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‘The Big Problem of the Petty Coins’, and how it could be solved in the late Middle Ages

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Abstract

In this paper, the problem of why low-purchasing power silver coins depreciated relative to high-purchasing power gold coins is examined. The standard explanation by Sargent and Velde is refuted. It is argued that the relative stability of gold was due to the demand from consumers able to detect debasements and to choose other suppliers; the rulers’ fear of a loss of reputation therefore allowed them to commit to monetary stability. Consumers of silver were less able to detect changes in the standard and therefore willing to accept debased coins, which meant that rulers could not easily commit to preserving stable silver currencies. The problem could be solved by establishing an independent agency responsible for monetary policies. As infringements of these agencies’ autonomy would be obvious to a wider audience, rulers could then commit to respecting monetary stability. Data on the standards of urban and princely currencies supports the conclusion that this mechanism solved the problem of maintaining the stability of low-purchasing power silver coins.

1. Introduction

To the modern eye, late medieval monetary systems exhibit a number of baffling complexities: They were usually based on some variant of a duodecimal system; they contained ‘ghost units’ that never circulated as coins but were solely used for accounting purposes; the numerical relations between denominations of the same currency were not necessarily stable; and they suffered frequent changes in the bullion content of the coins from which they were composed. In 1953, Carlo Maria Cipolla (1956) gave a series of classic lectures at the University of Cincinnati where he addressed some of these problems. One of his lectures, called ‘the big problem of the petty coins’, became particularly famous. There, Cipolla asked why the bullion content of coins with a high purchasing power seems to have been more stable than that of coins

whose purchasing power was low, why, in other words, authorities in the late Middle Ages failed to develop a system of fractional money where the smaller denominations were token coins issued in limited quantities, with only the larger units having a material value that approached their face value. While eschewing a systematic answer to his question, Cipolla provided a wealth of detail and discussed at length the motives and aims of political actors and social groups involved in monetary policies.

Taking up Cipolla's subject, subsequent research has variously claimed that smaller coins were occasionally supplied in quantities that drove the larger denominations, whose bullion content was proportionally higher, out of circulation (van der Wee, 1969, p. 375), or that there was an undersupply that left the public short of small change (Grierson, 1976, p. 113). John H. Munro (1988, p. 414) used fourteenth- and fifteenth-century mint accounts from Flanders in combination with data on the development of commodity prices to determine whether supply matched demand, concluding that the case for a chronic scarcity of petty coins had not been proven. More recently, Thomas J. Sargent and François R. Velde (1999; 2002) redirected the focus of research to the question of the relative stability of high- and low-purchasing power denominations. They adapted Cipolla's title, changing it in the process to the racier 'big problem of small change', and provided an in-depth analysis based on a model that they applied to a number of episodes from the monetary history of several European countries. While this is not the place to review the model in any detail or to do justice to its elegance, it is possible briefly to summarize the core of the argument. The starting point is the idea that traditional theories of commodity money are faulty because they assign the same function to all denominations within one currency. Sargent and Velde (2002, p. 9), by contrast, distinguish among denominations and claim that smaller ones play a special role large coins cannot fulfil: '[S]mall denomination coins can be used to purchase expensive items,

but large denomination coins cannot be used to buy cheap items'. In their model, this so-called 'penny-in-advance constraint' causes a fall in the exchange rate of small coins relative to large ones: large denominations provide their owners with an extra return that compensates them for their lack of liquidity. Small change therefore becomes at the same time relatively scarce and cheaper. Such price signals, in turn,

> 'perversely hasten the day when small coins will eventually be melted. Since they depreciate as currency, they ultimately become more valuable as metal than as coins, unless the government makes appropriate adjustments in the parameters governing the melting points for small coins. This feature of the model explains the widely observed persistent depreciation of small coins, inspires our interpretation of debasements of small coins as a cure for shortages of small change within the medieval money supply mechanism, and suggests how that mechanism needed to be reformed' (Sargent and Velde, 2002, p. 10).

Put briefly, small coins are more useful than larger ones, hence demand for them is relatively stronger, hence they tend to be relatively scarce; and in order to be able to increase their quantity, governments reduce their content of bullion more rapidly than that of larger denominations.

Sargent and Velde's model has been widely acclaimed for the analytical rigour that went into its construction (e.g. Yeager, 2003; Rolnick and Weber, 2003; Redish, 2003). However, with few exceptions (cf. the review by Schnabel, 2005) economic historians seem so far to have paid little heed to it. It is of course futile to speculate about why this should be the case. What is hopefully not futile is drawing attention to some flaws in Sargent and Velde's argument, pointing out that there is much counter-evidence which their model leaves unexplained, and offering an alternative solution that at least with regard to the period discussed here – that is, to the fourteenth to sixteenth centuries – fits the historical record

better. The whole issue is important because in order to be able to compare prices from different localities – which is essential for e.g. integration studies, analysis of income development etc. – we need information on the bullion content of the several denominations which late medieval currencies consisted of. Apart from that, the shortage or abundance of specific denominations influenced other data, for example rates of interest, which we can not even begin to study in a meaningful way without understanding the underlying causes.

The rest of the paper is organised as follows: In the next section (2.1.), some flaws in Sargent and Velde's argument are discussed. Here, counter-evidence is also presented. In section 2.2., an alternative explanation is suggested. This is based on the idea that the issue of why smaller denominations were debased more quickly than large ones is due to the costs which consumers faced when they checked that the money had its expected content of bullion, and of the varying ability of the suppliers of coinage to credibly commit to stable and predictable monetary policies. The question of how these problems could be (and occasionally were) solved is discussed in the subsequent section (2.3.). A final section (3.) summarises the argument and the main findings of the study.

2. The Problem, its Causes, and how it Could be Solved

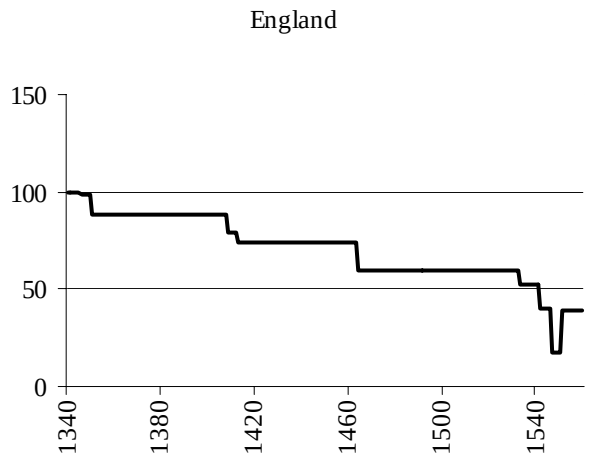
2.1. Small Change and Large Coins: the Dynamics of Late Medieval Minting

Before taking a closer look at Sargent and Velde's argument, it is useful briefly to check whether or how far the phenomenon they set out to explain – the 'persistent depreciation in the silver content of small coins' (Sargent and Velde, 2002, p. 15) – actually existed. The authors suggest that it did exist by providing a graph which charts the number of small

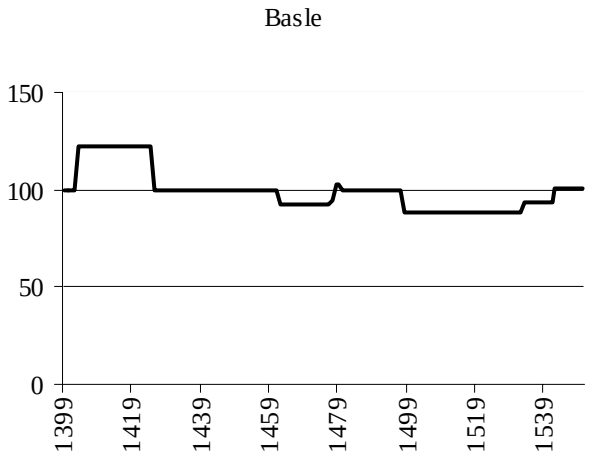
coins produced from a given weight of silver in six countries (Sargent and Velde, 2002, p. 16). The data shows that these numbers grew considerably over time, indicating that the quantity of silver contained in each individual coin fell to a sometimes spectacularly low level. There is of course no dispute that many medieval and early modern currencies experienced frequent debasements. However, debasements as such are not the issue. The issue is rather whether small coins depreciated relative to large ones (cf. Sargent and Velde, 2002, p. 5), and this is less easy to show. There are two reasons for this. First, there is a lack of evidence: In many cases, we have no reliable information about the standard of the smaller coinage, even when we are well informed about that of the larger denominations. Second, there were currencies where the numerical relationship between smaller and larger coins was unstable. If we want to compare rates of debasement, we need a common denominator such as the silver equivalent of the units of account (the 'ghost' units that were sums of actual coins and were used for accounting purposes). Thus, even when we know how much silver the several types of coins contained, we cannot use this information if we do not know how they related to each other and to the unit of account of the currency in question. Still, we do have sufficient information to take a sample of ten late medieval currencies. The result is given in the following graph, which plots the silver equivalents of the units of account based on the smallest denominations of these currencies as a percentage of this silver equivalent based on the largest coins (for example, the silver equivalent of the pound sterling, calculated as the sum of 960 farthings or ¼-penny-pieces as percentage of the silver equivalent of the pound calculated as the sum of 60 groats or 4-penny-pieces). To provide the necessary background information, the graph also charts the debasements which the largest denominations of the currencies suffered.

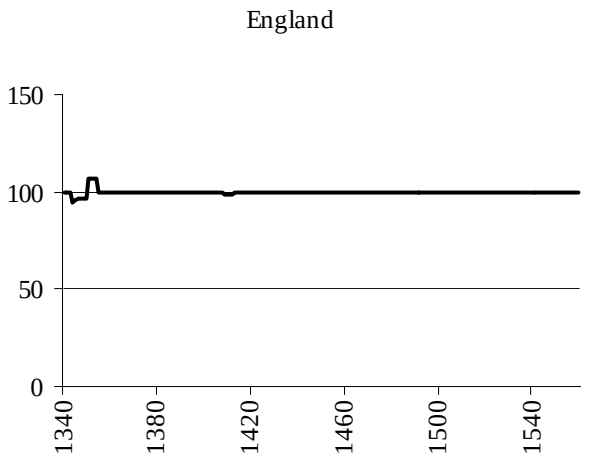
Fig. 1: Silver Equivalents of the Units of Account Based on the Bullion Content of the Largest Denominations (left); Silver Equivalent of the Units of Account in the Smallest Denominations as percent of the Silver Equivalent in the Largest Denominations (right)

Debasements of largest denominations

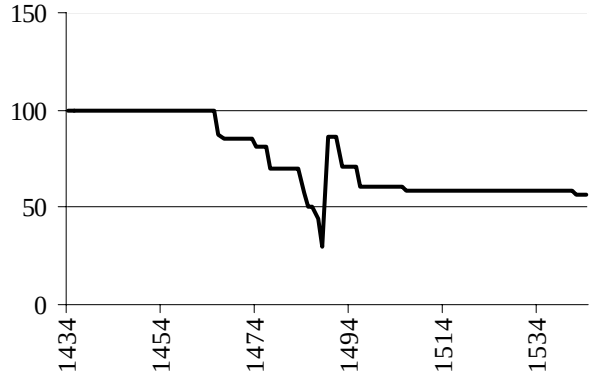


Proportional silver content of small change





Flanders



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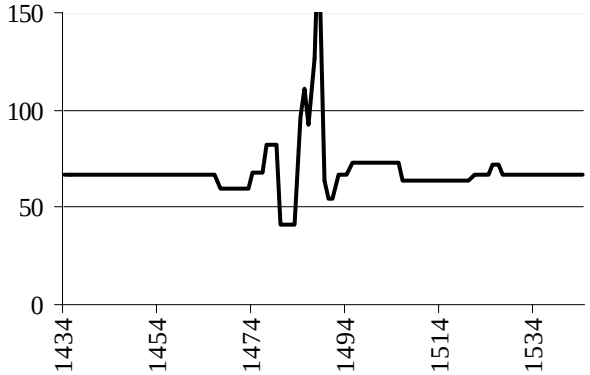
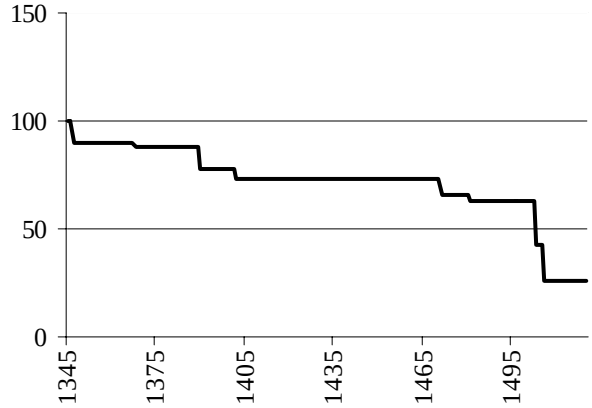


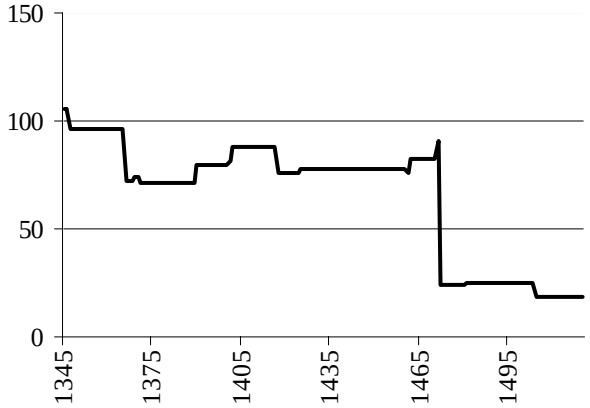
Debasements of largest denominations

Proportional silver content of small change

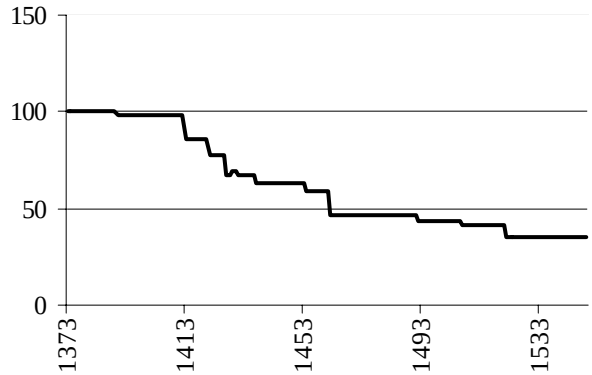
Florence



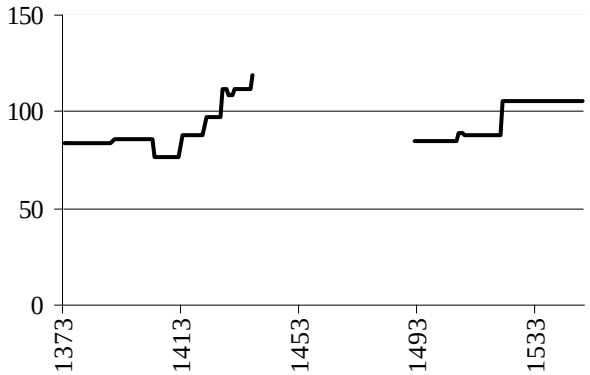
Florence



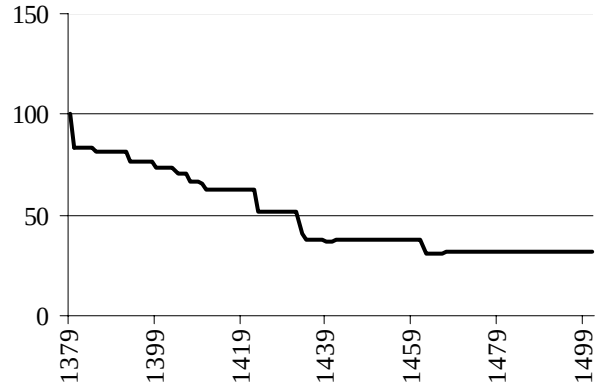
Genoa



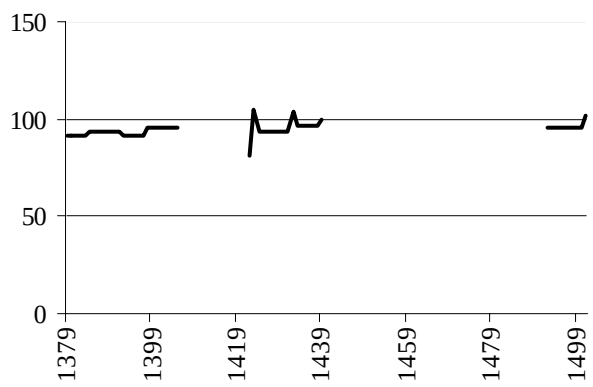
Genoa



Luebeck



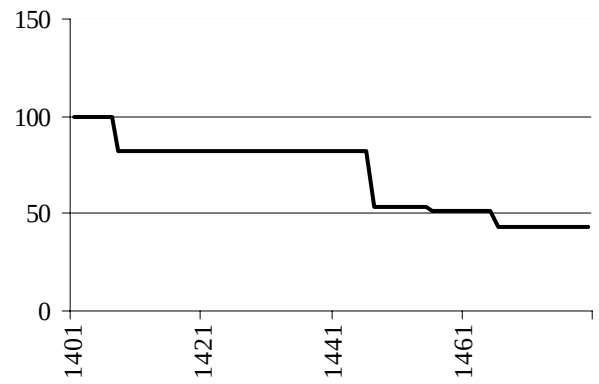
Luebeck



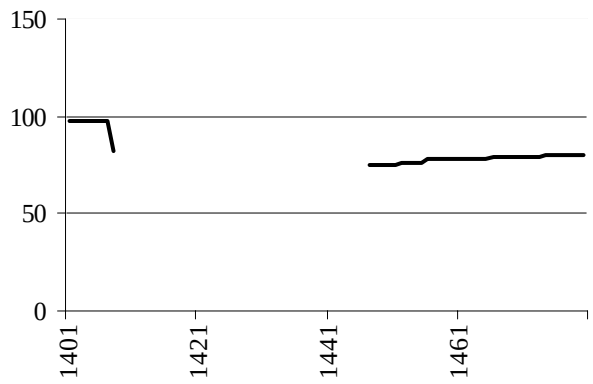
Debasements of largest denominations

Proportional silver content of small change

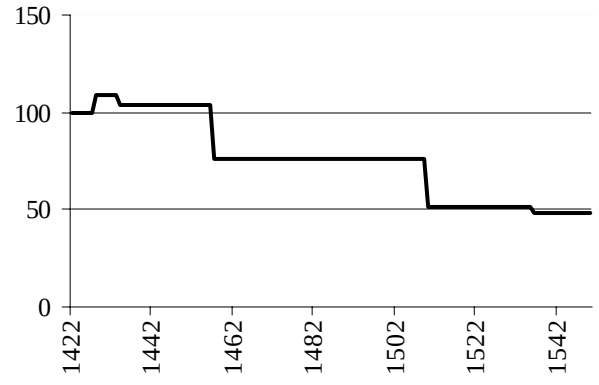
Milan



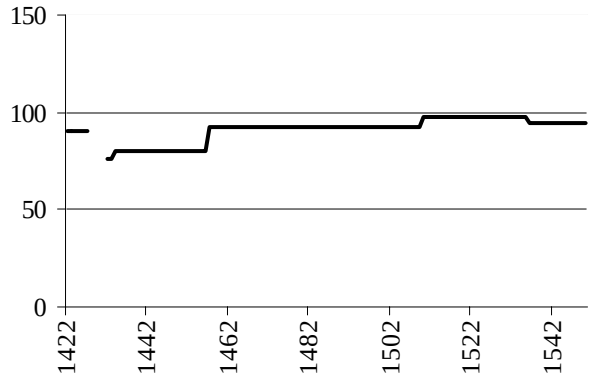
Milan

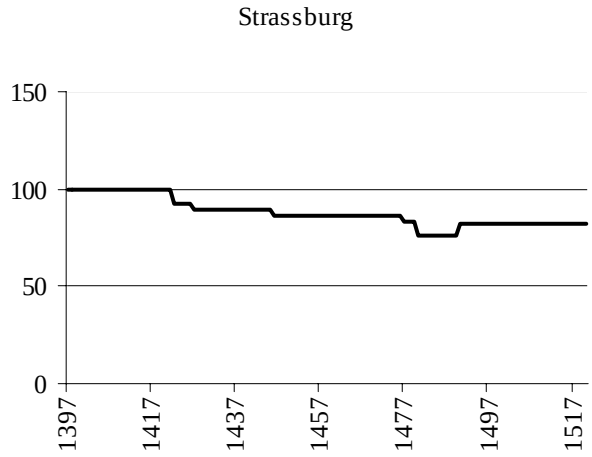


Nuremberg

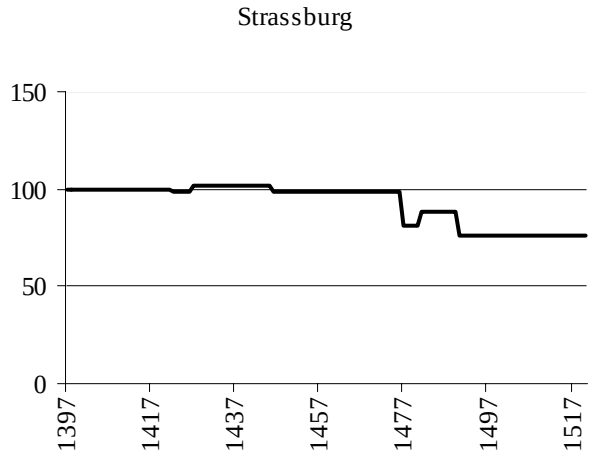


Nuremberg

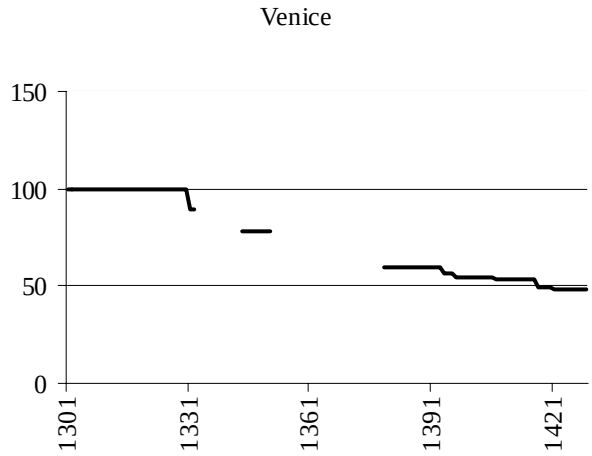




Debasements of largest denominations



Proportional silver content of small change



Sources: See the appendix. Numerical ratios between small and large coins fluctuated in Genoa, Nuremberg and Venice. All other currencies here shown were internally stable.

The data reveal that regardless of the rates of debasement which the several currencies experienced, in most cases small silver coins were not more quickly debased than larger denominations. In England, the pound sterling almost always contained exactly as much silver when it was made up of small coins as when it consisted of larger ones. In most other currencies, small coins contained proportionally less silver than the larger denominations (cf. Munro, 1988, p. 403), but there is no evidence that this proportion grew over time. The only authority in the sample that

did disproportionally debase its smaller denominations was Florence. In 1472, the city introduced a token coinage, reducing the silver content of the denaro from about 0,028g to a barely perceptible 0.008g. Thus, what Sargent and Velde (2002, pp. 10, 210) call ‘the medieval money supply mechanism’ does not seem to have played any important role in the Middle Ages. It existed, but it was certainly no ‘pervasive and persistent’ phenomenon.

Let us next take a closer look at the explanation they offer for small change depreciations. One of their core arguments is that small and large denominations fulfilled different functions, large coins being useful in large transactions only, while small coins could be used in both small and large transactions. Strictly speaking this is true. However, as pointed out by Schnabel (2005, p. 312) with regard to modern conditions, there is not only a ‘penny-in-advance’, but also a ‘dollar-in-advance’ constraint: small denominations can be used to buy expensive things, but large ones are more convenient. To be sure, in the late Middle Ages sometimes even small coins had a relatively high purchasing power (Munro, 1988, p. 393), and there is practically no direct evidence that reveals which coins people chose to use in which transactions. Still, some choices are more likely than others. In early fifteenth-century Prussia, for example, most German peasants paid an annual monetary rent of between 1¼ and 1½ marks (Burleigh, 1984, p. 24). The coins circulating at that time in Prussia were pennies and shillings. As the Prussian Mark (no coin but a ‘ghost’ unit) was made up of 60 shillings or 720 pennies, it is likely that both peasants and landlords preferred the larger denomination. According to Spufford (1991, pp. 235 f.) the introduction of multiples of silver pennies such as the Italian grossi (or the Prussian shillings) in the thirteenth and fourteenth centuries was linked to the spread of urban wage labour and the concurrent need to regularly pay large numbers of relatively modest sums. By contrast, the slightly later decision to issue gold coins was

motivated by their usefulness in long-distance trade, in particular in trade between the Italian cities and North Africa (Lopez, 1956). In all cases – agriculture as well as industry and commerce – the issue was the transaction costs per instance of exchange, which could be reduced by employing larger units than the penny. Consumers would have been prepared to use small coins to pay for expensive items if and when the extra return on them as compared to that on larger coins would have surpassed the transaction costs savings that large denominations made possible. We can estimate neither side of this non-equation. However, in a world of positive transaction costs, just checking that a large purchase amounted to the correct sum when paid in small change must have been so cumbersome and time-consuming that it is hard to imagine people did it if they had an alternative.

Sargent and Velde's explanation involves another problem. Their argument is that in cases of small change shortages, governments would reduce the standard of the smaller coins in order to produce more of them. Here two assumptions are involved: first, that medieval rulers would be able to monitor the development of the quantity of money in relation to the demand for specific denominations, and second, that they would step in to satisfy demand. Both assumptions are equally open to questions. A ruler who kept his administrative apparatus under close control might have some adequate notion of the output of his mint. However, this was not necessarily the case. Even in the sixteenth century, control of the bureaucracy was patchy at best; for example, in 1527 the duke of Prussia was surprised to learn that the master of his mint had issued money for years in the face of an official non-minting policy. Being questioned, the master naively declared that he had just minted to cover his personal expenses (Volckart, 1996, p. 410). Even if a ruler was well informed about what went on in his mint, he had no means to find out the demand for specific denominations; after all, he had no statistical apparatus, no clear

idea of how large the number of his subjects was, and not the slightest notion of any aggregate values such as GDP etc. At best, he could rely on information he received in the form of petitions or complaints passed on to him by his counsellors. Unnecessary to say, such information might be distorted in any number of ways. Finally, even supposing that rulers received relatively reliable information on the output of their mints and on the demand for money, why should they behave like benevolent dictators from a welfare-economics textbook? When there were no external constraints on their monetary policies, they would order their mints to produce coins as long as it was profitable to do so, and when they were strained for money, they would order those denominations to be produced in larger quantities whose seignorage was higher. The former Minorite monk and metal expert Burkhard Waldis, who, in 1532, wrote a memorandum on monetary policies for the master of the Teutonic Order in Livonia, put it in a nutshell: 'If they may mint more than just one type of coin, they mint that one most that brings them the highest profit' (Arbusow, 1910, p. 799).[1]

In this context, Sargent and Velde (2002, pp. 49 ff.) claim that 'per unit of value, the production process made small coins more expensive to produce than larger ones, since the same effort was required to strike a coin of any size, and not much less to prepare smaller blanks than larger blanks'. In consequence, small coins production 'required either cross-subsidization of lower denominations by higher ones, or subsidization of the mint by the government'. The argument is plausible, but not conclusive. In many mints wages were paid not in proportion to the number of coins produced, but rather in proportion to the quantity of fine

[1] This is not to claim that there were never any other motives. Political authorities might exercise their right of coinage just to demonstrate that they had it and to make a statement about the range of their power. The city of Lueneburg did this in the fifteenth century, as did the duke of Prussia in the sixteenth (North, 1990, p. 37; Volckart, 1997, pp. 432 f.).

silver used in the production process. This was done in places as diverse and far apart as Ulm in South-West Germany and Dorpat in Livonia (Häberle, 1935, p. 75; Schwartz, 1905, pp. 61 f.). Where wages were a proportion of output, their share in total costs was larger when the mint produced small coins. In Prussia in the 1420s for example, the wages of the coiners who struck the blanks amounted to 0.6 percent of the production costs of shillings and to 9.1 percent of those of pennies. However, here – as in most other places – the bullion content of the smaller coins was proportionally lower. This more than outweighed the larger share of the wages, so that minting pennies allowed a profit of 9.4 percent, whereas the profit of the production of shillings was only 1.7 percent (Volckart, 1996, pp. 99, 156). Further west, in the Hanseatic cities of Wismar, Luebeck, Hamburg, Lueneburg and Bremen, seignorage rates were similar (Sprandel, 1975, p. 158).

How about Sargent and Velde's factual evidence for small change shortages? They claim that pre-modern monetary systems were repeatedly plagued by this problem. Occasionally complaints about shortages of smaller denominations did surface (e.g. in Prussia 1391, Volckart, 1996, p. 55), and given the priorities of the suppliers of money, anything else would be a surprise. However, there is also potential counter-evidence, some of which Sargent and Velde themselves cite. For example, in 1365 the king of France ordered his mints to make new pennies, but only one day every fortnight 'for the needs of the people, so that the gold coin may not rise above 16s. by the excessive quantity of small coinage'. Sargent and Velde (2002, p. 135) treat this as proof that small change was scarce, but it could be just as well read as evidence of the opposite, that is, of an already existing 'excessive quantity' of small coins which was not to be enlarged any further to prevent the exchange rate of gold increasing. In fact, policies that can be interpreted as attempts to limit the quantity of small coinage were not uncommon in the

late Middle Ages. For example, when the duke of Pomerania appointed two new masters of the mint in 1500, he determined the maximum yearly quantity of silver that they were to use to make pennies (Klempin, 1859, pp. 585 f.). Whatever motivated such policies, they can be taken on their own as proof neither of small change shortages nor of the opposite, that is, of an oversupply of small coins. However, there is more direct evidence indicating that at least occasionally there was an oversupply. For example, in the 1420s and '30s, the Prussian estates repeatedly complained that the country was flooded with pennies, shillings (the only larger denomination) being produced in far too small quantities. Given the Teutonic Order's strained financial position in the decades after its defeat at Tannenberg/Grunwald in 1410, and given the relative profitability of the production of smaller and larger coins, this policy can not come as a surprise. Of course, it could not be pursued indefinitely. At some point the quantity of pennies would become so large that their purchasing power fell below that of the silver they contained. In Prussia, the market took care of this problem, with goldsmiths melting down pennies in order to turn them into jewellery (Volckart, 1996, p. 402). Here the numerical relation between denominations remained stable.[2] On the whole, as pointed out by Cipolla (1956, p. 32), periods of small change abundance seem to have been as common as periods of scarcity.

Does all this mean that Sargent and Velde try to explain something that happened a little bit with something that happened even less? Not necessarily: there still may be something to the problem they discuss. Many late medieval authorities did not only issue silver coins, at which we have so far exclusively looked, but also coins of gold, which had a much

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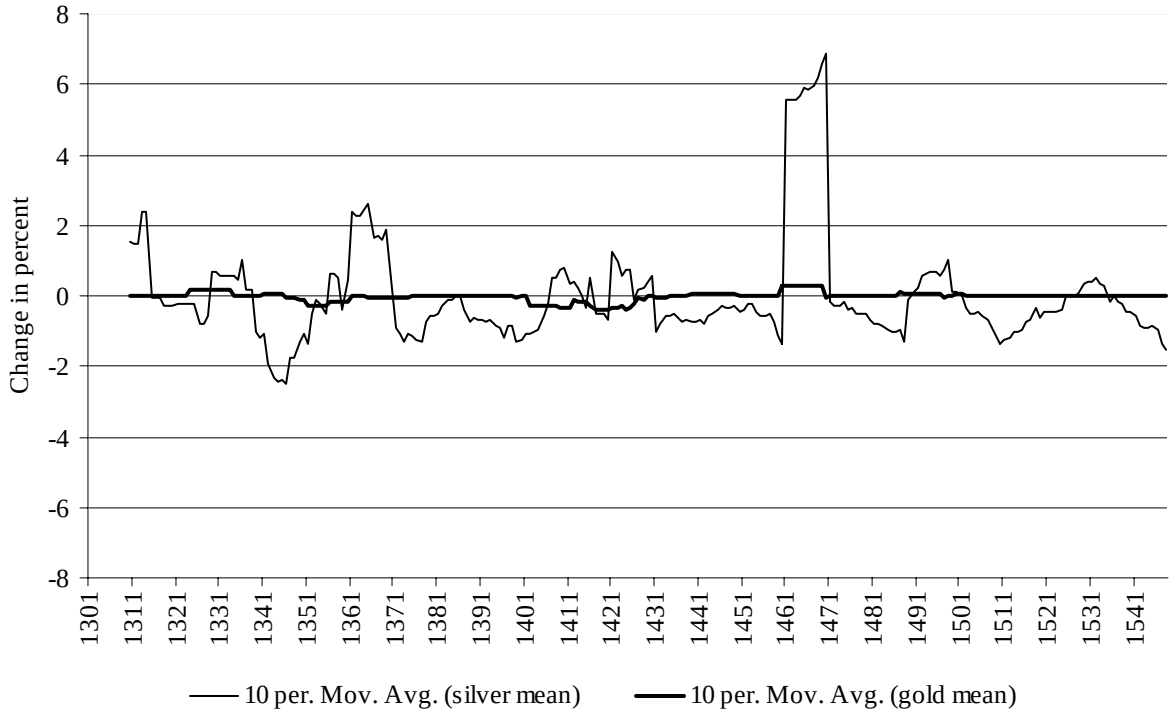
[2] Despite the shillings' proportionally higher content of bullion, the pennies did not drive them out of circulation. Greshams's law applies to monetary units that are perfect substitutes. Due to the higher transaction costs involved in the use of smaller denominations, this was here not the case.

higher purchasing power. The two types of coins did not form part of the same currency, as most gold coins had no fixed face value, not being part of the denominational structure based on silver (van der Wee, 1969, p. 374).[3] In fact, they formed parallel second currencies. Unlike Cipolla (1956, p. 32), who explicitly referred to the contrast between gold and silver when he introduced 'the big problem of the petty coins' into the academic literature, Sargent and Velde do not discuss the diverging rates of debasements of denominations made up of different kinds of bullion. However, their argument might apply to this context, as well; after all, relative to high-purchasing power gold coins, silver coins were indeed small change. So, was silver more rapidly debased than gold?

In order to determine whether this was the case, we can compare 8 gold and 23 silver currencies. The following graph charts the un-weighted average of the yearly rates of change in the standard of these currencies, the curve for silver being based on the bullion content of the largest denominations.

[3] The only government that seems to have consistently succeeded in enforcing the circulation of gold at its nominal par value was that of England, where the gold noble continuously equalled ⅓ of a silver pound sterling. In all other cases, foreign and domestic gold coins usually seem to have circulated at flexible rates (for example the Luebeck gulden had a varying exchange rate in silver marks of Luebeck) (cf. Miskimin, 1985/89).

Fig. 2: Yearly Rates of Change in the Standard of Gold and Silver



Gold: English noble, Flemish noble, Florin, Genovino of Genoa, Hungarian ducat, Luebeck gulden, Rhinegulden, Venetian ducat. Silver: Basel, Bern, Bohemia, Cologne, Constance, England, Flanders, Florence, France, Genoa, Goslar, Hanover, Holland, Kempten, Luebeck, Meissen, Milan, Nuremberg, Prussia, Strassburg, Venice, Vienna, Zuerich. Sources: See appendix. The exceptionally tall peak for silver in the 1460 is due to the reinforcement of the Viennese penny ('schinderling') following a period of severe debasement that led to one of the few medieval episodes of hyperinflation.

Both types of currencies were occasionally reinforced: gold in the 1320s and again in the 1460s, and silver in the 1360s, between 1400 and 1420, in the 1460, again between 1490 and 1500 and finally in the 1530s, but periods of debasement clearly dominate. In most periods, the silver curve is lower and more volatile than the one for gold (the mean standard deviation for gold is 0.002 and 0.068 for silver over the whole period), indicating that silver currencies experienced more violent changes and were on the whole debased more rapidly. We are still lacking much information on the bullion content of late medieval money, but all data we have suggest that this sample of altogether 31 currencies is

representative: Gold coins were more stable than even the largest denominations made of silver. Hence, a phenomenon not unlike the one Sargent and Velde set out to explain was really typical of monetary conditions in fourteenth- to sixteenth-century Europe: coins with a low purchasing power depreciated relative to those with a higher purchasing power. What we need is an explanation of this phenomenon which fits the historical record better than the one they suggest.

2.2. The basic commitment situation: why gold was more stable than silver

In this paper, the diverging rates of depreciation for high- and low-purchasing power coins are discussed in terms of political economy, with the focus being first on the incentives that rulers faced, and then on the way these changed under the influence of newly developed institutional arrangements. At the most basic level, incentives were contradictory. Nicolas Oresme, who wrote a widely read treatise on monetary policies in the fourteenth century, nicely captured this conflict: On the one hand, he declared to be convinced ‘that the main and final cause why the prince pretends to the power of altering the coinage is the profit or gain which he can get from it’ (Oresme, 1956, p. 24). Here he discussed debasements introduced in order to achieve a short-term increase in revenues from the seignorage, a motive that dominated for example French monetary policies during the Hundred Years War, when in some years the share of the profit from minting grew to two thirds of the total revenues of the French crown (Spufford, 1991, p. 305). On the other hand, Oresme (1956, p. 33) pointed out that ‘good merchandise or natural riches cease to be brought into a kingdom in which money is so changed, since merchants, other things being equal, prefer to pass over to those places in which they receive sound and good money’. In this context, he implied that debasements harmed the long-term revenues a prince could draw

from customs and market dues. This was felt by rulers such as for example the dukes of Brunswick-Lueneburg, who in 1412 noted '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 that had been debased], which does great damage to our customs revenues and also to our other affairs' (Jesse, 1924, p. 35). Annalists mention similar occurrences, for example for the territory of the Teutonic Order in the years following its defeat at Tannenberg/Grunwald: 'The land of Prussia was not visited by merchants due to the coinage that had been very much debased…. And neither copper nor silver nor steel nor iron came into the country' (Hirsch et al., 1866, p. 348). To summarise, late medieval governments faced the choice of trading seignorage for customs and other revenues. As under modern conditions, creating stable price expectations and refraining from discretionary policies equalled a long-term investment. However, as Klein (1974, p. 449) pointed out, modern politicians whose positions are not secure and whose time horizon is comparatively short face strong incentives not to undertake this investment. The same was the case in the period examined here.

The starting point of the analysis below is that fundamentally the problem rulers had to solve was one of credibility: If they wanted to avoid revenue losses due to the exit of owners of mobile factors of production such as merchants, they had to convince consumers that they would supply a stable currency not only at present, but also in future. The question is then under which conditions rulers were able credibly to commit to upholding stability. Commitment situations have in recent years come into the focus of research (cf. Shepsle, 1991; North, 1993; Greif et al., 1994; Greif, 2000; Boerner and Ritschl, 2002; Greif, 2005). Often, the aim of this research is to analyse how agents can engage in mutually profitable exchange in the absence of third party enforcement, or how they can substitute third-party enforcement offered by the state – whose

services they may regard as partial, unreliable, costly, slow or undesirable for some other reason – with other enforcement mechanisms. The focus here is usually on economic markets, but mutually beneficial exchange occurs in the political sphere too, and with a ruler involved, a third party able to enforce the contract is missing by definition. Hence the theoretical tools designed to analyse commitment situations on economic markets are also useful in the analysis of political exchange.

The situation at issue here is a case in kind. Basically, the exchange took place between a ruler, who supplied a currency and demanded taxes or other dues, and the consumers who, preferred using money over barter, therefore demanded a currency, and in return paid taxes etc. In this, conditions in the Middle Ages did not fundamentally differ from those assumed in models that are designed to capture the present. For a modern government, reneging on the implicit contract that links it with the consumers means setting an inflation rate that exceeds the public's expectations. For the consumers, it means evading taxes or 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.).

Despite the overall similar structure of the situation, medieval conditions differed in a number of important respects from modern ones. As mentioned above, feudal rulers could reap 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 (which usually played a minor

role in the period analysed here), they could attempt to evade customs or refuse to accept the currency that was locally provided.

This latter option, which in effect meant exiting to a different supplier of money (cf. Hirschman, 1970), merits closer attention. If the consumers' actual or threatened exit was to enable the local ruler credibly to commit himself to preserving monetary stability, a number of conditions had to be given. In the first place, substitutes for the good he provided 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, 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 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 groschen were widely used all over Poland and Prussia,[4] while coins jointly minted by the 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

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

(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).

Models of currency competition are based on the assumption that consumers are a homogeneous group in two respects: first with regard to the information accessible to them (cf. Barro and Gordon, 1983), and second with regard to the structure of their demand for money. The importance of information as such is undisputed: Hayek (1976, pp. 58 ff.) for example pointed out that in order to be able to choose among currencies, consumers must be well-informed about the purchasing power of the monies circulating side by side. What is disputed is whether medieval consumers were willing or able to access comparable information, i.e. data on the bullion content of the coinage. Thus, Sargent and Velde (2002, p. 17) assume that money was used 'by tale', that is, that consumers were concerned with the face value of the units they handled rather than with the content of fine gold or silver.[5] Rolnick et al. (1996, p. 802), by contrast, claim that agents were aware of the intrinsic value of money, using it 'by weight'. However, there is abundant evidence indicating that this cannot have been the case. For example, in the mid-fifteenth century, the council of the city of Cologne repeatedly complained about the influx of foreign imitations of the domestic coinage (Stein, 1895, pp. 310 f., 356). The council's countermeasure was to cut any foreign imitation that they detected in half (Stein, 1895, p. 341). This clearly indicates that consumers were using money not by weight, but by tale:

[5] This assumption implies that information – here: information on the bullion content of the coinage – was not a free good and that transaction costs were positive. Oddly enough, with regard to the use of small change in large transactions and to the information on the supply of and demand for money, which was accessible to politicians, Sargent and Velde's implicit assumption is that transaction costs were zero.

damaging the coins reduced them to their material value. Other evidence is from e.g. Hamburg, where in 1479 Johannes Zoltmann was jailed because he had tried to sell rhineguldens that had been ‘so to say falsified by clipping’ (Koppmann, 1878, p. 362). This was common practice: already twenty years earlier, the council of Hamburg had complained that ‘here in this city and its surroundings genuine rhineguldens are being shaved and clipped, thereby losing their just weight and content of bullion’. Similar incidents are recorded for 1567 (Bollandt, 1960, pp. 81, 421). Shaving and clipping the edges of coins would obviously have been pointless if consumers had used them by weight.

However, complaints such as those surfacing in Cologne and Hamburg and countermeasures such as cutting foreign imitations in half presuppose that some people at least did have access to information both on the correct and the actual fine gold and fine silver content of the coinage. Members of urban councils were often among these privileged consumers, as many councils and other political authorities organized so-called assays, having foreign money chemically tested (cf. Ropp, 1878, pp. 223 f.; Cahn, 1895, pp. 169 ff.; Munro, 1972, p. 212 ff.). Merchants, money changers and goldsmiths also seem to have been better informed than the average man on the street.[6] The difference is stressed in a letter written by the council of Koenigsberg to the grandmaster of the Teutonic Order in 1521. The grandmaster had just begun another war against Poland in the course of which he had debased his currency. The councillors pointed out that so far, only merchants knew about the scale of the debasements: ‘We will and can not disclose this to our common people, for what wailing and lament they would raise if they learned of

[6] This was indicated by Copernicus in the memorandum on monetary policies that he submitted to the Prussian estates in the 1520s (Sommerfeld, 1978, p. 35).

this, your grace can easily imagine…' (Arnold and Hubatsch, 1968, p. 218). While in practice there may have been finer distinctions, Sussman and Zaira (2003, p. 1776) seem to be correct overall when they distinguish between two groups of consumers, i.e. between experts on the one hand, who were able to obtain information on the bullion content of the coinage at relatively low costs, and less well-informed consumers on the other, who were less able to assess the material value of money.

In the present context, the important point about this distinction is the fact that the first group of consumers – specialists such as goldsmiths, professional money changers, long-distance merchants and political authorities who organised assays – was a small minority, whereas the vast majority of the population – people most of whom were illiterate and probably did not handle money on a day-to-day basis – faced prohibitive costs when trying to obtain information about the fine gold or fine silver content of the coinage. As coins circulating at that time were not marked with their face values, and as even those belonging to the same currency and having the same face value were not exactly identical, members of this second group tended to value all monetary units at 1:1 that looked superficially similar and had roughly the same weight. It was they who used money by tale.

The other assumption about consumer homogeneity, on which models of currency competition are based, concerns the structure of the demand for money. Today, each polity supplies just one distinct currency, which is used by all local consumers. In late medieval Europe, this was not necessarily the case. As indicated in the previous section, many rulers did not only provide silver money, but also gold. Both circulated side by side (usually at flexible rates), but fulfilled different functions and were demanded by different (though partly overlapping) groups of consumers. Gold was predominantly used by consumers of the first group characterised above, that is by long-distance merchants, goldsmiths or

money changers who were well-informed about the intrinsic value of the coins they handled. Silver, on the other hand, dominated small-scale exchange and local markets; it was used by people belonging to the larger and less well-informed second group of consumers (Spufford, 1991, p. 283).

A further point should be noted in this context. There were relatively cheap ways of obtaining information on the bullion content of the coinage: apart from the specific know-how, all that was needed was a pair of precision scales, a touchstone and a set of needles such as those described e.g. by Georgius Agricola in his treatise on mining (Agricola, 1556/1912, pp. 253 ff.). Such needles were made of silver or gold of differing, but known fineness. When the edge of the coin that was to be tested was lightly rubbed on the stone, it left a gray or yellow streak, whose colour could then be compared with lines left by the needles. In this way, the fineness of a coin could be determined to within at least 4 percent, and an expert with some experience could achieve an accuracy of 2-3 percent (Gandal and Sussman, 1997, pp. 443 f.). Better results required melting the coin. The important point about this is that relative to the value of the coin, the costs of testing gold were lower or, conversely, the costs of not testing it higher. Therefore even expert consumers would be more ready to make sure that the high-purchasing power gold coins, which they handled, had the correct bullion content than to perform similar tests on low-purchasing power coins made of silver.

Informational asymmetries, the differing structure of demand and the different incentives for analysing gold and silver coins had crucial implications for the ability of rulers credibly to commit to monetary stability. As the evidence of clipped and shaved rhineguldens shows,

there must have been consumers who used such coins by tale,[7] but most consumers of gold belonged to the relatively small first group whose members were better-informed about monetary standards than the average customer on local markets. They were therefore in the position to refuse to accept currencies that they regarded as instable. Under these conditions, a ruler who debased his gold just drove gold consumers into the arms of his competitors, who supplied more stable types of guldens. Note that this outcome is the same regardless of whether we assume a hypothetical perfectly informed consumer or, more realistically, just a relatively well-informed one. A perfectly informed consumer would have recognised debased gold without the need to perform any tedious tests, for example when the mint offered it to him, and would then have been willing to accept the coin at its material value. However, the mint would not have been prepared to sell it at that price because the whole point of the debasement was increasing the seignorage that resulted from the difference between the coin's nominal and material value. The perfectly informed consumer would then have turned to other suppliers of gold, just as the relatively well-informed consumer would have done after testing the coinage. So, no matter what we assume with regard to information, where the supply of gold was concerned reputation was sufficient as a mechanism to ensure a ruler's compliance with the implicit contracts that linked him and the minority group of consumers. The result was the relative stability of the gold currencies issued between the fourteenth and the sixteenth centuries and shown in fig. 2 above.[8]

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[7] This was also the case in England where the English noble and its Flemish imitation (whose content of fine gold was lower) circulated at par (Munro, 2000, p. 187). The English government enjoyed an exceptionally good reputation in monetary policies, providing one of the most stable silver currencies of Europe (Spufford, 1991, p. 295). Arguably, English consumers were therefore more trustful than consumers elsewhere.

[8] 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 et al. (1990). For fear of a loss of reputation,

Commitment to stable silver, on the other hand, was not possible that easily, as any ruler who debased his silver coinage would still find consumers willing to accept his inferior product. These consumers were not necessarily all badly-informed. Even well-informed specialists might be interested in debased silver as long as they could pass on these coins to the majority group of badly-informed consumers (they could not do this with gold because the majority of consumers did not demand gold). In 1539, the council of Hamburg gave a vivid description of such practices, claiming

> '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).

Eventually knowledge about the low bullion content would spread to the wider population; whilst at the same time people would realise that money was less tight (cf. Sussman and Zeira, 2003). The result would then be a rise in nominal prices. As for the commitment problem, the important point is that Gresham's law, which is frequently claimed only to hold for monetary units whose exchange rates are legally fixed (Hayek, 1976, p. 35), could operate on the late medieval market for silver currencies even when no political authority tried to impose exchange relations. Suppliers of silver could therefore behave *as if* they had no competitors and *as if* consumers had no exit option. Under such circumstances, rulers could not credibly commit to the stability of silver

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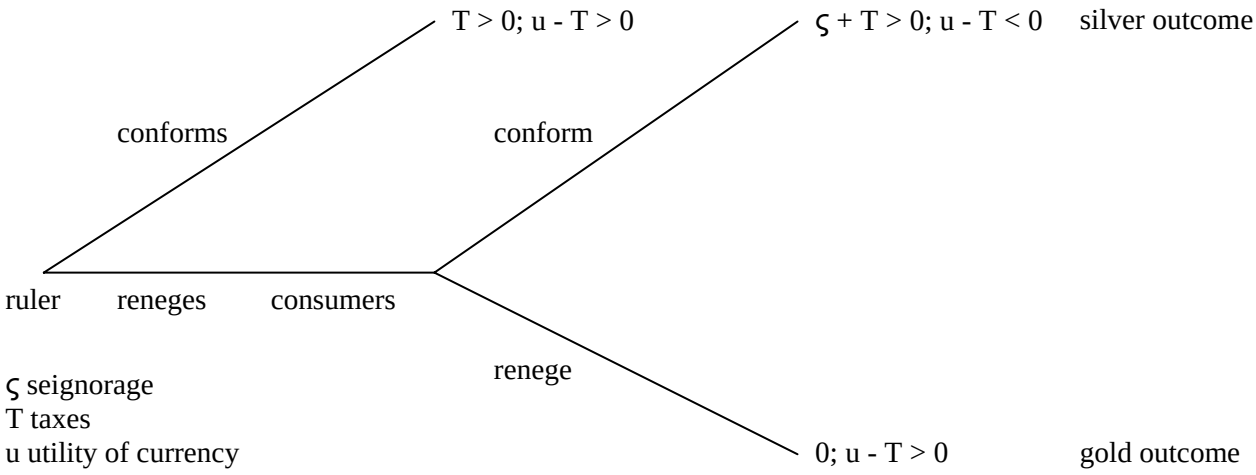
most princes preferred introducing new types of gold coins – easily recognisable due to their new design – to simply changing the bullion content of an existing type. This limits the number of gold currencies available for analysis over extended periods of time.

currencies. Small wonder that they debased them to the extent indicated in fig. 2. The interaction between rulers and consumers being structured like a sequential game, it is possible to represent it in a stylised form:

Fig. 3: The commitment-game between suppliers of money and consumers



Rulers can conform, providing a stable currency, in which case they receive no seignorage but taxes. For the consumers, the payoff consists of the utility of a stable currency minus the taxes they pay; it is still positive. Rulers can also renege, that is, debase the currency. If they do this with silver, they receive not only taxes but also a seignorage, while once information on the reduced standard of the coinage has spread, the consumers face the disutility of a debased currency on top of having to pay taxes. If rulers debase gold, however, consumers quickly notice this. Rulers will consequently receive no seignorage (being unable to sell their debased gold) and no taxes (having driven away the consumers). The consumers, on the other hand, enjoy the utility of an alternative gold-based currency, to whose supplier they pay taxes. Where silver is concerned, reneging is the dominant strategy for rulers, giving them their optimal payoff of seignorage plus taxes. However, for gold, conforming is

dominant because receiving taxes and no seignorage is better than receiving neither.[9] This – and not the rulers' well-meaning but misguided attempts to satisfy demand for small change by debasing the coinage – caused what Cipolla (1956) called 'the big problem of the petty coins'.

2.3. The advanced commitment situation: a solution for silver

Was there a solution to this problem in the late Middle Ages? The answer to this question is a tentative 'yes'. 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. Practically all merchants used silver for smaller purchases, retailing or in some regions such as the Baltic even for large payments (Spufford, 1991, pp. 282 f.). They 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 territories of Brunswick-Lueneburg or Prussia at the beginning of the fifteenth century. Still, on its own the fact that the few well-informed merchants, moneychangers and goldsmiths, who were unhappy with the money supplied by a local ruler, did have an exit option was insufficient to enable rulers to credibly commit to preserving the stability of their silver – after all, there was a large group of badly-informed consumers willing to accept debased coins. Under such conditions, reputation was no effective enforcement mechanism, so that rulers had to find a way to bind themselves if they wanted to credibly commit to monetary stability.

Involving an independent authority in the management of the currency was the solution most feudal rulers found. Thus, in 1380 the grandmaster

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[9] As Greif (2005, pp. 753 f.) pointed out, '[t]he prospect of losing future economic gains following an abuse can constrain coercive power even in the absence of countervailing coercive power. … Abuses can also be deterred by the expectation that the economic agents will shift their activities following an abuse in a manner that would be costly to the abuser'.

of the Teutonic Order 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. For example, already in 1189 Emperor Frederick I had conceded 'the right … to examine the pennies made by the coiners as to their weight and fineness' to the burghers of the city of Hamburg (Jesse, 1924, p. 27; cf. Berghaus, 1964, p. 77; Nau, 1964a, p. 145). 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. Urban control of a princely mint was thus a means of spreading information about whether the ruler reneged on the implicit contract between himself and the consumers who used his money. With 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 choose a more reliable supplier.[10] This, in turn, gave the rulers an incentive to comply with the contract. Thus 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 also take over the entire

[10] Milgrom et al. (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.).

management of monetary policies.[11] This is a policy to which the institutional environment of the Holy Roman Empire was eminently suitable, as rights claimed by political authorities had long become an object of exchange (Landwehr, 1971/86). The dukes of Brunswick-Lueneburg, who realised that their revenues suffered from the exit of mercantile capital due to the debasement of their coinage, chose this solution 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 issue their currency to the largest and most influential city within their territory, giving the burghers and magistrates of Brunswick 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.). By the middle of the sixteenth century, similar rights had been acquired by at least 80 to 90 Central European cities (Berghaus, 1964; Nau, 1964a; 1964b).

The grant to Brunswick was exceptional as the document, in which it was recorded, explicitly justified it with the exit of merchants and with revenue losses that the dukes suffered due to debasements. In most cases, by contrast, the motives of the parties involved were not

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[11] Comparable strategies were analyzed by Greif (2005, p. 755): 'By not creating an effective administration to govern a particular economic sphere, a ruler can commit not to abuse rights in that sphere because limited administration increases his cost of confiscation. … By being absent from a particular economic sphere – in the sense of not having an effective administration – a state can better commit to respect rights. … Commitment to not abuse the rights of asset holders can also be achieved by delegating state administration to these asset holders. Instead of having an administration controlled by the state, public goods and services to the state are provided directly by the asset holders'.

mentioned. The fact that not only Brunswick but many other cities were prepared to pay for such a right doubtless played a part. Still, in the present context motives are of secondary importance. The transfer of the right of coinage to a city may have been due to all kinds of considerations; regardless of what a ruler tried to achieve, the (possibly unintended) outcome of his decision was that he created a strong constraint on his future monetary policies. In fact, giving up his right to meddle with the coinage was the strongest conceivable means to restrict his future scope of action. He 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 the city to which he transferred the right to determine monetary policies would find their way into his coffers through the payment of customs and other dues. Functionally, such a transfer was therefore equivalent to establishing an independent central bank.

Still, this solution to the credibility problem posed two problems of its own, both of which have parallels under modern conditions. Firstly, 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 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 the dukes of Brunswick-Lueneburg concluded their contract with the city of Brunswick, they promised 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). In a similar vein, when the duke of

Mecklenburg granted the right to mint pennies to the city of Wismar, he promised not to strike any pennies of the type issued there; ‘however, if we want to have pennies minted …, we will mint or make them equal to and in the same manner as Slavic pennies’ (Jesse, 1924, pp. 32 f.) – these could easily be distinguished from the money of Wismar.

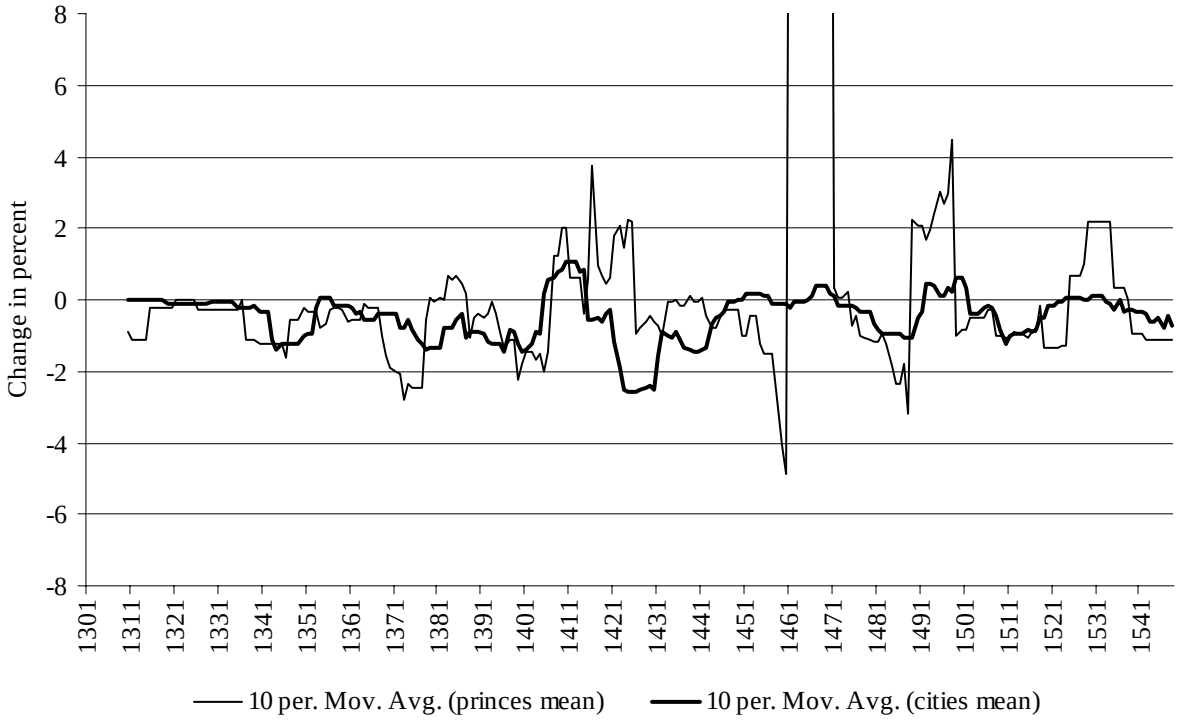
In the absence of effective third party enforcement, why did rulers comply with such clauses? Here again reputation was crucial, allowing *public* commitment to a rule (Lohmann, 1998, p. 15). This commitment would be effective even though the supply of silver was concerned, and the number of consumers was greater and their ability to acquire information smaller than in the case of 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 he, being the local supplier, clandestinely reduced the standard of his silver coinage, most consumers would realise this only after some time. By contrast, if he, having once renounced his right of coinage in favour of a city, began to issue money again, even illiterate consumers would notice this – except, of course, if his coins were such 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 on the ruler’s defection readily available. If he violated the rule, he would pay a political price or, to use a term coined by Lohmann (2003, p. 100), an ‘audience cost’ – the audience being the consumers who now were able to detect his defection. In this way, he would be able credibly to commit to respecting the stability of the local silver coinage.

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 them 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, 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 determined monetary policies, but rather a group of people, the costs of making decisions about changes to 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. To determine whether this was the case, we will ignore cases where cities just had the right to supervise princely mints, and concentrate on the distinction between currencies issued by feudal and urban authorities. As urban rights of coinage were a predominantly Central European phenomenon, we also restrict the analysis to this area. The following graph charts the un-weighted average of the yearly rates of change in the standard of 6 feudal and 10 urban currencies.

Fig. 4: Yearly rates of change in the standard of princely and urban currencies



Princely: Bohemia, Flanders, Holland, Meissen, Prussia, Vienna; urban: Basel, Bern, Cologne, Constance, Goslar, Hanover, Kempten, Nuremberg, Strassburg, Zuerich. Sources: See appendix. For the extreme volatility of princely currencies in the 1450s and early 1460 see fig. 2 above.

Both curves are roughly parallel, with common peaks (periods of reinforcement) in about 1410, 1470, 1490-1500 and 1530, and common troughs (periods of exceptionally strong debasements) in about 1340-50, 1390-1400, 1490, 1510 and 1540-50. This suggests that their course is not random, that is, that urban and princely monetary policies either were interdependent or subject to common external shocks. However, on the whole differences are more readily apparent than similarities, and interestingly, the main difference between urban and princely currencies is not in their rates of debasement but rather in their volatility. For the whole period, the mean standard deviation for urban currencies is 0.021, while that for princely currencies is 0.068; the latter were therefore on average about three times as volatile as the former. The sample is relatively small, as we still lack much information in particular on the standard of princely currencies which, due to the primitive state of development of territorial bureaucracies, is less well recorded than the coinage produced by cities. However, it is plausible that on the whole, princely currencies were affected more often by changes in their standard than urban ones, and that these changes were more violent. Hence, granting a city the right to strike its own coins was really a way for a ruler to credibly commit to respecting monetary stability. The result was not the introduction of a token coinage, but low-purchasing power coins were at least supplied in a more predictable way than otherwise. This was a viable solution to the ‘big problem of the petty coins’.

3. Conclusion

This paper takes its cue from a classic lecture given by Carlo M. Cipolla (1956) in 1953. There, Cipolla examined the problems many late medieval governments had with the supply of a stable currency composed of low-purchasing power denominations (made of silver).

Interestingly, high-purchasing power coins (made of gold) posed no such problems. The present study offers a systematic explanation of this phenomenon, shows how the problem could be solved, and at the same time contests the explanation recently advanced by Sargent and Velde (2002).

A closer examination of their arguments reveals that they misunderstood Cipolla, arguing that even in currencies based on silver alone, the depreciation of small coins relative to larger ones was a 'persistent and pervasive' phenomenon. Data on monetary standards show, by contrast, that while such depreciations and the concurrent debasements occasionally did occur in the late Middle Ages and at the beginning of the early modern era, they were rather exceptional. Sargent and Velde's model is moreover based on a number of implicit assumptions which contradict each other at least in part: On one hand, the authors assume that consumers use money by tale, which implies that information on the bullion content of the coinage is not free and that transaction costs are positive; on the other hand, however, consumers are willing to pay for large items with petty coins, which makes sense only when transaction costs are zero. Furthermore, politicians are not only perfectly informed about the supply of and demand for specific denominations – which again implies free information and zero transaction costs –, they are also willing to act in the public interest, which they correctly perceive. These assumptions are not only inconsistent, but (apart from the one relating to consumers who used money by tale) also lacking support from what late medieval sources reveal of human behaviour. Thus, Sargent and Velde's attempt to explain economic policy without political economy fails for two reasons: empirically because while small change depreciation and debasement relative to large coins did occur in the fourteenth to sixteenth centuries, it was no 'pervasive and persistent' phenomenon but a rare exception, and theoretically because

their model is based on inconsistent assumptions. An alternative explanation that explicitly refers to the problem first identified by Cipolla must take positive transaction costs, imperfect information and self-interested behaviour into account – it must, in short, be compatible with modern political economy.

The underlying hypothesis of the explanation suggested here is that the rapid debasement of silver relative to gold was a result of the weak ability of late medieval rulers to credibly commit to upholding the stability of silver currencies. Commitment was important both for the long-term welfare of their subjects and for their princely revenues, as many 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 profit from increasing the seignorage. 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 here 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, the common assumption of homogeneous consumers is relaxed, with two groups of consumers being distinguished: on one hand, there are those who are able at low costs to acquire information about the bullion content of the coins which they handle. 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 or international markets, while the other group needs 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 to commit credibly to monetary stability. However, this is only the case if two conditions hold: First, information on a ruler's defection must spread quickly among consumers, and second, 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 reductions 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. The conditions are not present as far as the second group of consumers is concerned, among whom changes in the standard of the silver coinage remain undetected for longer periods 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 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. This is supported by the data.

However, long-distance merchants did not only demand gold, but also silver, which they occasionally needed for large transactions and frequently for 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, though the incentive would be weak due to the rulers' chance of finding consumers unable to notice debasements. In this situation, a ruler had to 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 coinage to an independent authority was such a method. In the late Middle Ages, this independent authority would usually be a town.

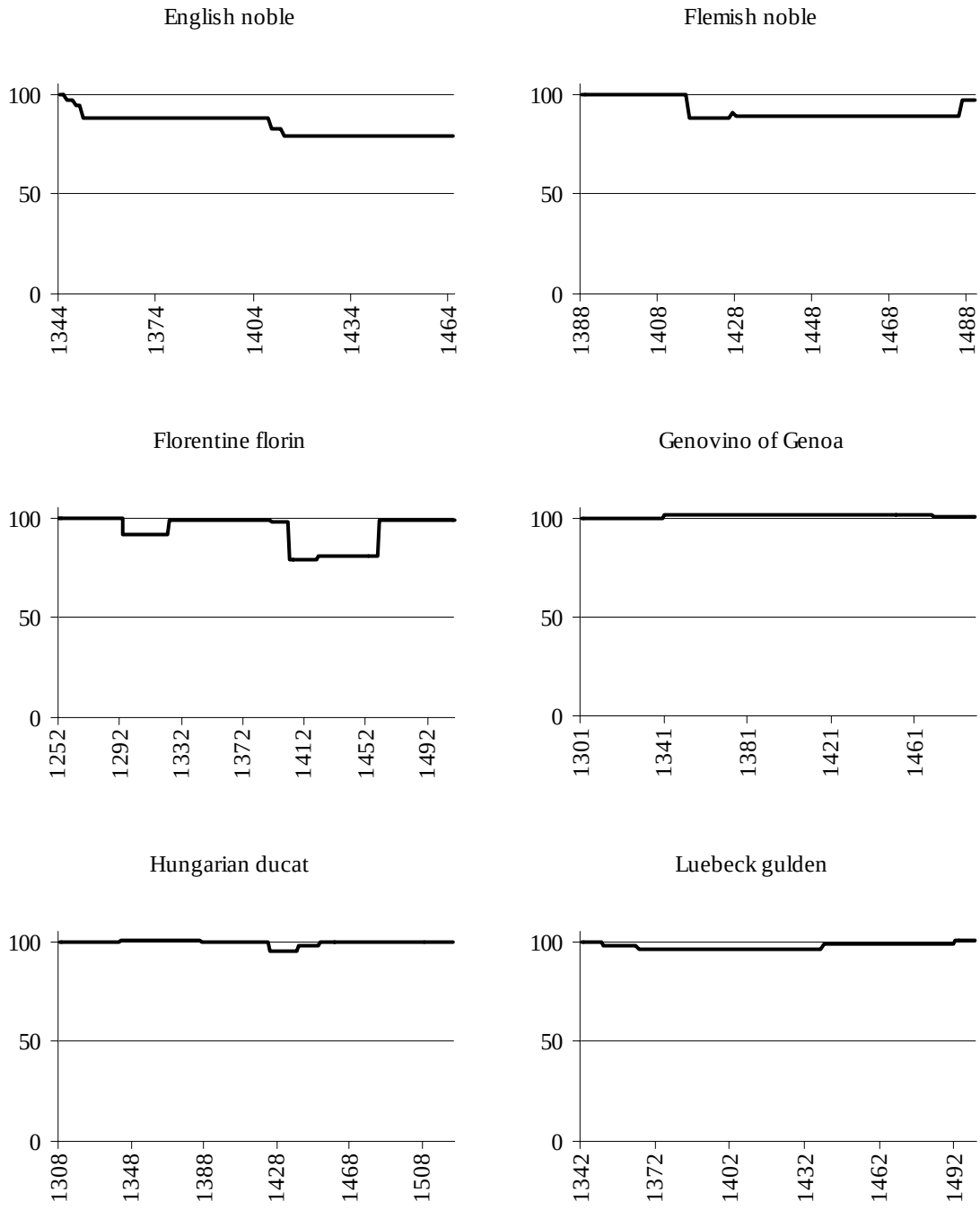
Rulers could credibly commit to respecting exclusive minting right granted to a town because here their defection would be immediately obvious. Urban authorities, too, had to credibly commit to the preservation of monetary stability. However, for them this was easier than for territorial rulers: They were governed by councils, whose members would not have benefited individually 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 due to discontent with the coinage. Consequently, cities debased their coinage less frequently than territorial rulers. Thus, conferring the right to determine monetary policies to them really made the rulers' commitment to monetary stability credible.

To summarize, the stability of high-purchasing power gold coins relative to low-purchasing power silver money was due to the fact that gold was demanded by consumers able to detect a ruler's defection and to exit to another supplier; here, reputation allowed the ruler to commit credibly to monetary stability. Consumers of silver faced higher costs when they wanted to detect changes in the standard and were therefore willing to accept debased coins. This caused Cipolla's 'big problem of the petty coins'. The problem could be solved by establishing an independent agency responsible for monetary policies. As infringements of this agency's independence would be immediately obvious to a wider audience, the ruler could here enter a credible commitment. Data on the

rates of debasements of urban and princely currencies support the conclusion that this mechanism by and large solved the problem of maintaining the stability of low-purchasing power silver coins.

Appendix: The currencies

Fig. 5: Fine gold content, indices (earliest documented value = 100)



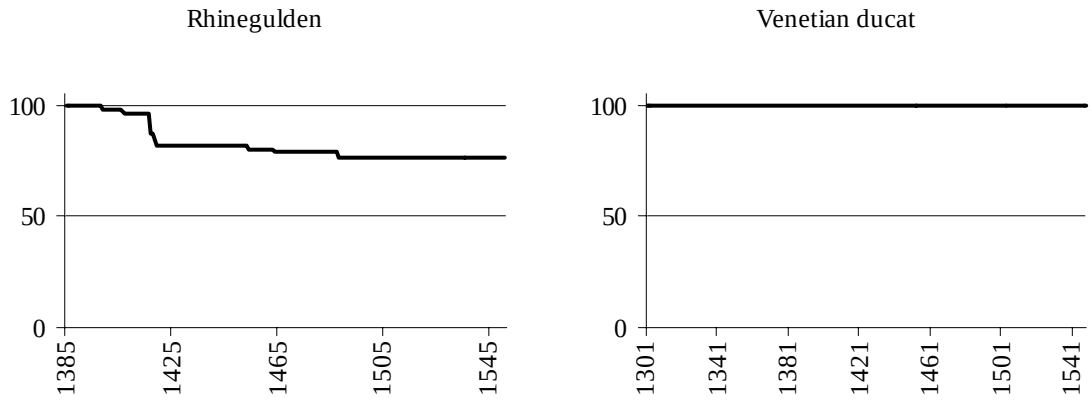
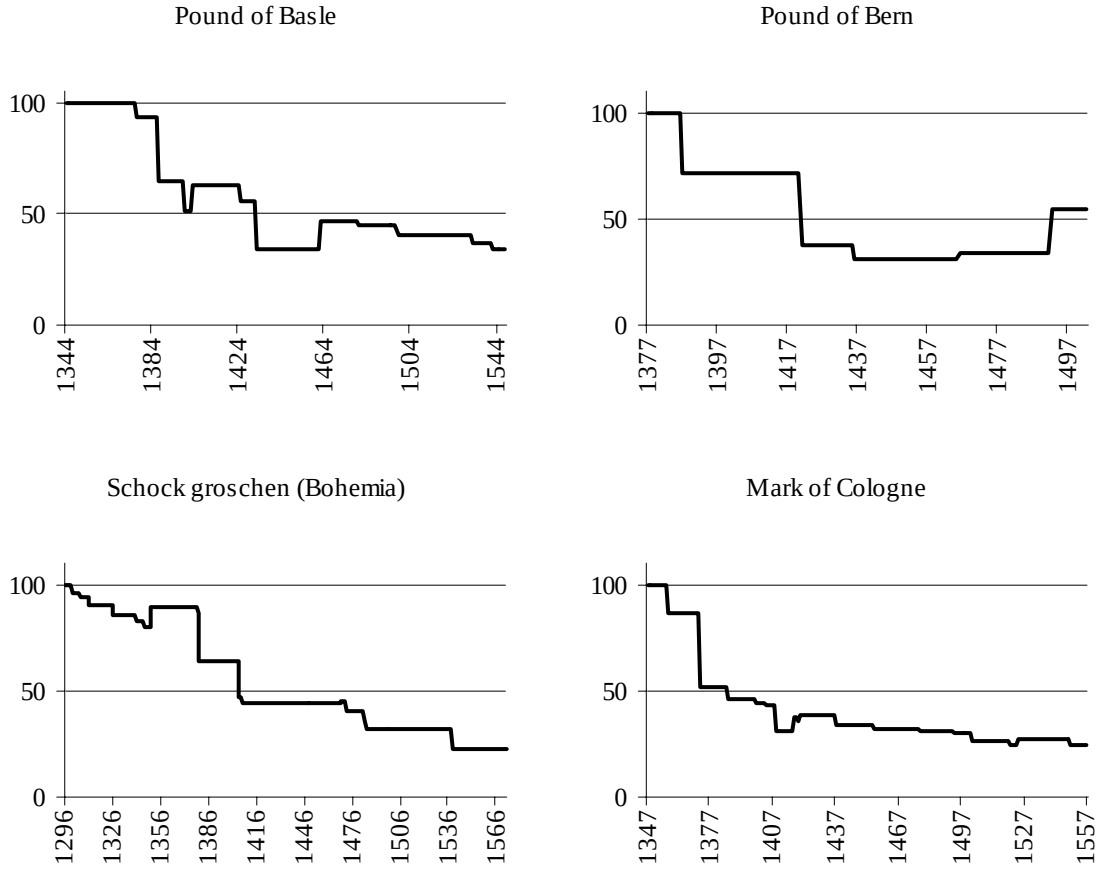
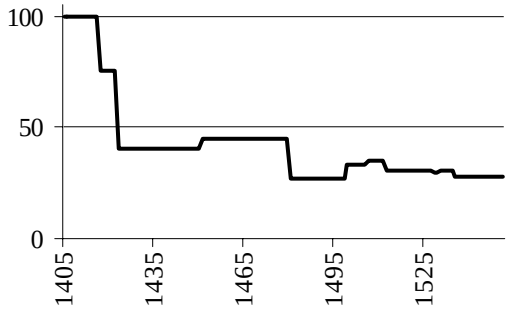


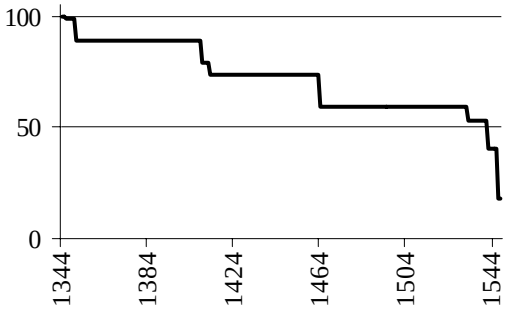
Fig. 6: Fine silver equivalent of the units of account, indices (earliest documented value = 100)



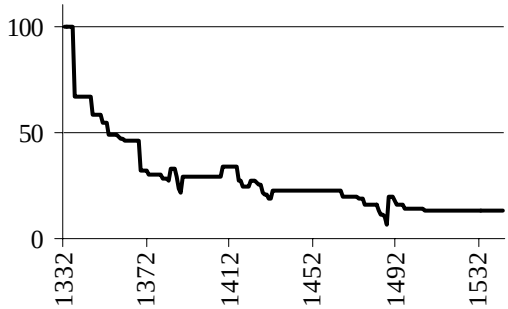
Pound of Constance



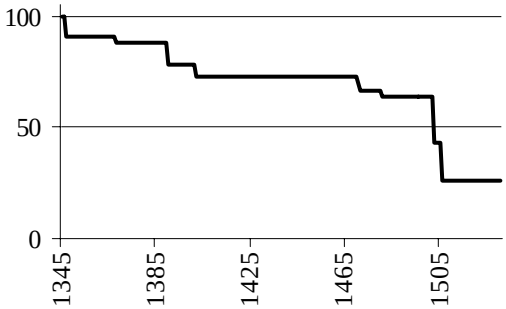
Pound sterling (England)



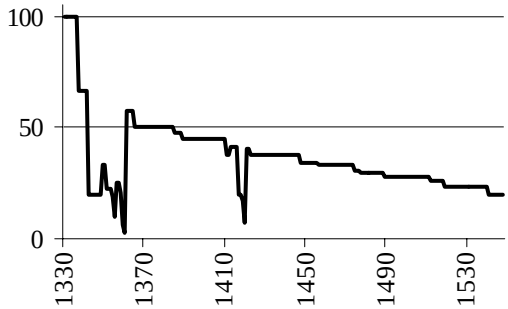
Pound grote (Flanders)



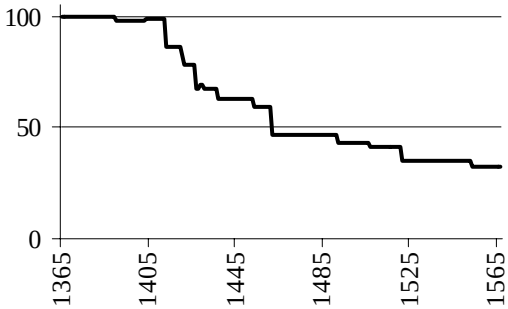
Lira of Florence



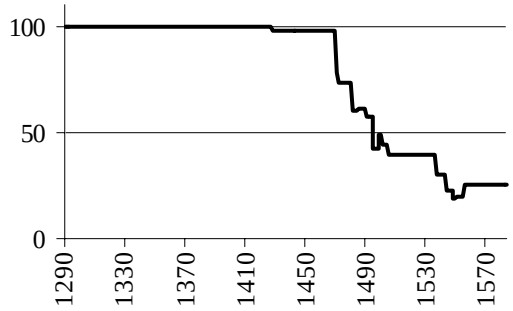
Livre tournois (France)



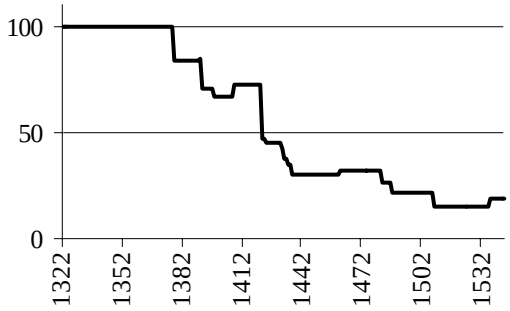
Lira of Genoa



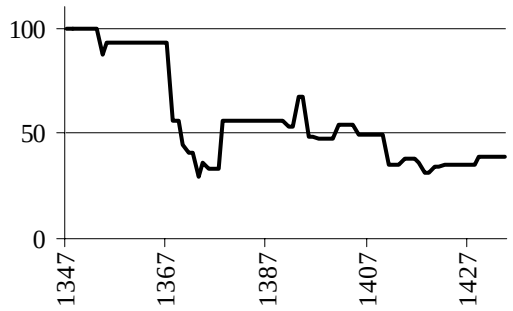
Pound of Goslar



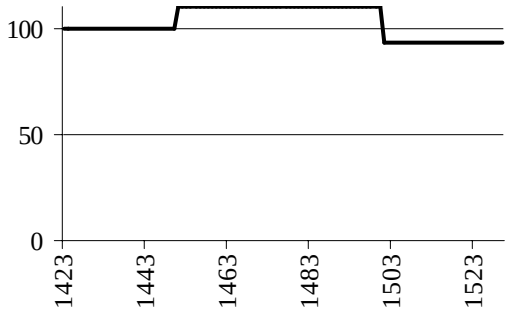
Pound of Hanover



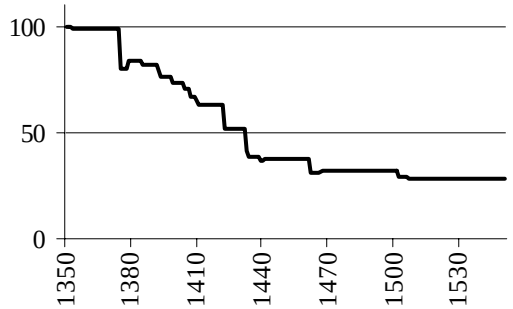
Pound of Holland



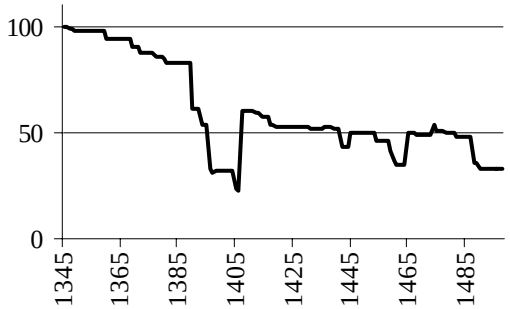
Pound of Kempten



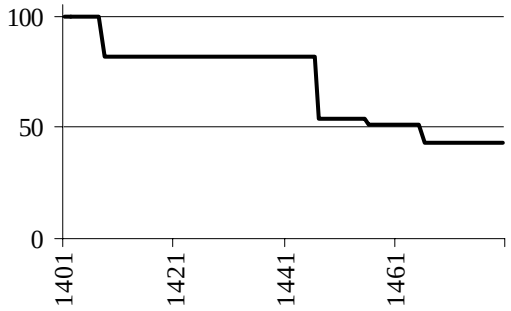
Mark of Luebeck



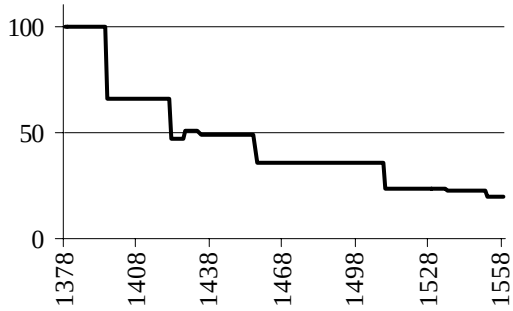
Schock groschen (Meissen)



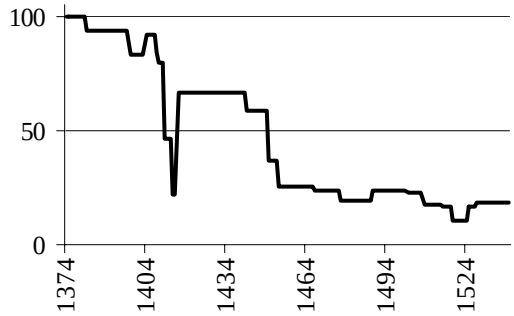
Lira of Milan



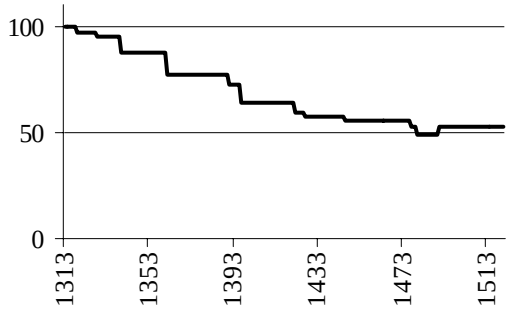
Pound of Nuremberg



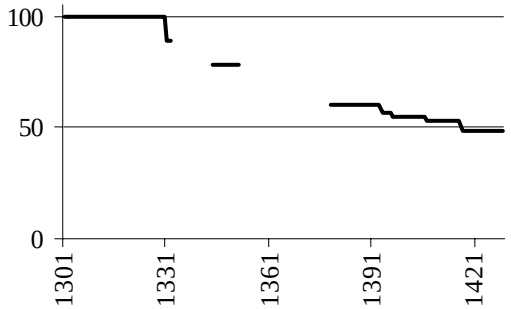
Mark of Prussia



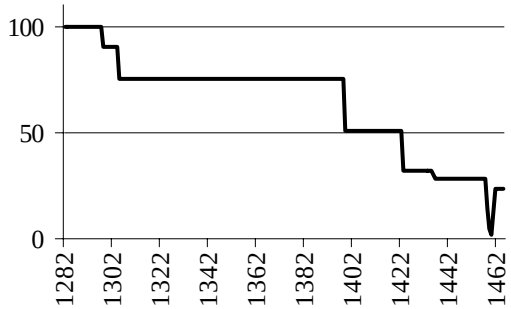
Pound of Strassburg

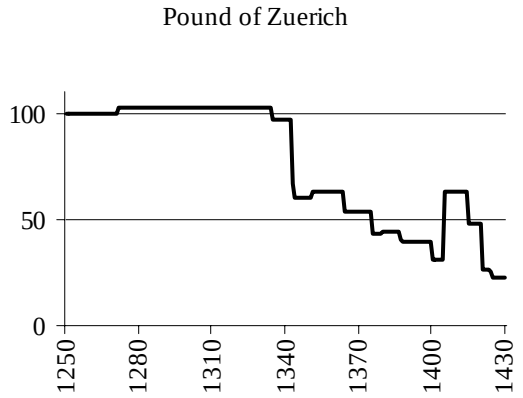


Lira a grossi (Venice)



Pound of Vienna





Gold: English noble (Challis, 1992); Flemish noble (Munro, 1972; Pusch, 1932); Florentine florin (Bernocchi, 1976); Genovino of Genoa (Pesce and Felloni, 1976), Hungarian ducat (Huszár, 1970-72; Schalk, 1880); Luebeck gulden (Dittmer, 1860; Ropp, 1878; Schäfer, 1888);Rhinegulden (Weisenstein, 2002), Venetian ducat (Lane and Mueller, 1985). Silver: Basle (Harms, 1907; Altherr, 1910; Cahn, 1901), Bern (Cahn, 1901; Geiger, 1968), Bohemia (Castelin, 1973), Cologne (Metz, 1990), Constance (Cahn, 1911), England (Challis, 1992), Flanders (Munro, 1972; Pusch, 1932), Florence (Bernocchi, 1976), France (Blanchet and Dieudonné, 1912), Genoa (Pesce and Felloni, 1976), Goslar (Buck et al., 1995), Hanover (Buck and Meier, 1935), Holland (Grolle, 2000), Kempten (Cahn, 1911; Häberle, 1935), Luebeck (Jesse, 1928), Meissen (Krug, 1974), Milan (Cipolla, 1990); Nuremberg (Scholler, 1916), Prussia (Volckart, 1996), Strassburg (Cahn, 1895), Venice (Lane and Mueller, 1985), Vienna (Huber, 1871; Schalk, 1880), Zuerich (Schwarz, 1940; Wielandt, 1959).

References

Agricola, G. (1556/1912). *De re metallica.* London: The Mining Magazine.

Altherr, H. (1910). *Das Münzwesen der Schweiz bis zum Jahre 1798 auf Grundlage der eidg. Verhandlungen und Vereinbarungen.* Bern: Stämpfli & Cie.

Arbusow, L. (ed.) (1910). *Akten und Recesse der livländischen Ständetage*, vol. 3 (1494 - 1535). Riga: Deubner.

Arnold, U. and Hubatsch, W. (eds.) (1968). *Scriptores Rerum Prussicarum: Die Geschichtsquellen der preußischen Vorzeit bis zum Untergang der Ordensherrschaft*, vol. 6. Frankfurt: Minerva.

Barro, R. and Gordon, D. B. (1983). Rules, Discretion and Reputation in a Model of Monetary Policy. *Journal of Monetary Economics* 12, 101-121.

Berghaus, P. (1964). Die Münzpolitik der deutschen Städte im Mittelalter. In *Finances et comptabilité urbaines du XIII au XVI siècle: Financien an boekhouding der steden van de XIIIe tot de XVIe eeuw* (ed. Centre Pro Civitate)*.* Bruxelles: Pro Civitate, 75-85.

Berghaus, P. (1965). Umlauf und Nachprägung des Florentiner Guldens nördlich der Alpen. In *Congresso Internazionale di Numismatica, Roma 11–16 settembre 1961*, vol. 2: Atti*.* Rome: Commision Internationale de Numismatique, 595-607.

Bernocchi, M. (1975). *Le monete della Repubblica Fiorentina*, vol. 2: Corpus Nummorum Florentinorum*.* Firenze: Leo S. Olschki.

Bernocchi, M. (1976). *Le monete della Repubblica Fiorentina*, vol. 3: Documentazione*.* Firenze: Leo S. Olschki.

Blanchet, A. and Dieudonné, A. (1912). *Manuel de numismatique Française*, vol. 2: Monnaies royales Françaises depuis Hugues Capet jusqu'a la Révolution*.* Paris: Picard.

Blockmans, F. and Blockmans, W. P. (1979). Devaluation, Coinage and Seignorage under Louis de Nevers and Louis de Male, Counts of Flanders, 1330-84. In *Coinage in the Low Countries (880-1500): The Third Oxford Symposium on Coinage and Monetary History* (ed. Mayhew, N. J.). Oxford: B.A.R., 69-94.

Boerner, L. and Ritschl, A. (2002). Individual Enforcement of Collective Liability in Premodern Europe: Comment. *Journal of Institutional and Theoretical Economics (JITE)* 158, 205-213.

Bollandt, J. (ed.) (1960). *Hamburgische Burspraken 1346 bis 1594 mit Nachträgen bis 1699*, vol. 2: Bursprakentexte. Hamburg: Hans Christians Druckerei und Verlag.

Bote, H. (1880). Von der pagemunte. In *Chroniken der niedersächsischen Städte: Braunschweig*, vol. 2 (ed. Historische Kommission bei der Königlichen Akademie der Wissenschaften). Leipzig: S. Hirzel, 409-450.

Buck, H., Büttner, A. and Kluge, B. (1995). *Die Münzen der Reichsstadt Goslar: Münzgeschichte und Geprägekatalog.* Berlin: Gebr. Mann Verlag.

Buck, H. and Meier, O. (1935). *Die Münzen der Stadt Hannover.* Hannover: Selbstverlag der Hauptstadt Hannover.

Burleigh, M. (1984). *Prussian Society and the German Order: An aristocratic corporation in crisis c. 1410-1466.* Cambridge, London, New York, New Rochelle, Melbourne, Sydney: Cambridge University Press.

Cahn, J. (1895). *Münz- und Geldgeschichte der Stadt Strassburg im Mittelalter.* Strassburg: Trübner.

Cahn, J. (1901). *Der Rappenmünzbund: Eine Studie zur Münz- und Geld-Geschichte des oberen Rheinthales.* Heidelberg: Carl Winter's Universitätsbuchhandlung.

Cahn, J. (1911). *Münz- und Geldgeschichte von Konstanz und des Bodenseegebietes im Mittelalter bis zum Reichsmünzgesetz von 1559.* Heidelberg: Carl Winter's Universitätsbuchhandlung.

Castelin, K. (1973). *Grossus Pragensis: Der Prager Groschen und seine Teilstücke; 1300 - 1547.* Braunschweig: Klinkhardt & Biermann.

Challis, C. E. (ed.) (1992). *A New History of the Royal Mint*. Cambridge: Cambridge University Press.

Cipolla, C. M. (1956). *Money, Prices and Civilization in the Mediterranean World, Fifth to Seventeenth Century.* New York: Gordian Press.

Cipolla, C. M. (1990). *Il governo della moneta a Firenze e a Milano nei secoli XIV-XVI.* Bologna: Società editrice il Mulino.

Dhont, J. (1964). Conclusions générales. In *Finances et comptabilité urbaines du XIII au XVI siècle: Financien an boekhouding der steden van de XIIIe tot de XVIe eeuw* (ed. Centre Pro Civitate). Bruxelles: Pro Civitate, 351-378.

Dittmer, H. C. (1860). Geschichte der ersten Gold-Ausmünzungen zu Lübeck im 14. Jahrhundert. *Zeitschrift des Vereins für Lübeckische Geschichte und Alterthumskunde* 1, 22-78.

Gandal, N. and Sussman, N. (1997). Asymmetric Information and Commodity Money: Tickling the Tolerance in Medieval France. *Journal of Money, Credit and Banking* 29, 440-457.

Geiger, H.-U. (1968). *Der Beginn der Gold- und Dickmünzenprägung in Bern: Ein Beitrag zur bernischen Münz- und Geldgeschichte des 15. Jahrhunderts.* Bern: Stämpfli & Cie.

Greif, A. (2000). The Fundamental Problem of Exchange: A Research Agenda in Historical Institutional Analysis. *European Review of Economic History* 4, 251-284.

Greif, A. (2005). Commitment, Coercion, and Markets: The Nature and Dynamics of Institutions Supporting Exchange. In *Handbook of*

New Institutional Economics (eds. Ménard, C. and Shirley, M. M.). Dordrecht: Springer, 727-786.

Greif, A., Milgrom, P. and Weingast, B. R. (1994). Coordination, Commitment, and Enforcement: The Case of the Merchant Guild. *Journal of Political Economy* 102, 745-776.

Grierson, P. (1976). Medieval Numismatics. In *Medieval Studies* (ed. Powell, J. M.). Syracuse: Syracuse University Press, 103-136.

Grolle, J. J. (2000). *De Muntslag van de graven van Holland tot de Bourgondische unificatie in 1434*, vol. 1: Inleiding en Catalogus. Amsterdam: De Nederlandsche Bank.

Häberle, A. (1935). *Ulmer Münz- und Geldgeschichte des Mittelalters.* Ulm: Verlag des Museums der Stadt Ulm.

Harms, B. (1907). *Die Münz- und Geldpolitik der Stadt Basel im Mittelalter.* Tübingen: Verlag der H. Laupp'schen Buchhandlung.

Hayek, F. A. v. (1976). *Denationalisation of Money: An Analysis of the Theory and Practice of Concurrent Currencies.* London: The Institute of Economic Affairs.

Hirsch, T., Töppen, M. and Strehlke, E. (eds.) (1866). *Scriptores Rerum Prussicarum: Die Geschichtsquellen der preußischen Vorzeit bis zum Untergange der Ordensherrschaft*, vol. 3. Leipzig: Hirzel.

Hirschman, A. O. (1970). *Exit, Voice, and Loyalty: Responses to Decline in Firms, Organizations, and States.* Cambridge/MA: Harvard University Press.

Huber, A. (1871). Untersuchungen über die Münzgeschichte Österreichs im 13. und 14. Jahrhundert. *Archiv für österreichische Geschichte* 44, 513-538.

Huszár, L. (1970-72). Der ungarische Goldgulden im mittelalterlichen Münzverkehr. *Hamburger Beiträge zur Numismatik* 24/26, 71-88.

Ireland, P. N. (2002). "Rules Rather Than Discretion" After Twenty Five Years: What Have We Learned? What More Can We Learn? In. Boston: Boston College Department of Economics.

Jesse, W. (ed.) (1924). *Quellenbuch zur Münz- und Geldgeschichte des Mittelalters*. Halle: Riechmann.

Jesse, W. (1928). *Der Wendische Münzverein.* Lübeck: Hansischer Geschichtsverein.

Klein, B. (1974). The Competitive Supply of Money. *Journal of Money, Credit and Banking* 6, 423-453.

Klempin, R. (1859). *Diplomatische Beiträge zur Geschichte Pommerns aus der Zeit Bogislafs X.* Berlin: A. Bath.

Koppmann, K. (ed.) (1878). *Kämmereirechnungen der Stadt Hamburg: 1471-1500*. Hamburg: Hermann Grüning.

Kreps, D. M., Milgrom, P., Roberts, J. and Wilson, R. (1982). Rational Cooperation in the Finitely Repeated Prisoners' Dilemma. *Journal of Economic Theory* 27, 245-252.

Krug, G. (1974). *Die meißnisch-sächsischen Groschen 1338-1500.* Berlin: VEB Deutscher Verlag der Wissenschaften.

Landwehr, G. (1971/86). Mobilisierung und Konsolidierung der Herrschaftsordnung im 14. Jahrhundert. In *Der deutsche Territorialstaat im 14. Jahrhundert*, vol. 2 (ed. Patze, H.). Sigmaringen: Thorbecke, 484-505.

Lane, F. C. and Mueller, R. C. (1985). *Money and Banking in Medieval and Renaissance Venice*, vol. 1: Coins and Moneys of Account. Baltimore, London: John Hopkins University Press.

Lohmann, S. (1998). Reputational versus Institutional Solutions to the Time-Consistency Problem in Monetary Policy. In *Positive Political Economy: Theory and Evidence* (eds. Eijffinger, S. and Huizinga, H.). Cambridge: Cambridge University Press, 9-22.

Lohmann, S. (2003). Why Do Institutions Matter? An Audience-Cost Theory of Institutional Commitment. *Governance: An International Journal of Policy, Administration, and Institutions* 16, 95-110.

Lopez, R. S. (1956). Back to Gold, 1252. *Economic History Review* 9, 219-240.

Metz, R. (1990). *Geld, Währung und Preisentwicklung: Der Niederrheinraum im europäischen Vergleich 1350-1800.* Frankfurt: Fritz Knapp.

Milgrom, P. R., North, D. C. and Weingast, B. R. (1990). The Role of Institutions in the Revival of Trade: The Law Merchant, Private Judges, and the Champagne Fairs. *Economics and Politics* 2, 1-23.

Miskimin, H. (1985/89). The Enforcement of Gresham's Law. In *Cash, Credit and Crisis in Europe, 1300-1600* (ed. Miskimin, H.). London: Variorum Reprints, IX, 147-161.

Munro, J. H. (1972). *Wool, Cloth, and Gold: The Struggle for Bullion in Anglo-Burgundian Trade, 1340-1478.* Brussels, Toronto: University of Toronto Press.

Munro, J. H. (1988). Deflation and the Petty Coinage Problem in the Late-Medieval Economy: The Case of Flanders, 1334-1484. *Explorations in Economic History* 25, 387-423.

Munro, J. H. (2000). The Maze of Medieval Monetary Metrology: Determining Mint Weights in Flanders, France and England from the Economics of Counterfeiting, 1388-1469. *Journal of European Economic History* 29, 173-199.

Nau, E. (1964a). Stadt und Münze im frühen und hohen Mittelalter. *Esslinger Studien* 10, 13-58.

Nau, E. (1964b). Stadt und Münze im späten Mittelalter und beginnender Neuzeit. *Blätter für deutsche Landesgeschichte* 100, 145-158.

North, D. C. (1993). Institutions and Credible Commitment. *Journal of Institutional and Theoretical Economics (JITE)* 149.

North, M. (1990). *Geldumlauf und Wirtschaftskonjunktur im südlichen Ostseeraum an der Wende zur Neuzeit (1440-1570): Untersuchungen zur Wirtschaftsgeschichte am Beispiel des Großen Lübecker Münzschatzes, der norddeutschen Münzfunde und der schriftlichen Überlieferung.* Sigmaringen: Thorbecke.

Oresme, N. (1956). *The De Moneta of Nicholas Oresme and English mint documents.* London: Thomas Nelson.

Pesce, G. and Felloni, G. (1976). *Le monete Genovesi: Storia, arte ed economia nelle monete de Genova dal 1139 al 1814.* Genova: Stringa Editore.

Pusch, G. (1932). *Staatliche Münz- und Geldpolitik in den Niederlanden unter den burgundischen und habsburgischen Herrschern besonders unter Kaiser Karl V.* München: Val. Höfling.

Redish, A. (2003). Book Review: The Big Problem of Small Change by Thomas J. Sargent; François R. Velde. *Journal of Economic Literature* 41, 1318-1319.

Rolnick, A. J., Velde, F. R. and Weber, W. E. (1996). The Debasement Puzzle: An Essay on Medieval Monetary History. *Journal of Economic History* 56, 789-808.

Rolnick, A. J. and Weber, W. E. (2003). Book Review: The Big Problem of Small Change. By Thomas J. Sargent and François R. Velde. *Journal of Political Economy* 111, 459-463.

Ropp, G. F. v. d. (ed.) (1878). *Hanserecesse von 1431-1476*, vol. 2 (2. Abt.). Leipzig: Duncker & Humblot.

Sargent, T. J. and Velde, F. R. (1999). The Big Problem of Small Change. *Journal of Money, Credit and Banking* 31, 137-161.

Sargent, T. J. and Velde, F. R. (2002). *The Big Problem of Small Change.* Princeton, Oxford: Princeton University Press.

Schäfer, D. (ed.) (1888). *Hanserecesse von 1477-1530*, vol. 3 (3. Abt.). Leipzig: Duncker & Humblot.

Schalk, C. (1880). Der Münzfuß der Wiener Pfennige in den Jahren 1424 bis 1480. *Numismatische Zeitschrift* 12, 186-282, 324-378.

Schnabel, I. (2005). Book Review: Thomas J. Sargent and François R. Velde, The Big Problem of Small Change. *Financial History Review* 12, 311-313.

Scholler, E. (1916). *Der Reichsstadt Nürnberg Geld- und Münzwesen in älterer und neuerer Zeit (Ein Beitrag zur reichsstädtischen Wirtschaftsgeschichte.).* Nürnberg.

Schwartz, P. (ed.) (1905). *Liv-, est- und kurländisches Urkundenbuch*, vol. 11: 1450-1459. Riga, Moskau: J. Deubner.

Schwarz, D. W. H. (1940). *Münz- und Geldgeschichte Zürichs im Mittelalter.* Aarau: H. R. Sauerländer & Co.

Shepsle, K. A. (1991). Discretion, Institutions, and the Problem of Government Commitment. In *Social Theory for a Changing Society* (eds. Bourdrieu, P. and Coleman, J. S.). Boulder, San Francisco, Oxford: Westview Press, 245-263.

Sommerfeld, E. (ed.) (1978). *Die Geldlehre des Nicolaus Copernicus: Texte, Übersetzungen, Kommentare*. Vaduz, Liechtenstein: Topos Verlag.

Sprandel, R. (1975). *Das mittelalterliche Zahlungssystem nach hansisch-nordischen Quellen des 13.-15. Jahrhunderts.* Stuttgart: Hiersemann.

Spufford, P. (1991). *Money and its Use in Medieval Europe.* Cambridge, New York, Port Chester, Melbourne, Sydney: Cambridge University Press.

Stefke, G. (1995). Der "Wendische Münzverein" und seine Nachbarn: Ein Überblick auf der Grundlage des heutigen Forschungsstands. *Geldgeschichtliche Nachrichten* 167, 125-133.

Stein, W. (ed.) (1895). *Akten zur Geschichte der Verfassung und Verwaltung der Stadt Köln im 14. und 15. Jahrhundert*, vol. 2. Bonn: Hermann Behrendt.

Sussman, N. and Zeira, J. (2003). Commodity Money Inflation: Theory and Evidence from France in 1350-1436. *Journal of Monetary Economics* 50, 1769-1793.

Töppen, M. (ed.) (1878). *Acten der Ständetage Preußens unter der Herrschaft des Deutschen Ordens*, vol. 1 (Die Jahre 1233-1435). Leipzig: Duncker & Humblot.

van der Wee, H. (1969). International Business Finance and Monetary Policy in Western Europe, 1384-1410. *Business History Review* 43, 372-380.

Volckart, O. (1996). *Die Münzpolitik im Deutschordensland und Herzogtum Preußen von 1370 bis 1550.* Wiesbaden: Harrassowitz.

Volckart, O. (1997). Early Beginnings of the Quantity Theory of Money and their Context in Polish and Prussian Monetary Policies, c. 1520-1550. *Economic History Review* 50, 430-449.

Weisenstein, K. (2002). Die Münzpolitik der rheinischen Kurfürsten (Rheinischer Münzverein) unter besonderer Berücksichtigung der Einflüsse von Reich und Städten. In *Währungsunionen: Beiträge zur Geschichte überregionaler Münz- und Geldpolitik* (ed. Cunz, R.). Hamburg: Museum für Hamburgische Geschichte, 105-143.

Wensky, M. (2002). Städtische Führungsschichten im Spätmittelalter. In *Sozialer Aufstieg: Funktionseliten im Spätmittelalter und in der frühen Neuzeit* (ed. Schulz, G.). München: Harald Boldt, 17-27.

Wielandt, F. (1959). *Schaffhauser Münz- und Geldgeschichte.* Schaffhausen: Meier & Cie.

Yeager, L. B. (2003). Book Review: The Big Problem of Small Change. *Cato Journal* 22, 188-191.

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