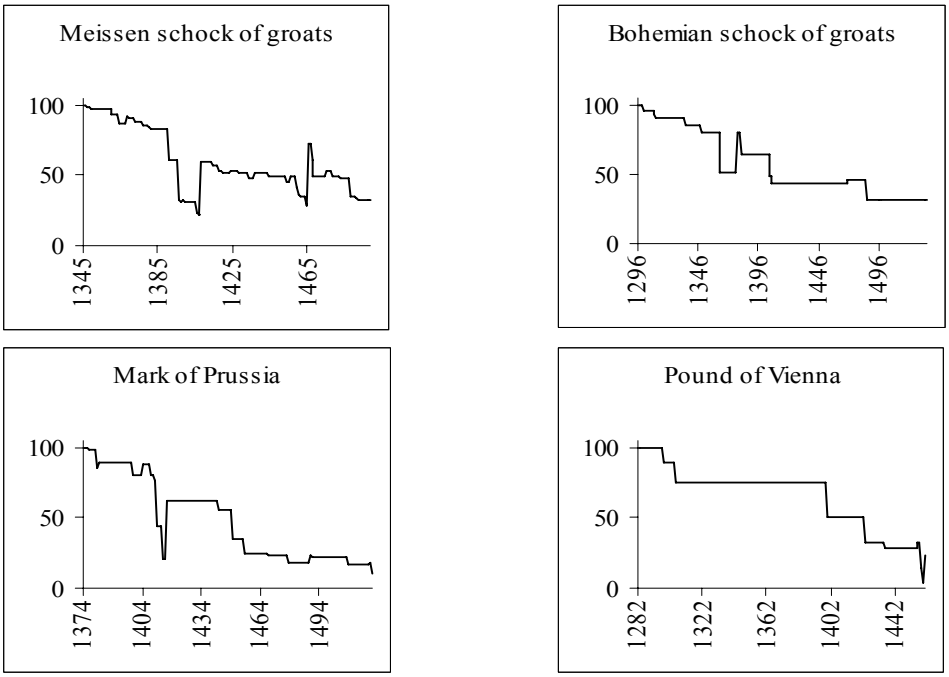
There was one final important difference between medieval conditions and those assumed in modern models: Today, each central bank supplies just one distinct currency. In late medieval Germany, this was not necessarily the case. Many rulers did not only provide silver money, but additionally gold. Both circulated side by side (usually at flexible rates), but they fulfilled different functions and were demanded by different (though partly overlapping) groups of consumers. Gold was predominantly used by merchants active on international markets and in long-distance trade, while silver dominated small-scale exchange and local markets (Spufford, 1991, p. 283). As long-distance merchants were better informed about monetary standards than the average

customer on local markets, having a good notion of the fine gold content of the coins struck by rulers, they could refuse to accept gold-based currencies that they regarded as instable. Information on devaluations being easily accessible to the small number of persons involved, reputation should have been sufficient as a mechanism to ensure the rulers' compliance with the implicit contracts that linked them and the merchants. Put differently, it should have been easier for rulers to commit to the preservation of monetary stability where their supply of gold was concerned. This hypothesis is supported by the data shown in figure 1.

Fig. 1: Debasement of gold and silver, index (earliest documented value = 100) [4]



[4] The data on which the figure is based are accessible at http://www2.wiwi.hu-berlin.de/institute/wg/volckart/hist_data.html.



The graphs indicate that while silver currencies were occasionally reinforced, gold was much more stable. The four gold units included, i.e. the English noble, the Florentine florin, the Hungarian ducat and the rhinegulden, suffered a yearly loss of on average about 0.1 percentage points of their original gold content. By contrast, the silver currencies, that is, the pounds of Flanders, Holland and Vienna, the schocks of groats from Bohemia and Meissen, and the mark of Prussia, lost c. 0.5 percentage points of their silver content per year. This confirms the argument made above, i.e. that feudal rulers were much better able to commit to monetary stability where gold was concerned. Here, their commitment was motivationally credible: They themselves were interested in issuing stable units of gold because the most important group of consumers – merchants who used this gold in international transactions – were able at low costs to acquire information about changes in the standard of the coinage, and to refuse to accept debased gold. Thus, in contrast to modern conditions, where reputation-based cooperative equilibria can emerge, in the late Middle Ages this was possible only to a limited extent, i.e. only as far as gold was concerned.

2.2. Imperative credibility

While in most parts of Europe gold dominated long distance commerce, there were regions where it was used sparingly. English gold nobles, for example, did penetrate the Baltic area – as did other types of gold coins notably from France and the Netherlands – but here, silver was used more often in long-distance commerce (Spufford, 1991, pp. 282 f.). In North Germany, merchants kept using stamped silver ingots in parallel to

silver groats from France, Bohemia or Meissen for large scale transactions well into the fifteenth century (Jesse, 1952, pp. 39 ff.). And everywhere international merchants, who were accustomed to using gold in transactions among themselves, had to handle silver when they did business with local traders or engaged in retail sale. Hence, the importance silver money had for large-scale and long-distance commerce should not be underrated.

As a matter of fact, the difference between commitment regarding the issue of stable silver and gold was not fundamental but rather one of degree. Merchants who used silver for large-scale transactions could react to the supply of debased units of this metal just as they could react to the supply of debased gold. They could, for example, evade customs, as in the relatively small duchy of Brunswick-Lueneburg at the beginning of the fifteenth century. Still, on its own the fact that merchants, who were unhappy with the money supplied by the local ruler, did have an exit option was insufficient to enable the dukes to commit credibly to preserving the stability of their silver money. In such cases, the group of consumers using the coins was not only larger than in the case of gold, but consisted of different actors, i.e. of individuals who were unable to distinguish coins with a high content of fine silver from debased pieces. Consequently, a ruler who reneged on his implicit contract with the consumers, that is, who secretly reduced the standard of the silver coinage, would still be able to find buyers for his inferior product. Under such conditions, reputation would not be an effective enforcement mechanism, so that he had to find a way to bind himself if he wanted to credibly commit to monetary stability.

Involving an independent authority in the management of the currency was the solution most feudal rulers came up with. Thus, in 1380 the grandmaster of the Teutonic Order that ruled Prussia decided to introduce a formalised procedure of control, which was supposed to increase confidence in the coinage he produced in his mint at Thorn: “And if the burghers were present at the inspection and emission of the money we would be pleased to see that, so that in all things one might be the surer and more certain” (Volckart, 1996, p. 396). Further west, urban rights of control had been established earlier, going in some cases back to late antiquity (Berghaus, 1964, p. 77; Nau, 1964a, p. 145, cf. table 1 below). A ruler who granted such rights did not directly commit himself to preserving the established standard of the coinage, but rather to publicising any changes of this standard. In other words, urban control of a princely mint was a means of spreading information about whether the ruler reneged on the implicit contract

between him and the consumers who used his money. Due to this information, reputation could function as a commitment device, allowing individuals, who otherwise would not have been able to detect clandestine debasements, to credibly threaten to exit to a more reliable supplier.[5] This, in turn, gave the rulers an incentive to comply with the contract. Hence, granting rights of control to the cities allowed princes to commit to monetary stability, even though their commitment was indirect and probably relatively weak.

A more credible commitment required stronger measures, i.e. the establishment of an authority that was not only independent and had the right to supervise the coinage, but that could take over the entire management of monetary policies. This is the solution chosen by the dukes of Brunswick-Lueneburg in 1412. As usual in the Middle Ages, they did not create a costly new bureaucratic apparatus but made use of an organisation that already existed: They transferred the right to emit their currency to the largest and most influential city within their territory. Giving up their right to meddle with the coinage was the strongest conceivable means to restrict their future scope of action. The dukes would not only never again have the chance to profit from debasements, but would also acquire a strong interest in monetary stability – after all, some of the coins struck by Brunswick would find their way into their coffers through the payment of customs and other dues. In fact, transferring the right to issue the currency to an independent body, such as a town, was functionally the equivalent of establishing an independent central bank. Of course the huge differences between conditions in the Holy Roman Empire in the fourteenth to sixteenth centuries and e.g. England in the late seventeenth century, where the first independent central bank was created, need to be given due consideration. Still, the mechanism analysed above allowed late medieval rulers credibly to commit to monetary stability in much the same way as the foundation of the Bank of England allowed the English government to commit to the repayment of its debts (cf. North and Weingast, 1989).

Still, this solution to the credibility problem posed two problems of its own, both of which have parallels under modern conditions. For one thing, as Lohmann (1998, p. 11) pointed out: "If the policy maker cares strongly about the future, she can directly commit herself to the ex ante optimal monetary policy path. So why would she bother

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[5] Milgrom, North and Weingast (1990) show that in the absence of third party enforcement, facilitating the spread of information about defaulters allows agents on otherwise anonymous markets credibly to commit to contracts. Cf. Greif (2005, pp. 733 f.).

making institutional commitments…?" In other words: where is the difference between committing to upholding monetary stability in the first place and committing to respecting the independence of the central bank – or, in the present case, the exclusive urban right of coinage –, once this has been established? Political actors in the late Middle Ages were fully aware of this problem. Thus, when dukes Otto and Bernard of Brunswick-Lueneburg concluded their contract with the city of Brunswick, they had to promise that neither they themselves nor their "heirs and successors (would) … set up, hold or have another mint, nor allow others to do so in any way in our lands of Brunswick" (Jesse, 1924, p. 35). However, in the absence of any effective third party enforcement, what mechanism ensured that the dukes complied with this clause of the contract? In fact here reputation was again crucial, allowing *public* commitment to a rule (Lohmann, 1998, p. 15). This commitment would be effective even though the supply of silver was concerned, and the number of consumers was greater and their ability to acquire information smaller than in the case of the issue of gold. The difference was that once an exclusive minting right had been transferred to a city, any defection by the ruler would be much more obvious. If the ruler, being the only local supplier, clandestinely reduced the standard of his silver coinage, most consumers would realise this only after some time. By contrast, if a ruler, having renounced his right of coinage in favour of a city, began to issue money again, even illiterate consumers would notice this – except, of course, in cases where the ruler's coins were so close imitations of those struck by the city that he was, in effect, committing an act of forgery. Still, even then he had to buy the necessary raw materials, which would raise distrust if he did it locally, or involve high costs if he tried to import them on his own. Thus, the transfer of the right of coinage from a feudal ruler to a city amounted to the establishment of a mechanism that would make information about the ruler's defection readily available, thus allowing him credibly to commit to respecting the stability of the local silver coinage.[6]

Dukes Otto and Bernard were not the only feudal rulers to transfer the right of coinage to a city within their territory (cf. Berghaus, 1964). Table 1 and the map on page 16 (both of which do not claim to be comprehensive) give an impression of how often this expedient was used. In the table, cities frequently appear several times due to the fact

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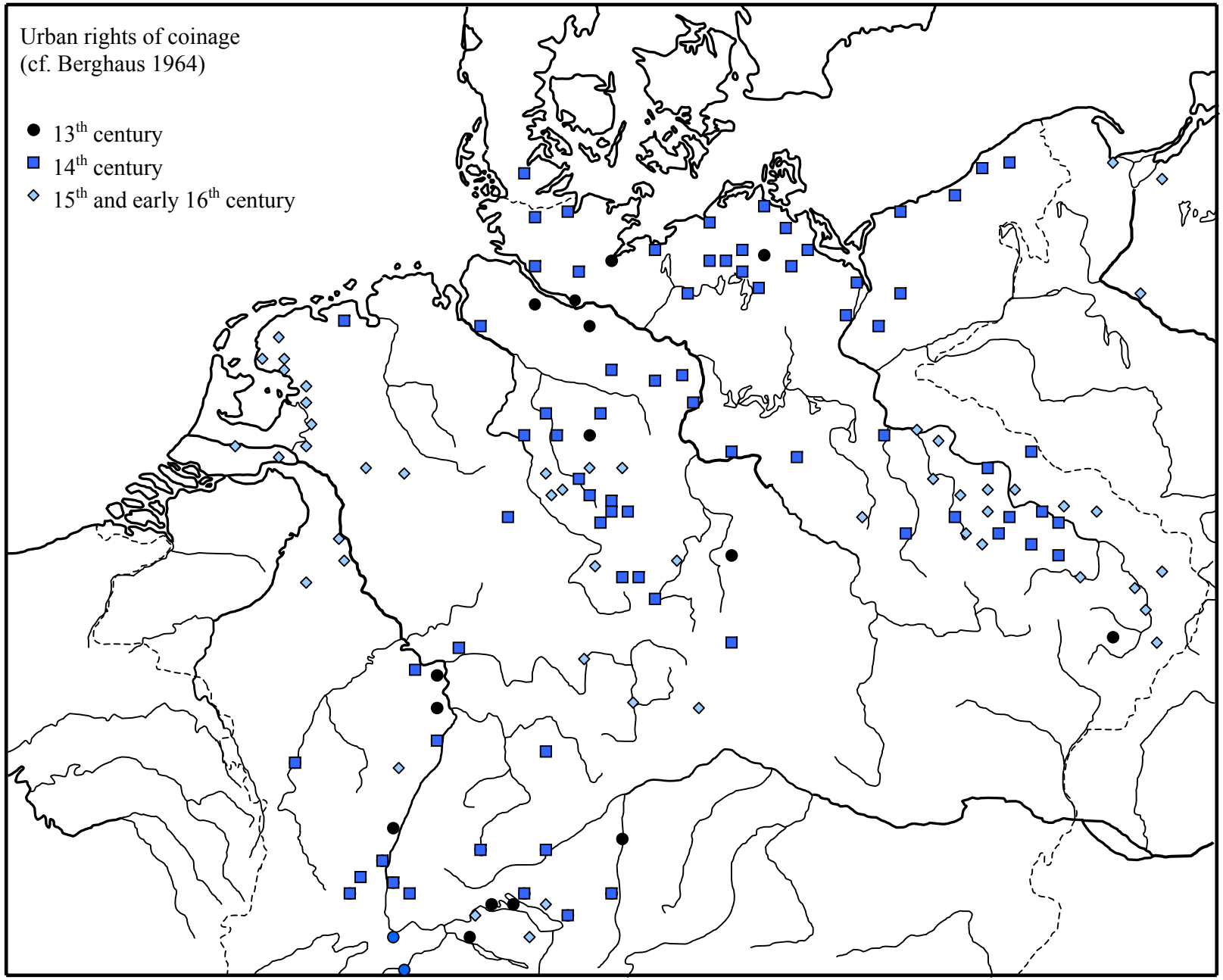
[6] There is a broad literature on the importance of information for the establishment of cooperative equilibria in prisoner dilemma situations. Important contributions were made by Kreps et al. (1982) and Milgrom, North and Weingast (1990).

that they began by acquiring either temporarily or functionally limited rights relevant for the supply of a currency, later leasing the mint, and only in the last stage definitely buying it. The fact that cities were prepared to pay for their privilege was of course an additional incentive for rulers, since it made the sale of the right of coinage doubly attractive, especially when being in need of short term funds.

Table 1: Urban takeovers of minting rights (Nau, 1964b, pp. 148 ff.; Jesse, 1952; Volckart, 1996).

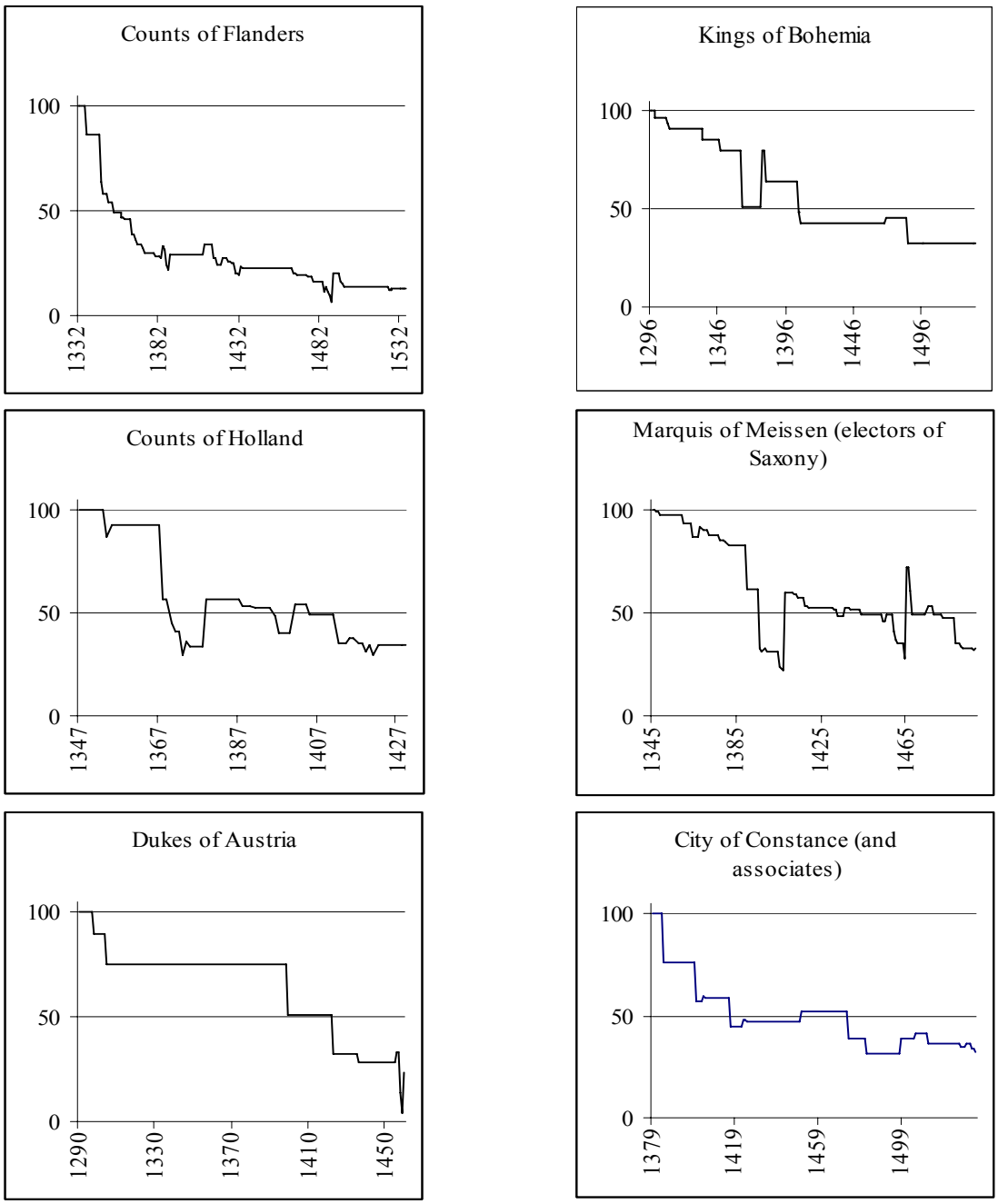
		temporary minting right (pledge, lease)		indefinite minting right (purchase)	
period	urban control of standard	granted by the king	granted by a prince	from the king	from a prince
1225-1249	Constance, Hanover, Strassburg, Hameln		Schaffhausen, Zuerich, Worms (for 10 years)	Luebeck (for silver), Hall	
1250-1274	Cologne	Altenburg, Stade, Augsburg (for 3 years), Oppenheim (for 10 years)			Stade
1275-1299	Brunswick	Augsburg, Constance (for 10 years)	Strassburg (for 4 years), Hamburg	Goslar	Lueneburg and the estates of Brunswick-Lueneburg, Strassburg
1300-1324	Hildesheim, Bremen	Schaffhausen, Lindau, Strassburg	Hamburg, Brunswick		Salzwedel, Hanover and the estates of Brunswick-Lueneburg, Kiel
1325-1349	Erfurt, Halle	Frankfurt (for silver)	Zuerich, Brunswick	Schongau, Luebeck (for gold), Speyer (for heller)	Hamburg, Greifswald, Anklam, Stralsund, Rostock, Northeim, Stettin
1350-1374	Nuremberg, Rottenburg, Dillingen, Stuttgart, Goeppingen, Oettingen		Mainz, Bremen, Basle	Breslau (for heller)	Rottweil, Goettingen
1375-1399	Thorn		Solothurn	Colmar (for pennies), Hall (for pennies), Ulm (for pennies)	
1400-1424	Frankfurt (for gold)	Frankfurt (for gold), Noerdlingen (for gold)	Ueberlingen, Lindau	Ulm (for shillings), Lucerne, Fribourg, Nuremberg	Einbeck, Brunswick
1425-1449			Thorn (for 10 years), Danzig (for 10 years)	Zuerich, Frankfurt, Lueneburg, Hamburg, Ravensburg, Jena, Hildesheim	Hameln
1450-1474		Graz	Helmstedt	Thorn, Danzig, Elbing	
1475-1499				Cologne, Constance	
1500-1524				St. Gallen, Worms, Rottweil, Kempten, Ratisbon, Augsburg	
1525-1549				Donauwoerth, Kaufbeuren, Bremen	


Urban rights of coinage
(cf. Berghaus 1964)
13th century
14th century
15th and early 16th century

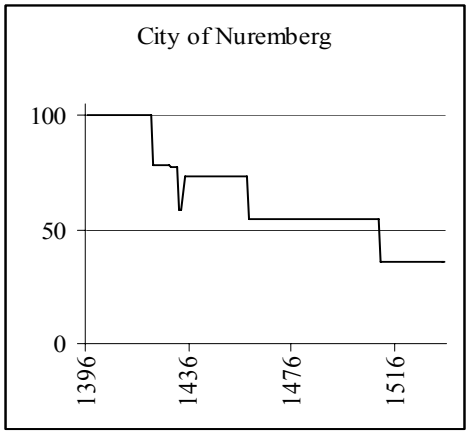
The second problem that emerged with the transfer of the right of coinage concerns the reliability of the central bank, that is, under medieval conditions, the behaviour of the magistrates of a city that had been granted a mint. The question is under which conditions such an independent body would itself be willing to commit to monetary stability (cf. Ireland, 2002, p. 10). It might seem that the transfer of the right of coinage would just amount to moving the commitment problem to a lower level. After all, urban councils faced similar incentives to debase the currency, frequently suffering from raising expenditures and accumulating deficits (Berghaus, 1964, p. 83; Dhont, 1964, pp. 354 f.). To be sure, they were not immune to the lure of debasements. However, committing to the preservation of monetary stability posed a less serious problem to councils than to princes. For one thing, most councils were dominated by patrician elites that were composed either of merchants or of ex-merchants who had acquired landed property, living off rents paid by their peasants. Export-oriented producers who might have been interested in devaluations were usually not represented (Wensky, 2002). Therefore, the members of most councils would not individually have benefited from the circulation of debased money. Also, in contrast to a feudal ruler, none of them could have made a personal profit by increasing the seignorage. Furthermore, because it was not a single actor such as a prince who decided about monetary policies, but rather a group of people, the costs of making decisions about changes of the standard of the coinage were comparatively high. Finally, urban councils had to take the mood of their citizenry into account. Unpredictable and violent reactions to the decisions concerning the coinage would hit them much more directly than they would hit a feudal prince, living safely in his castle. This is what happened in Brunswick in the later fifteenth century, when the council took some drastic measures in monetary policies. The consequence was a large-scale uprising where the rioters chanted “mint master – head off” (Bote, 1880, p. 427). Thus, here too, reputation was at the heart of the matter.

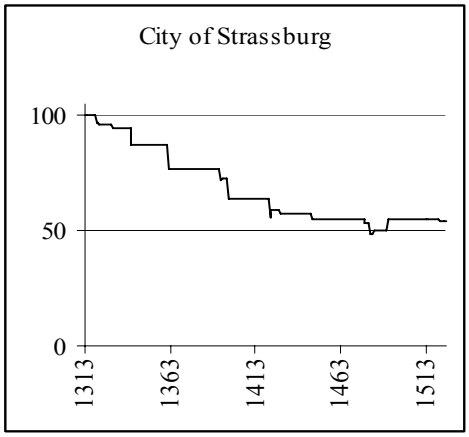
To summarize, there were several mechanisms which should have allowed councils credibly to commit to the preservation of monetary stability – more credibly than princes, at any rate. Urban currencies should consequently have been more stable. Ignoring cases where cities just had the right to supervise princely mints, and concentrating on the distinction between currencies issued by feudal and urban authorities, the data suggest that this was indeed the case.

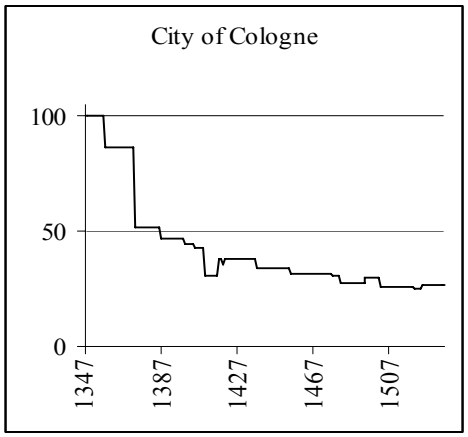
Fig. 2: Debasement of currencies issued by feudal and urban authorities (index, earliest documented value = 100)[7]

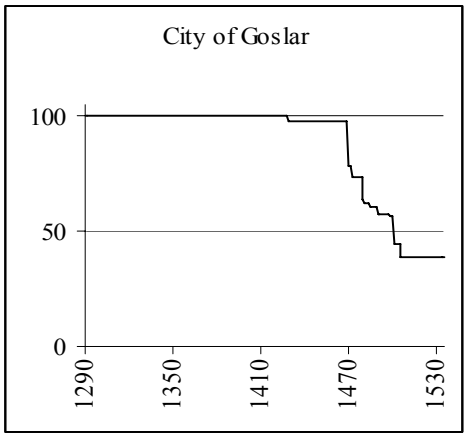


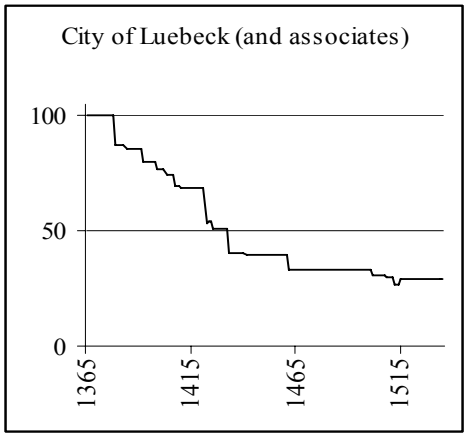
[7] The data on which the figure is based are accessible at http://www2.wiwi.hu-berlin.de/institute/wg/volckart/hist_data.html.

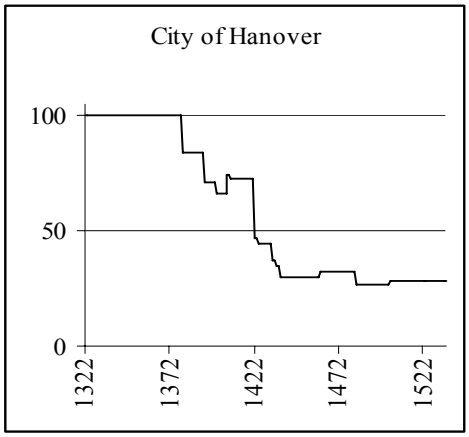












There were of course many more Central European authorities who issued their own currencies, but as yet information on changes of the monetary standards is too scanty to provide more than the sketch presented above. According to these data, feudal silver currencies lost on average about 0.49 percentage points of their content of bullion per year. By contrast, urban currencies lost only about 0.37 percentage points. The difference is not nearly as large as the one between gold and silver, which was discussed above. Still, market performance suggests that contemporaries at least assumed that transferring the right of coinage to a town would help to stabilise the currency. This issue is the subject of the following section.

3. Urban monetary autonomy and the efficiency of financial markets

3.1. The Method

If granting the right to issue the currency to a city was functionally equivalent to establishing an independent central bank, as was suggested in the previous section, the consequences for the efficiency of financial markets – that is, of markets where agents traded either currencies or substitutes for hard money, such as bills of exchange – should have been similar: Markets should have been more efficient in cities that could pursue their own monetary policies than in cities whose policies were determined by some feudal lord. The efficiency of pre-modern financial markets is rarely analysed in a quantitative way. Neal (1985; 1987), for example, examined early eighteenth-century English and Dutch stock markets. Schubert (1988), who used exchange rates and fees paid for bills of exchange, managed to extend the analysis into the late seventeenth century. As it is usually assumed that due to the paucity of data, it is impossible to go further back in time, most authors who discuss earlier times confine themselves to making qualitative statements (Denzel, 1996).

However, there is a simple approach to this issue which suggests itself under a commodity money system such as that which existed in late medieval Germany and her neighbours. This approach draws on the literature on market integration, starting out from the assumption that a better integration of financial markets is evidence of a higher degree of efficiency. Integration studies commonly make use of the law of one price (cf. Kindleberger, 1989, pp. 67 ff.). They are based on the comparison of prices paid at different localities, treating prices that are similar or that at least move in step with each other as indicators of well-integrated markets, whereas spreads between prices indicate a lack of integration. This approach can be used in the present context because late medieval merchants tended to treat money just as any other commodity. A telling description of how they profited from arbitrage on the money market is given in a treatise written by the chronicler Hermen Bote from Brunswick, where in the late fifteenth century ill-advised council measures set off a speculative craze. According to Bote,

> "the merchants were the first to take up this occupation: They traded and bought money for money or goods that were bullion and silver, and in this way became exceedingly rich people, until at last the common burghers learned this trade, too: whoever had a good silver penny or a gulden of full weight solely looked for his

> advantage. Until at last the peasants, too, learned this, so that no good penny, groat or gulden would stay in circulation: whenever one appeared it was withdrawn" (Bote, 1880, p. 410).

Bote described an extreme case, but profiting from arbitrage on financial markets was common in the late Middle Ages. In fact, the Holy Roman Empire with its large number of currencies provided an almost ideal environment for such transactions. Unsurprisingly, therefore, account books kept by merchants or political authorities and other sources contain an abundance of exchange rate notations which can be used in order to examine how efficient financial markets were. This can be done by combining data on exchange rates between currencies based on gold and silver with data on the monetary standards in order to determine local gold-silver ratios. When these ratios are interpreted as prices paid on local financial markets, the approach based on the Law of One Price can be used: Gold-silver ratios which were similar between several localities indicate well-integrated markets, whereas differences between local ratios show that opportunities for arbitrage existed that were not exploited, the market being consequently relatively inefficient.

The problems involved in this approach have elsewhere been discussed in detail (Volckart, 2006, pp. 14 ff.). Here it is therefore sufficient to briefly summarize them and to show how they can be solved. To turn first to exchange rate notations, it should be pointed out that they were based on several types of transactions (cf. Spufford, 1986, pp. l f.): The most elementary one was manual exchange, that is, the simultaneous and on the spot exchange of coins of different currencies. A more sophisticated kind of exchange made use of bills, which developed during the high Middle Ages. And finally, there were official rates that were determined or imposed by political authorities not only for domestic, but occasionally even for foreign gold. A broad literature exists where such rates, particularly those based on the nominal values of domestic gold coins, are used as a basis for calculating gold-silver ratios (e.g. Watson, 1967; Lane and Mueller, 1985, pp. 324 f.). Harry Miskimin (1985/89, pp. 148-51) forcefully argued against this approach, claiming that Renaissance princes were seldom able to enforce the circulation of their gold at its nominal par value. Hence, politically imposed exchange rates are excluded from the analysis, whose focus is on market rates.

As for exchange rates found on bills, two points should be noted. On the one hand, they may contain a hidden interest rate. Hence, there may be a systematic difference between

them and the rates paid in manual exchange (cf. de Roover, 1968, pp. 32 ff.). On the other hand, it has sometimes been claimed that already by the fourteenth and fifteenth centuries, bills and other credit instruments constituted an important part of the money supply (Henning, 1981). If this was the case, their bare existence would have influenced rates of exchange. Still, as long as bills were not freely negotiable, their prices was not completely independent from manual exchange rates. There is no evidence that the endorsement of bills was practised in anywhere in Germany in the fourteenth, fifteenth or early sixteenth centuries; in fact, negotiability was a development of the seventeenth century. Apart from this, too few bills of exchange are preserved to make it possible to identify a systematic difference between exchange rates stated on them and those based on manual exchange. Hence, it seems acceptable to use all quotations indiscriminately.

A more serious problem is posed by the ambiguity and lack of clarity of the sources. Often enough, the merchant or official or whoever authored the document, where the quotation is found, did not bother to clearly define which kind of gold coin the exchange rate actually applied to. Changes of the standard of the gold or silver coinage, also present a problem. If an exchange took place shortly after such an alteration, it is often impossible to determine whether the coins that changed hands were newly minted or had already circulated for some time. Here, the same assumptions were made as in Nikolaus Wolf's and the author's (2006) recent paper about silver exchange rates: Debased coins dominated circulation more quickly than re-enforced ones, and older coins continued to circulate abroad for a longer time than at home, where they had been minted.

Even if it is known which types of coins were exchanged, it is difficult to determine their content of specie. The principal class of sources that contain the relevant information are mint ordinances and contracts concluded between the authority that issued the coins and the mint master. Usually, such documents defined the fineness of the alloy from which money was to be coined, and the number of coins to be drawn from a specified quantity of that alloy. They could be straightforwardly interpreted if it were not for several obstacles. For one thing, in some cases there is no clarity about the exact metric equivalents of the units of weight used between the fourteenth and sixteenth centuries. For another, the ability of medieval and early modern mint technicians to make chemically pure gold and silver has been questioned (Miskimin, 1963, p. 31; Jesse, 1928, p. 160). The 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 anyway 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. 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 rely on 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 of them 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 final problem is posed by the fact that, once in circulation, money became worn down and defaced. For silver, losses due to wear and tear have variously been estimated to lie between 2 and 2.75% per decade (Mayhew, 1974, p. 3) and between 0.25 and 0.87% per year (North, 1990, p. 108). Although losses and wear and tear influenced the amount of specie in circulation, and therefore probably affected the price level, as far as exchange rates are concerned, their effect was less important. Presumably, coins made of both metals suffered alike from defacement, so that its effects on gold and silver cancelled each other out.[8] Still, for this reason, too, a margin of error is unavoidable.

Fortunately, there is a group of sources that helps to minimise such errors. Many late medieval and early modern authorities had foreign money assayed more or less regularly (cf. Ropp, 1878, pp. 223 f.; Cahn, 1895, pp. 169 ff.; Munro, 1972, p. 212 ff.). The interpretation of medieval assays is, of course, problematic due to uncertainty about the metric equivalents of ancient units of weight, but if these sources are checked against the results of modern chemical tests (cf. Grierson, 1981; Kubiak, 1986), it is possible to derive a clear enough picture of how much gold and silver really changed hands when money was exchanged.

When all problems involved in determining the specie content of the coins in circulation have been solved, it is necessary once again to turn to the way prices of gold and silver coins developed. Some of them, for example the Florentine Florin, the English Noble or the Hungarian Ducat, were more popular than others, so that buyers were willing to pay

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

a premium. Hence, gold-silver ratios that are determined for one place, but on the basis of different types of coins are not necessarily alike. There are two ways to solve this problem: Either, and this applies to the fourteenth century for which data are scarce, the yearly mean value of all ratios that can be found is established. Alternatively, when circulation was dominated by a single type of gold coin, as for example in Hamburg since the middle of the fifteenth century when the Rhinegulden was the most popular type of gold, the yearly ratios based on this are used and all others are ignored.

The analysis presented in the next section is based on c. 6100 exchange rate quotations – i.e. gold-silver ratios – from altogether 25 cities, most of which lay in the Holy Roman Empire. Some were in neighbouring countries such as France, Flanders, England, Prussia and Poland, but were linked by strongly frequented trade routes or intensive exchange relations to cities within the empire.[9] Theoretically, 25 cities give 300 city-pairs between which spreads between gold-silver ratios can be measured. As the analysis covers 210 years, the earliest observation being from 1352 and the latest from 1562, there should be a total of 63,000 observations. However, there are only a few cities where the sources yield so many exchange rate notations that the time series are a more or less unbroken: Cologne, Basle, Hamburg, and some other places where the series extend at least over a couple of decades, such as Schaffhausen or Nuremberg. Hence, the number of city-pairs is reduced to 176 and the number of yearly observations of exchange rate spreads to c. 2000.[10]

3.2. Analysis and Results

The hypothesis tested in this section is that markets between cities, which could themselves determine their monetary policies, were better integrated and hence more efficient than markets between cities whose policies were determined by a feudal lord. In order to show how it is possible to undertake this test, it is useful briefly to consider the approach described above from a slightly more formal point of view.

The exchange rate of some type of gold coin sold at a specified locality L for silver money can be defined as $E_L = \frac{kC_S}{C_G}$, where *k* represents the nominal sum in some silver

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[9] Amsterdam, Antwerp, Avignon, Basel, Bremen, Bruges, Cologne, Constance, Danzig, Elbing, Freiburg, Gnesen, Hamburg, Koenigsberg, Leiden, London, Luebeck, Lueneburg, Marienburg, Nuremberg, Reval, Schaffhausen, Stuhm, Thorn and Vienna.

[10] The data are accessible at http://www2.wiwi.hu-berlin.de/institute/wg/volckart/hist_data.html.

currency (C_S) which equalled one gold coin (C_G). The par ratio between gold and silver is given by $R_L = \frac{kC_S S}{C_G G}$. Here, S is the silver equivalent of the unit of account to which the silver coins belonged, i.e. the amount of silver contained in the notional unit of reckoning (usually the pound or mark). G is the fine gold content of the gold coin. A local gold-silver ratio is the average of the par ratios found per year (i.e. R_L'), subject to the restrictions described in the previous section. Spreads between such aggregates are therefore given by $\Delta = \left| R_L' - R_{Ln}' \right|$. As shown above, large spreads indicate weakly integrated and inefficient markets, whereas small spreads show that the markets where the ratios were measured were well-integrated and efficient.

In the model which is used to test the hypothesis, the logarithm of these spreads is the dependent variable. Among the independent variables, an autonomy-dummy variable takes first place. This dummy takes the value of 1 if both cities between which the spread was measured could determine their monetary policy on their own; else it takes the value of 0. In principle, it would be desirable to take other forms of urban influence on the territorial supply of money into account, too, that is, to introduce for example a dummy that captures the urban control of the standard of the princely coinage. However, in many cases it is impossible to know for how long the agreements were in force, which gave cities the right to supervise the rulers' mint. By contrast, determining whether a town had acquired the right to issue its own coinage is easy, last but not least because there is physical evidence in the form of urban coins that can be dated more or less closely.

There are a number of further variables that need to be taken into account. Thus, integration studies usually stress the importance of transportation costs. Whether and to what extent these costs fell during the period here considered is not clear. On the one hand, van der Wee (1963, p. 327) points to technical innovations in maritime transport, which imply that costs fell. Menard (1991), on the other hand, argues that a 'transport revolution' did not take place, fright charges in the eighteenth century being only slightly lower than in the high Middle Ages. As for overland transport, Munro (2001, p. 27) claims that due to an increase in peace and security and to organisational innovations such as the emergence of specialised cartage firms, the costs of overland transport probably decreased from at least the middle of the fifteenth century onwards. According to Spufford (Spufford, 2002, p. 19), however, cartage firms were an essential

component of the commercial revolution of the high Middle Ages, being thus long in place by the fourteenth century. Also, while in Western Europe peace and security may have increased with the end of the Hundred Years' War, in Central Europe the 100 years after 1450 were not necessarily more peaceful than the 100 years before. In view of these uncertainties and due to the favourable weight-value ratio of hard money transport costs must have been comparatively low anyway, it seems best to omit this factor.

Normally one would expect the degree of integration between financial markets to be positively correlated to the volume of trade between these markets. In gravity models that are employed to predict trade volumes between modern countries, distance – commonly between national capitals – is used as a standard component, others being variables such as the gross national product. There are two reasons why such a model cannot be employed in the present context: For one thing, data which could be used to estimate GNP have not been preserved, and for another, late medieval princely territories were no modern national states, lacking essential characteristics such as governments invested with a monopoly of force and clearly defined borders. Hence, even if there were sufficient data to estimate GNP, it would be impossible to determine exactly to which area these data apply. However, the assumption that trade volumes and market integration were positively correlated in the late Middle Ages is still plausible. As in this study the units of analysis are not national states but rather cities, a proxy is needed that captures their involvement in long-distance trade. Lacking better data, it should be possible to use their population for this purpose. Still, population figures for the 25 cities analysed here are incomplete at best, having for most of them been estimated for specific years, which are usually decades apart. Interpolating the missing data is unavoidable. Having done that, and making the assumption that the volume of trade between two cities was positively correlated with the log of their population and negatively to the log of the distance between them, it is possible to construct a variable that can be used as a proxy for trade. There should be a negative correlation between this variable and the spreads between the local gold-silver ratios.

A number of the cities covered by this analysis were using the same silver currency, which was either supplied by themselves (in case of a currency union) or by their feudal overlord. Whereas today, there are no deviations between exchange rates within a currency area, this was not the case between the fourteenth and the sixteenth centuries. For example, the price of the Rhinegulden might be different in Luebeck and Hamburg

even though the same silver currency, the Mark of Luebeck, was used in both cities. Still, one would expect spreads between local gold-silver ratios to be smaller in cases where both places had the same silver currency than if different silver currencies were used. Hence, it is necessary to include currency unions into the analysis. This can be done by creating a dummy that takes the value of 1 if both cities had the same currency in the year when the spread between the ratios was observed, and 0 if they had different currencies. The dummy and the spreads should be negatively correlated.

Further, the influence of infrastructure needs to taken into account. Important differences in the quality of the roads linking the cities here considered probably did not exist, but it is well known that using roads was more expensive than sea transport. This difference can be captured by introducing an infrastructure dummy, which is 1 if both cities had a port, and else 0. Here, there should also be a negative correlation with the spreads between the local ratios. A similar dummy is used to capture the effects of navigable rivers, on which both cities lay.

Finally, language could have had an influence on the integration of financial markets, since speaking a similar idiom reduced transaction costs and therefore improved market efficiency. German as a national language began to develop only toward the very end of the period analysed here. Generally, in the Hanseatic cities Low German was still spoken, a language that was closer to Dutch than to the dialects of Upper Germany. Other languages spoken in cities here considered were French, English and Polish. The effect of having the same or a very similar language is captured by introducing a final dummy which in this case takes the value of 1, and is 0 if languages in the two cities between which a spread in the gold-silver ratio were different. As usual in integration analyses which use data from multiple localities (cf. Ritschl and Wolf, 2003), the model takes the form of a panel analysis. A hausman-test indicates that a random-effects regression is appropriate. This equation is used:

$$\log(\Delta) = \beta_1(autonomy) + \beta_2(trade) + \beta_3(union) + \beta_4(port) + \beta_5(river) + \beta_6(language) + c$$

Table 2 gives the results for a number of tests where variables are consecutively added.

Table 2: Regression results (Panel analysis, whole period, different variables)

	logspread	logspread	logspread	logspread	logspread	logspread
autonomy	-0.471	-0.453	-0.467	-0.482	-0.485	-0.491
	(4.65)**	(4.07)**	(4.30)**	(4.33)**	(4.22)**	(4.27)**
trade		-0.100	-0.019	-0.011	-0.012	-0.009
		(1.81)	(0.32)	(0.18)	(0.20)	(0.15)
union			-0.763	-0.747	-0.745	-0.791
			(3.11)**	(3.03)**	(3.01)**	(3.14)**
port				-0.103	-0.103	-0.089
				(0.61)	(0.61)	(0.52)
river					0.014	0.017
					(0.07)	(0.09)
language						0.120
						(1.02)
Constant	0.365	0.762	0.467	0.451	0.455	0.405
	(5.79)**	(3.15)**	(1.84)	(1.77)	(1.77)	(1.54)
Observations	1993	1890	1890	1890	1890	1890
Number of city-pairs	183	165	165	165	165	165

Absolute value of z statistics in parentheses
* significant at 5%; ** significant at 1%

The analysis reveals that over the whole period here considered, i.e. 1352 to 1562, urban autonomy with regard to monetary policies had a strong and highly significant negative influence on the spreads between local gold-silver ratios. The autonomy-coefficient and its significance remain practically unchanged, regardless of how many other variables are included. This finding increases confidence in the regression results and confirms the central hypothesis of the present paper: Financial markets between cities that issued their own currencies were much better integrated and more efficient than markets between cities whose currencies were supplied by some outside ruler.

As for the other variables, trade has the expected negative sign – that is, the larger its volume was, the smaller spreads between local gold-silver ratios became –, but the coefficient is insignificant. This may be due to the fact that city sizes and distances between them are not sufficient to predict trade volumes, which may have depended on any number of further influences. In fact, it is known that there were comparatively large cities where trade played a relatively minor role, such as for example Bamberg, while a number of fairs that were established in the early fifteenth century and that quickly gained more than just regional importance were located at small towns, such as Petronell in Austria (Epstein, 1994, p. 464). In sixteenth-century North Germany, important financial fairs emerged at such remote places as Kiel in modern Schleswig-Holstein and Stolp in Pomerania, which were otherwise totally insignificant in international commerce (Petersen, 1980). In contrast to trade, the union-variable has a highly significant influence on market efficiency, which is even stronger than the one of

urban autonomy. Evidently, having the same silver currency was the single most important factor that fostered the integration of financial markets. As expected, the port-dummy has a negative influence on spreads between local gold-silver ratios, but the coefficient is insignificant. Probably, due to the favourable weight-value ratio of gold and silver transport costs were so low that it really did not matter if a city had a port or was landlocked. The river-dummy is likewise insignificant; its positive sign might be due to the fact that traffic along rivers was actually easier to control and to tax than road traffic. The influence of language, finally, was also insignificant.

The analysis presented above reveals that there was a close correlation between urban autonomy and market integration, but leaves open the question of causalities. In other words, it does not tell whether market integration and efficiency improved due to the grant of the right of coinage to a city, or whether cities, whose financial markets were relatively efficient from the start, acquired monetary autonomy more often than cities whose markets were less efficient. It is possible to approach a solution to the problem by defining another dummy. This receives the value of 1 if both cities in a city-pair gained the right of coinage at some later date during the period of time here considered, and the value of 0 if at least one city remained subject to the monetary policies of a feudal lord over the whole period. If cities with well integrated and efficient financial markets tended to acquire monetary autonomy, the coefficient for the dummy should be negative, indicating small spreads between the urban gold-silver ratios. By contrast, a positive coefficient shows that markets between cities that gained their autonomy at some later date were, if anything, less efficient than markets between cities that never issued their own currency. The following table contains the results:

Table 3: Regression results with a later-autonomy dummy as independent variable (Panel analysis, whole period)

	logspread	logspread	logspread	logspread	logspread	logspread
lateraut	0.691	0.692	0.715	0.717	0.713	0.707
	(4.83)**	(4.28)**	(4.48)**	(4.46)**	(4.42)**	(4.35)**
trade		-0.111	-0.032	-0.030	-0.022	-0.023
		(1.99)*	(0.53)	(0.49)	(0.36)	(0.36)
union			-0.744	-0.740	-0.736	-0.749
			(2.99)**	(2.95)**	(2.92)**	(2.91)**
Port				-0.025	-0.039	-0.034
				(0.15)	(0.23)	(0.20)
river					-0.134	-0.133
					(0.70)	(0.69)
language						0.039
						(0.32)
Constant	0.146	0.604	0.308	0.305	0.287	0.275
	(2.61)**	(2.42)*	(1.18)	(1.16)	(1.08)	(1.01)
Observations	1993	1890	1890	1890	1890	1890
Number of city-pairs	183	165	165	165	165	165

Absolute value of z statistics in parentheses
* significant at 5%; ** significant at 1%

The results indicate that the hypothesis that market efficiency led to autonomy in matters of monetary policy can be excluded. If the temporal order of developments reveals anything about causalities, it seems to be obvious that a higher degree of market efficiency was the consequence of autonomy, and not its cause. Merchants who conducted business on the money market apparently trusted the monetary policies pursued by cities rather than those practiced by feudal lords. Hence, granting a city the right to strike its own coins was a way how a ruler could credibly commit to maintaining monetary stability. Feudal lords based the authorization of cities to issue a currency on rational expectations of an improved performance of the markets. As for the effect on the princely revenues, data about their development during these centuries are so sketchy than it is impossible to determine whether they grew due to the establishment of urban autonomy in monetary matters, but it is likely that at least the income from market dues and customs increased.

Instead of analysing the whole period of time between the middle of the fourteenth and the second half of the sixteenth century, it is informative to split the data-set into several periods. A plausible divide would be the years around 1460-70 when large new lodes of silver were discovered in the mining districts of Saxony and the Tyrol, and when the long upward trend of prices that was to continue through the whole sixteenth and into the seventeenth century began. The following table presents the results.

Table 3: Regression results (Panel analysis, specific periods)

	whole period logspread	to 1460 logspread	from 1461 Logspread
autonomy	-0.491	-0.567	-0.188
	(4.27)**	(3.80)**	(0.93)
trade	-0.009	-0.020	0.139
	(0.15)	(0.26)	(1.21)
union	-0.791	-0.652	-1.517
	(3.14)**	(2.21)*	(3.08)**
port	-0.089	-0.054	-0.017
	(0.52)	(0.26)	(0.06)
river	0.017	0.238	-0.414
	(0.09)	(1.06)	(1.30)
language	0.120	0.153	0.035
	(1.02)	(1.06)	(0.17)
Constant	0.405	0.440	-0.337
	(1.54)	(1.36)	(0.71)
Observations	1890	1123	767
Number of city-pairs	165	133	107

Absolute value of z statistics in parentheses
* significant at 5%; ** significant at 1%

Interestingly, the positive influence of urban autonomy on the efficiency of financial markets became weaker and lost its significance after c. 1460. On the other hand, having the same currency became more important. Both developments may, actually, have been due to parallel outside influences, i.e. due to the transformation of the princely territories within the Holy Roman Empire into something that more nearly began to resemble a modern state. State-building went hand in hand with two developments which affected the performance of financial markets: on the one hand, urban autonomy was reduced, and on the other, rulers increasingly tried to banish foreign currencies from the territory they claimed to rule, or to enforce their circulation at politically imposed rates (cf. Konow, 1989, for Pomerania). The process increased the importance of having the same currency for the efficiency of financial markets. However, a detailed analysis of how state formation influenced market efficiency requires further research and is a task that is clearly beyond the scope of this paper.

4. Conclusion

The present study has a double aim: on the one hand to clarify whether and how rulers in the late medieval Holy Roman Empire were able to credibly commit to the preservation of monetary stability, and on the other hand to examine how their decisions affected the efficiency of financial markets. This commitment was important both for the long-term welfare of their subjects and for their princely revenues, as many feudal rulers realised. However, incentives not to commit or to violate a commitment once

made were strong. After all, under the conditions of a commodity money system such as that then existing, it was possible to reap a short-term and transient profit by increasing the seignorage by reducing – a procedure that required a reduction in the standard of the coinage and that therefore caused a rise in the price level in the medium and long term, i.e. as soon as consumers became aware of the debasement. As the need of a ruler to require short term funds was common knowledge, it was difficult to credibly commit to the preservation of monetary stability.

To analyse this commitment situation, it is modelled as an instance of exchange between the ruler who provides a currency and the consumers who pay taxes and other dues, notably custom duties. Both sides of this market are linked by implicit contracts. For the ruler, reneging means secretly decreasing the standard of the coinage, for the consumers to evade taxes or customs or to refuse to accept the money locally supplied. In this context, two groups of consumers are distinguished: on the one hand, there are the ones who are able to acquire information about the bullion content of the coins which they handle at low costs. This group is primarily composed of merchants active in long-distance trade. On the other hand, there are consumers for whom the acquisition of this type of information is more costly; this group consists of practically everybody else. A further assumption is that both groups of consumers demand different kinds of money, merchants being interested in gold coins which they can use in large-scale transactions on international markets, while the others need silver for their local retail trade or for small day-to-day consumer transactions.

As rulers and consumers interact not only once but repeatedly, and as interaction is usually open ended, reputation is potentially sufficient to ensure prolonged cooperation, i.e. to enable rulers credibly to commit to monetary stability. However, this is only the case if two conditions are given: First, information on a ruler's defection must spread quickly among the consumers, and second, the consumers must have a chance to react to a ruler's violation of the contract by reneging themselves. These conditions exist for the first group of consumers, i.e. for merchants. Merchants quickly notice any reduction in the standard of the coinage they demand, that is, in its content of fine gold, and are furthermore able either to exit the reneging ruler's territory (thus evading taxes or customs) or to substitute local gold with gold supplied by more reliable producers abroad. Hence, reputation is sufficient to enable rulers credibly to commit to the stability of their gold coinage. In Shepsle's (1991) words, commitment is motivationally credible because it is in the actor's interest not to violate their implicit contract.

The conditions are not given as far as the second group of consumers is concerned, among whom changes in the standard of the silver coinage remain undetected for a longer period of time, and who have fewer chances to exit the ruler's territory or to substitute his coinage with foreign silver money. Hence, credible commitment of the motivational kind is impossible in this situation. What is to be expected from this is that late medieval rulers would supply a relatively stable coinage in gold, but would reduce the standard of their silver coinage much more quickly. In fact, this is supported by the data.

However, historically there were cases where long-distance merchants did demand silver money not only for large transactions but also for the business they conducted with local traders. In such cases, the exit of merchants unsatisfied with the locally supplied silver would provide rulers with an incentive credibly to commit themselves to the stability of their silver currency, but the incentive would be weak due to the rulers' chance of finding consumers unable to notice debasements. In this situation, motivational credibility would not be given. Still, there was a solution: A ruler had to imperatively bind himself to the contract, that is, he had to find a way that made it impossible for him to renege. Transferring the right to issue the coinage to an independent authority was such a method. In the late Middle Ages, the independent authority would usually be a town.

Feudal rulers could credibly commit to respecting the exclusive minting right that they had granted to a town because here, their defection would be immediately obvious. Urban authorities, too, had to credibly commit to the preservation of monetary stability. However, for them this was easier than for territorial rulers: They were governed by councils, whose members would not individually have benefited from reductions of the standard of the coinage. Furthermore, such reductions required an agreement among the council members which was costly to reach, and finally, councils were directly affected by urban unrest that was due to discontent with the coinage. A council's commitment to the stability of their silver money was motivationally more credible than that of a prince. Consequently, cities debased their coinage less frequently than territorial rulers. Hence, there is no fundamental difference between motivational and imperative commitment or between reputational and institutional solutions to the problem of preserving monetary stability. In the last resort, imperative or institutional commitment would be credible because here, too, reputation was an effective mechanism to enforce compliance with

restraints on discretionary behaviour – restraints that the ruler imposed on himself either on his own or by involving another actor such as a city.

As commitment refers to future behaviour, it generates trust if it is credible. Trust in the monetary polices of a council or a prince would, in turn, increase a merchant's willingness to undertake business in that city or territory. Hence, it is to be expected that markets between localities whose silver money was supplied by an urban council would be better integrated and more efficient than markets whose money was provided by a feudal ruler. This hypothesis is tested by making use of a new method to analyse the integration of financial markets. The approach is based on linking exchange rate data to data on the money's content of fine gold and fine silver, to use this information to construct local gold-silver ratios, and to interpret spreads between these local ratios as indicators of weak integration and market inefficiencies. The analysis covers data from 25 cities from the Holy Roman Empire and the adjoining countries and from the time between 1352 and 1562. Due to incomplete time series, spreads between only 176 cities are measured; there is a total of about 2000 observations.

The analysis confirms the hypothesis that urban monetary autonomy had a significant and negative impact on spreads between local gold-silver ratios. In other words, financial markets between cities that managed their coinage on their own were better integrated and more efficient than markets between cities whose money was supplied by a prince. Evidently, merchants trusted in urban rather than in princely monetary policies. Transferring the right of coinage to a city was, therefore, a way how a feudal ruler could credibly commit to the preservation of monetary stability.

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