# The "Kipper- und Wipperzeit" and the Foundation of Public Deposit Banks[*]

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## Abstract

The "Kipper- und Wipperzeit", one of the most severe hyperinflations in the time of commodity money, gave rise to the foundation of the famous public deposit banks, such as the Bank of Amsterdam and the Bank of Hamburg. We show that the combination of asymmetric information between trading parties about coin values and imperfectly flexible exchange rates promotes Gresham's Law and helps to explain the spread of debasements across the regions of the Holy Roman Empire, following trade itineraries. We then argue that the deposit banks mitigated monetary disturbances by making the value of money common knowledge. In this sense, the banks may be thought of as early precursors of modern central banks.

**JEL: E42, E58, N13. Keywords: Gresham's Law; debasement; common knowledge; central banks.**

## 1   Introduction

Shortly after the beginning of the Thirty Years War (1618–1648), the small German states and neighboring principalities that comprised the Holy Roman Empire experienced one of the most severe economic crises ever recorded,

with rampant hyperinflation and the breakdown of trade and economic activity. The crisis became known as the "Kipper- und Wipperzeit" (i.e., the clipping and culling times), named after the practice of clipping good coins and sorting good coins from bad.

Episodes of currency debasement are common throughout history, but the Kipper- und Wipperzeit stands out for two reasons. The first is the severity of the crisis and its regional spread. The debasement proceeded at such a pace that the public authorities quickly lost control of the downward spiral. Unlike many episodes of currency debasement in which the sovereign engineers a controlled debasement so as to generate revenue, the Kipper- und Wipperzeit gives all the impressions of an uncontrolled "race to the bottom" in which the debasement gathers momentum and takes on a life of its own. The crisis spread from one state to another, and even spilled over to neighboring states such as Poland.

The second reason why the Kipper- und Wipperzeit stands out from other episodes is because it coincided with the establishment of some of the most important public deposit banks. The famous deposit bank of Amsterdam was established already in 1609 when the currency debasement was still mild, compared to later years. The German deposit banks, the bank of Hamburg (founded in 1619) and the Banco Publico of Nuremberg (1621), were established at the height of the crisis. The public deposit banks issued a notional currency called "bank money" that was backed by holdings of gold and silver coins, and set up a cashless payments system in which transactions between account holders were settled by transfers from one account to another in terms of the notional currency.

The potential relationship between the currency disturbances and the foundation of deposit banks has been remarked upon by Adam Smith in

his *Wealth of Nations.* He argued that the foundation of deposit banks was a response to the monetary disturbances of the time (see his "Digression concerning Banks of Deposits, particularly concerning that of Amsterdam"):

> "Before 1609 the great quantity of clipt and worn foreign coin, which the extensive trade of Amsterdam brought from all parts of Europe, reduced the value of its currency about nine per cent below that of good money fresh from the mint. Such money no sooner appeared than it was melted down or carried away, as it always is in such circumstances. The merchants, with plenty of currency, could not always find a sufficient quantity of good money to pay their bills of exchange; and the value of those bills, in spite of several regulations which were made to prevent it, became in a great measure uncertain.
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> ...
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> In order to remedy these inconveniences, a bank was established in 1609 under the guarantee of the city."

To the extent that public deposit banks succeeded in maintaining the soundness of the currency, they have a good claim to being the early precursors of the modern central banks.[1] In seeing the origin of central banks in these early public deposit banks, our view differs from the conventional view (as argued, for instance, by Charles Goodhart (1988)) that central banks were established as a way for the state to finance wars. Hence, the ability to lend is typically seen as the crucial characteristic of central banks. Goodhart

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[1]This view is in line with other research that has pointed to early deposit banks as precursors of modern central banks. For example, Kohn (1999) and Fratianni and Spinelli (2006) have pointed to the Venetian public deposit banks as predecessors to the Bank of England.

also argues that central banks initially did not play a catalytic role in the development of the financial system and the economy more broadly.

In contrast, the public deposit banks of the early 17th century initially were not supposed to engage in lending; their main function was to provide for a payment and clearing system. In fact, the banks did also engage in lending to the state, although to different degrees. However, this was against the ideas of the original founders, and conflicted with the banks' other functions. One extreme example was the Banco Publico of Nuremberg, which engaged in lending to the City from the very beginning even though this was against the bank charter. Interestingly, this bank was also far less successful than the banks of Amsterdam and Hamburg. Due to its meagre deposit base, it never managed to establish its bank money as a major means of payment. Besides preserving the soundness of the currency, the Banks of Amsterdam and Hamburg played crucial roles in promoting the institutions that underpin financial innovation and economic development (see, for instance, Schnabel and Shin (2004) on the role of the public deposit banks in promoting trade and credit).

Indeed, the economic performance during the Kipper- und Wipperzeit of those regions that successfully established public deposit banks, namely Hamburg and the Netherlands, appears to have been much better than that of other regions. One may even speculate that the following rise of Amsterdam and Hamburg as the economic and trade centers of Northern Europe may have been related at least partly to innovations in the financial sector, stimulated by the foundation of public deposit banks. In this respect, our paper has some bearing to the debate on the relationship between financial institutions and growth.

The precise manner in which the public deposit banks were successful in

4

accomplishing this stabilizing role is a matter that deserves further study, since it gives valuable insights both into the way in which currency debasements take place, and how public deposit banks may arrest such debasements. Kindleberger (1991, 1999) is one of the few scholars who have commented on the potential relationship between the currency disturbances and the foundation of public deposit banks, an aspect neglected in much of the historical literature on the "Kipper- und Wipperzeit." However, even Kindleberger does not explain the mechanism by which the deposit banks were able to solve the problems of the time. The existing literature on deposit banks mentions the inflation only incidentally.

In this paper, we will argue that public deposit banks played a key role in establishing *common knowledge* in monetary transactions. Commodity money (typified by coins minted from precious metals) is a prime example of an asset plagued by problems of informational asymmetries, especially in times of frequent devaluations. Such informational problems constitute a severe impediment to the efficiency of exchange. Hence, our paper is related to the theoretical literature dealing with the question of how trade can be facilitated in the presence of informational asymmetries regarding asset values. Our argument rests on the potentially corrosive effects of incremental erosion of the precious metal content of circulating coinage when two parties to a transaction do not have common knowledge of the values underpinning an exchange.

In order to argue for a rationale for public deposit banks, we first provide a formal model of the incremental debasement of currency, and provide an analysis of the circumstances that validate "Gresham's Law." Gresham's Law is commonly stated as the principle that bad money drives out good: When two similar commodity monies circulate concurrently, and one is infe-

rior to the other in terms of intrinsic value (e.g., in metallic content), then the inferior money will continue to circulate, but the superior money will be gradually withdrawn from circulation, and hoarded for melting down or for export. However, the simple statement of Gresham's Law begs a number of questions.

One important question is why the market rate of exchange between the inferior and superior monies does not adjust so as to take into account the different intrinsic value of the two currencies. Once the prices adjust in this way, and a fair rate of exchange is established, then both currencies would circulate, but at prices that reflect the fair premium or discount. Indeed, Rolnick and Weber (1986) cite several historical episodes from the United States and Britain where precisely such an adjustment happened. An unresolved question in the literature is why there are episodes where currency debasements lead to a "race to the bottom" (such as in the Kipper- und Wipperzeit) and others where the currencies of different qualities circulate concurrently at fair rates of exchange.

Our model of the Kipper- und Wipperzeit stresses several features of the political and institutional landscape of the time that we believe proved to be a fertile environment for the "race to the bottom." Two key features stand out:

- the political fragmentation of the states within the Holy Roman Empire, and the associated fragmentation of minting activities across the states, and

- the "international" nature of the trade within the Holy Roman Empire, where the trade in goods and money were conducted across jurisdictions.

6

The first bullet point refers to the fact that, in spite of the attempts to harmonize minting across the Empire, it remained in the realm of the regional princes to mint their own coins.[2] The minting of coins was not only an element of sovereignty, but also an important part of the states' revenues in the form of seignorage. The fragmentation of minting was responsible for the large variety of coins circulating within the Empire. Through trade, the different coins would spread across regions. In our model, we assume that traders within a particular jurisdiction would be more familiar with the differing qualities of coins produced within their own jurisdiction, but would have less familiarity with the heterogeneity of coinage produced in other regions. In this sense asymmetric information lies at the heart of our story, akin to Akerlof's (1970) "lemons" problem. However, the nature of the asymmetric information differs from the original "lemons" problem in that the asymmetric information would apply equally to both sides of the transaction. That is to say, one side has better information about his own coins than the other side; but no one has an absolute advantage over the others. In this sense, the asymmetric information applies "symmetrically."[3]

We argue that public deposit banks removed monetary uncertainty and, hence, enhanced the efficiency of trade. The role of monetary uncertainty in trade has already been analyzed by Chwe (1999). He argued that the expected utility from trade may be maximized by making the value of money common knowledge. As an example, he mentions the introduction of "reeded edges," which prevented the "clipping" of coins and made their value publicly

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[2] A similar problem existed in the United Provinces, although to a lesser extent (van Dillen 1934, p. 81).

[3] Of course, we are not the first to provide an explanation for Gresham's Law based on asymmetric information. As well as Akerlof's (1970) original contribution, Aiyagari (1989), Banerjee and Maskin (1996), and Velde et al. (1999) have presented asymmetric information models of Gresham's Law.

verifiable. However, the technological prerequisites for the production of such coins were quite high and became common only towards the end of the 17th century, i.e., well after the foundation of the deposit banks (Sargent and Velde 2002, p. 270).[4] The foundation of deposit banks in the beginning of the 17th century may have been another way of making the value of money common knowledge. By pooling good coins and creating a notional currency, these banks created common knowledge among traders about the value of coins. One interesting question concerns the role of the government in this process. In the model by Gorton and Penacchi (1990), banks mitigate inefficiencies by making asset values informationally insensitive; however, under certain conditions, the government has to intervene to ensure efficient trading. The public guarantee of the early deposit banks may have played a similar role.

The paper proceeds as follows: After briefly summarizing the existing literature on the Kipper- und Wipperzeit, we describe the history of the crisis. Then we present the institutional details on the deposit banks founded in Amsterdam and Hamburg. In the subsequent section, we present a theoretical model that describes how two-sided asymmetric information about coin values promoted Gresham's Law and the spread of the debasements across regional borders; we then show how a public deposit bank could increase the efficiency of trade by reducing informational asymmetries and making the value of coins common knowledge. Finally, we draw some comparisons to modern economic issues, such as the role of central banks in stabilizing the currency, and the relationship between financial institutions and growth.

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[4]The common technology used for coin production at the time in Germany was the cylinder press ("Walzenprägewerk"). The screw press ("Spindelpresse"), with which milled edges could easily be produced, had already been invented, but was not in use at the time due to the opposition of the mint masters (von Schrötter 1930).

# 2 Existing literature

There is an extensive historical literature on the "Kipper- und Wipperzeit" (mostly in Dutch or German), whereas the economic aspects of the crisis have hardly been analyzed. A notable exception are two insightful papers by Kindleberger (1991, 1999), who was the first to stress the regional spread of the crisis across different regions. He argues that the simultaneous severe debasements in many states could not be considered as independent events, but that the crisis propagated from one region to another. In contrast, the historical literature has tended to focus on those regions or towns that were affected most by the crisis and has neglected the potential propagation across regional borders; there is no comprehensive analysis comparing the evolution of different regions of the Empire.[5] Kindleberger (1991) argues that the crisis spread through Gresham's Law. However, most of the theoretical literature on Gresham's Law focuses on gradual erosion of coin values within one country. We have not found any article dealing with the spread of a devaluation across regions.

There also is an extensive literature on public deposit banks whose institutional features are well-documented. Van Dillen (1934) and Soetbeer (1866, 1867) have authoritative treatments of the foundation and institutional details of the Bank of Amsterdam and the Bank of Hamburg, respectively.[6] Poschinger (1875) describes the foundation of the Bank of Nuremberg in

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[5] See Wuttke (1894) on Saxony (Kursachsen), Schöttle (1921) on Upper Swabia, Wagner (1940) on Erfurt, Ernstberger (1954) on Bohemia, Gaettens on Lower and Upper Saxony, Bogucka (1975) on Poland, Altmann (1976) on Bavaria, Schneider (1981) on Hamburg, Schneider (1991) on Frankfurt, and Weisenstein (1991) on Trier. For more general treatments, see Opel (1866), Freytag (1888), Gaettens (1955), Redlich (1972), Rittmann (1975), North (1994), and Sargent and Velde (2003).

[6] See also Adam Smith (1776 [1991]) and Baasch (1927) on the Bank of Amsterdam, and Büsch (1790), Levy von Halle (1891), Sieveking (1934), and Pohl (1986) on the Bank of Hamburg.

great detail. Interestingly, the literature on deposit banks is largely disconnected from the literature on the crisis. While stating that the foundation of deposit banks was a response to the monetary disturbances of the time (e.g., van Dillen 1933, p. 80), none of the sources tries to explain the economic rationale for the bank foundations. Again it was Kindleberger (1991, 1999) who first analyzed the potential relationship between the currency disturbances and the foundation of public deposit banks. But even Kindleberger is largely silent on the mechanism by which public deposit banks were able to deal with the monetary disturbances.

In this paper, we will try to fill these gaps in the literature by

1. proposing a stylized model of the process by which the devaluation of coins spread across regions, and

2. explaining how the public deposit banks were able to mitigate the monetary disturbances.

We will start by describing the major features of the crisis, as well as the major characteristics of deposit banks.

## 3 History of the crisis

### 3.1 The Augsburg imperial mint ordinance

In 1559, the Holy Roman Empire sought to harmonize its coinage system by issuing the Augsburg imperial mint ordinance ("Reichsmünzordnung").[7] According to this decree, minting was to be carried out by a selected group of princes maintaining a limited number of mints. Mints could not be sold

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[7]Note that the mint ordinance did not apply to the Netherlands, Switzerland, and some of the Western border regions (Schneider 1981, p. 48).

or leased. The export of domestic money or silver was prohibited, and the amount of foreign coins limited. The intrinsic content of coins was fixed throughout the denomination structure; even small coins were full-bodied. The alteration of coins was to be punished by the death penalty. The supervision of minting was delegated to the Imperial Circles who employed coin inspectors ("Kreiswardeine") and who organized regular "probation days" where inferior coins were declared void. The mint masters who were responsible for the production of inferior coins were to be punished. The ordinance put the Empire on a bimetallic standard: The largest coins ("Dukaten") were in gold, whereas all the other coins were in silver.

However, the mint ordinance was inherently flawed. Given the higher costs of producing subsidiary coins, the minting of small coins proved to be unprofitable. The official mints stopped producing small coins, which led to a shortage of small change. As small coins were needed for daily transactions, some unauthorized mints (so-called "Heck(en)münzen") started to mint inferior coins which allowed for at least some seignorage profit. The strong increase in the number of mints put pressure on the price of silver, which induced the mints to reduce the silver content of coins even further. Later even the official mints started to take part in the coins business. The coin supervision proved to be little effective (Schneider 1981, pp. 48–49), and the prohibition of coin adulteration does not seem to have been enforced at any time.

## 3.2 Creeping debasement of small coins

The increasing circulation of debased subsidiary coins implied a creeping increase in the price of large coins (which still largely were full-bodied) in terms of small coins. Average over the Empire, the Reichstaler increased between

1582 and 1609 from 68 to 84 Kreuzer, a devaluation of the Kreuzer of one fifth (Shaw 1895, p. 103). The process was fueled by the looming war, which induced the princes to prepare a war chest by increasing seignorage revenues and set the stage for the following hyperinflation. One of the extreme cases was the Duke of Braunschweig–Wolfenbüttel. In 1617, he ordered to coin 210 Groschen from one Mark silver compared to 110 according to the ordinance. By 1621, this number went up to 330 Groschen, implying a decrease of the silver content by two thirds. More and more states started to violate the imperial mint ordinance. The bad money also spilled over to regions not issuing adulterated coins, not only within the Empire, but also across its borders, e.g., to the Netherlands.

## 3.3 Hyperinflation and the "Kipper- und Wipperzeit" (1619-1623)

In 1618, the defenestration at Prague marked the beginning of the Thirty Years War. The war still increased the princes' need for revenues, setting the stage for the following hyperinflation. By 1621, the coin standard had been decreased from 9 1/2 Gulden per Mark silver (as prescribed by the mint ordinance) to 46. The most spectacular deal was concluded in 1622 when a coin consortium led by the banker Hans de Witte from Prague, and including such famous people as Albrecht von Wallenstein, leased all mints in Bohemia, Moravia, and Lower Austria from the Emperor. At the same time, they were granted a monopoly for silver purchases and coin production in those areas. This silver was to be coined at a standard of 79 fl. (Gulden) per Mark, which was way above the current standard (46 fl.). In fact, the consortium diluted the standard even more. Wallenstein and the other members of the consortium are said to have become rich by this deal, which allowed Wallenstein

12

to finance its own army during the war without any problems. In addition, the Emperor himself earned an amount of 6 million fl. from the lease, which was six times his former revenue from Bohemia, including the revenue from minting.

Similar actions were observed in other parts of the Empire, where new mints sprang up "like mushrooms after a warm rain".[8] To provide for a sufficient supply of silver, the mints employed subcontractors who went buying old coins with higher silver contents (paying with debased money at increasing prices) to bring them to the mint to receive larger amounts of debased coins, bearing the same nominal values. These people were later to be called the "Kipper und Wipper".

The initial effect of the enormous monetary expansion was an economic boom. However, eventually, prices started to increase rapidly, and the initial boom turned into a crisis. By now, many of the new coins were made almost entirely of copper.[9] The increasing scarcity of copper even led people to bring their pots and pans to the mints. At some point, trade and business stagnated almost completely. Craftsmen and farmers were no longer willing to sell their services and products for worthless money. Tax revenues also ran dry, as taxes were paid in copper money. The skyrocketing of prices was followed by riots in many big cities, which were often directed against the money changers rather than the sovereigns who were often just as responsible for the depreciation. At the beginning of 1623, when people were no longer willing to accept the worthless money, one mint after the other ceased its operations. This also slowed down the inflation.

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[8]Langer (1978, p. 30) as cited in Kindleberger (1991, p.160).
[9]Redlich (1972, pp. 11) claims that the Empire was de facto on a copper standard.

## 3.4   Stabilization

Since 1622, the authorities tried to reorganize the coinage system. One state
after the other returned to the old mint ordinance. The Kipper coins were
invalidated and could be sold at a price corresponding to their silver con-
tent, which often was negligible. This price was between 75 and 100 percent
below the nominal value. The old coins were melted and recoined, often at
a substantial loss for the public authorities (who had to bear the minting
costs). The economic consequences of the inflation have not been explored
satisfactorily. However, there seems to be a consensus that the performance
of states was very heterogenous.[10]  In particular, the depreciation in the
Northern states, especially in the Hanseatic cities and also in the Nether-
lands, appears to have been much lower than in the Southern and Eastern
states.[11]   The course of the Reichstaler rose from 1 fl. 32 Kr. in 1618 to 6
fl. in 1622 (i.e., the value quadrupled) when averaged over different states of
the Empire (Shaw 1895, p. 103).[12]  A much larger increase was observed in
specific regions: For example, the Reichstaler climbed to 7 fl. in Frankfurt,
10 fl. in Southern Germany, 11 fl. 15 Kr. in Bohemia, and 15 fl. in Electoral
Saxony ("Kursachsen") and Nuremberg, compared to the official standard
of 4 fl. 30 Kr. (North 1994, pp. 104, 106, Kindleberger 1991, p. 158).   In
contrast, in Hamburg the course of the Reichstaler started from 44 schilling
in 1618, reached its peak at 54.5 in 1621, and then dropped to 48 in 1622
(Soetbeer 1866, p. 28); this amounts to an increase of "only" 24 percent
up to the peak. Interestingly, the depreciation before the foundation of the
deposit bank had been higher than average: 33 percent in Hamburg versus
10 percent averaged over the Empire. North (1994, p. 106) has argued that

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[10]See, e.g., North (1994, pp.101, 106).
[11]Schneider (1981).
[12]Note that 1 florin equals 60 Kreutzers.

the geographical proximity to strongly or weakly affected areas was one important determinant of the degree of the depreciation. If we believe in the gravity formulation of international trade, then trade flows among geographically close areas would have been larger than among distant ones. Hence, the observation that geographically close regions had similar depreciation rates may be seen as evidence that the depreciation spread through trade. In fact, this will be one idea underlying our theoretical formulation.

# 4  Public Deposit Banks

The foundation of the major deposit banks of Northern Europe coincided with the monetary crisis. The Bank of Amsterdam was the first in 1609, followed by banks in Middelburg (1616), Hamburg (1619), Delft, and Nuremberg (both 1621). We are mostly interested in the banks of Amsterdam and Hamburg because they are the ones that became most famous and influential in the centuries to come. However, we will also consider the Bank of Nuremberg because it is located in an area that was affected more severely by the crisis than the other places. Interestingly, the bank was also far less successful than the others.

## 4.1  The Bank of Amsterdam

The Bank of Amsterdam was founded in 1609 as a publicly guaranteed deposit and giro bank.[13] It is well established that the bank was modeled on the Venetian Banco della Piazza di Rialto (founded in 1587), but the goal of its establishment was quite different: In Venice, the bankruptcy of the pri-

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[13]The classic description of the functioning of the Bank of Amsterdam is the one by Adam Smith (1776) in his "Digression Concerning Banks of Deposit, Particularly that of Amsterdam" (pp. 421). A more recent exposition can be found in van Dillen (1934, pp. 79).

vate deposit banks caused by excessive lending had led to the establishment of a public bank; in Amsterdam, it was the monetary confusion that led to the bank foundation.[14]

The Bank of Amsterdam functioned as follows: Coins could be deposited, and the respective amount would be credited in an imaginary currency, called *bank money*. Bank money could be transferred to somebody else's account by assignment, avoiding the costs and pain of transferring the coins directly. Importantly, the quality of coins would be assayed at the time of deposit to ensure that only full-bodied coins would enter the bank. This was to provide for a stable relationship between bank money and "good" commodity money. In contrast, circulating money could be worn, clipped, or debased, implying a high degree of uncertainty in transactions involving circulating coins. As a consequence, bank money most of the time bore a premium (called agio) compared to the circulating money. One reason for this were the quality differences between deposited and circulating coins, but it was probably also due to a reduction in uncertainty, which made the bank money very valuable for the merchants.[15]

It does not come as a surprise that the deposit banks evolved in the major trade centers of the time. In trade, monetary uncertainty was particularly harmful because foreigners would be even more sceptical regarding the value of coins. In fact, the foundation of the deposit bank in Amsterdam had been preceded by private initiatives of merchants who deposited full-bodied coins at cashiers and established a cashless payments system among the participating merchants. However, such activities were soon prohibited; the fear was that good coins would be withdrawn from circulation, thereby accelerating

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[14]See van Dillen (1934, pp. 80, 85), Kohn (1999), and Fratianni and Spinelli (2006).

[15]According to Adam Smith (1776 [1991], pp. 421, 426), the typical agio was around 5 percent in Amsterdam, and 14 percent in Hamburg.

16

the depreciation of the currency (Soetbeer 1866, p. 24). At first, the idea of a bank was looked at with the same suspicion by the general public, and it was only due to the merchants' insistence that the bank ever came into existence.

Originally, the Bank was no fractional-reserve bank; the creation of bank money was, at least de jure, strictly limited by the amount of gold and silver in the bank's vaults. The credibility of this arrangement relied substantially on the ability of the bank to commit to not dilute the value of the bank money. The bank had several provisions in this respect: First, the bank benefited from a government guarantee. Second, the bank was controlled by the merchants themselves who had a clear interest in monetary stability.

The credibility was decreased somewhat by the creation of a lending bank in 1614, which was created primarily to extend loans to the public authorities, but also to extend lombard loans against collateral, mostly coins and bullion.

Note that the bank also allowed for the creation of money through the writing of bills of exchange, which were crucial in international payment transactions. Any account holder could write bills in terms of bank money. In fact, the bank law prescribed that bills of exchange above a certain amount had to be paid in bank money. This possibility of money creation provided an additional threat to the stability of bank money. There was no mechanism to prevent account holders from writing huge amounts of bills on the basis of their bank accounts.

However, in spite of these limitations, Amsterdam bank money soon emerged as the key currency in international finance.The legendary reputation of Amsterdam bank money – which was not always justified – was fostered by the huge stocks of precious metals in Amsterdam, which arose from the city's dominating position in the bullion trade (Baasch 1927, pp.

215). Only in very few instances, the stability of the bank money appears to have been questioned.

## 4.2   Other deposit banks

Similar institutions developed elsewhere, most notably in Hamburg whose financial institutions were almost one-to-one copies of the ones in Amsterdam (Soetbeer 1866, p. 23). As in Amsterdam, the giro bank was complemented by a lending bank, and the city became the largest debtor from the very beginning; in contrast, loans to private agents initially were negligible (Sieveking 1934, p. 129). However, the bank's lending activities may not even have been known to the merchants or the general public as the bank's books were kept secret. The bank's success can be inferred from its rapid growth: Between 1621 and 1655, the bank's total assets increased from 832 thousand Marks to 3,506 thousand Marks (Sieveking 1934, pp. 129, 131).

The "Banco Publico" of Nuremberg was the only public deposit bank that was founded in the southern part of the Empire. Its foundation was again motivated by the monetary disturbances, and again it was the merchants who pleaded for the bank's foundation. Most of its provisions were adopted from the Bank of Hamburg, with one major exception: Deposits could be made not only in full-bodied, large coins, but also in current small money, both domestic and foreign (Poschinger 1875, p. 21). Although this arrangement was later removed, it reduced the bank's credibility from the beginning: It implied that the uncertainty of the value of bank money was not removed because part of the bank's coins was possibly less valuable than determined in the mint decree. In addition, it appears that the bank extended loans to the public authorities from the very beginning, even though this was prohibited by the bank's statutes. In 1623, such loans amounted to almost one third

of the bank's total assets (Poschinger 1875, p. 36). The abuse became even worse in later years when the bank's vault was virtually plundered by the city's officials such that the bank was sometimes not even able to repay deposits on demand (North 1994, p. 117, Poschinger 1875, p. 29). Against this background, it is not surprising that the bank's total assets decreased sharply in the early years after the bank's foundation. Other than in Amsterdam and Hamburg, the volume of the bank's deposits remained too small to establish a widely used bank money for trade transactions.

## 4.3 Performance of public deposit banks

There are different views on the success of the public deposit banks. Early writers like Adam Smith appear to have admired institutions like the Bank of Amsterdam. Kindleberger (1991) also describes the banks as having been a success. In contrast, van Dillen (1934) is more sceptical, especially regarding the ability of the banks to mitigate the monetary disturbances: "The irony of history... would have it that ... the world-famous institution [the Bank of Amsterdam] was not to succeed [in improving monetary conditions]." Van Dillen's judgment appears to be based on the observation that the devaluation of the currency was not stopped completely. Given that bank money was only used in wholesale transactions, this may not come as a surprise. Also, it should be noted that the debasement in Amsterdam and Hamburg was much smaller than in other places that did not have a public deposit bank.

Other than the Banks of Amsterdam and Hamburg, the Banco Publico of Nuremberg clearly seems to have failed in its goal of establishing monetary stability. This seems to have been caused by serious flaws in the bank's organization: First, the deposit of coins had not been limited to full-bodied

19

coins; second, the bank was not able to escape the grasp of the public authorities on its vault, which diminished its credibility. The same problem also loomed at the other banks when the giro banks were supplemented by lending banks. Thereby, the banks de facto became fractional-reserve banks and became vulnerable to bank runs; in fact, such runs occurred recurrently in the later history of the banks, and were countered by the banks' temporary closure (similar to the "suspension of convertibility" discussed in the bank run literature; see Diamond and Dybvig 1983). Also, similar to the Bank of Nuremberg, the Bank of Hamburg was repeatedly abused as financier of the state – though not to the same extent.

# 5 Toward a Theory

## 5.1 Issues

In order to show how the public deposit banks removed the uncertainty regarding coin values and thus arrested the debasement, we need a model describing how such debasements came about. As we stressed above, the Kipper- und Wipperzeit was special in that the debasement was not limited to single states, but spread from one state to another. Kindleberger (1991, p. 149) argues that "the process spread through Gresham's Law: bad money was taken by debasing states to their neighbors and exchanged for good. The neighbor typically defended itself by debasing its own coin."

### 5.1.1 Circulation by weight versus circulation by tale

As was indicated above, the applicability of the simple version of Gresham's Law – that bad money drives out good – is, however, a matter of considerable controversy. The most important question is why different types of coins would not circulate at an exchange rate reflecting their intrinsinc values (what

is called "circulation by weight"). One strand of the literature argues that the exchange rate between the two monies is fixed (so-called "circulation by tale"), for example, due to legal tender laws, mint exchange policies, or conventions (see, e.g., Sargent and Wallace 1983, Sargent and Smith 1997, and Li 2002). However, Rolnick and Weber (1986) argue that such a stance is untenable, both from an institutional and empirical point of view. Indeed, Rolnick and Weber cite several comparatively recent historical episodes from the United States and Britain where different types of coins circulated side by side at a floating exchange rate. For instance, during the early 19th century in the United States, both the U.S. silver dollar (containing 371.25 grains of silver) and the Spanish milled dollar (with 373.5 grains) circulated concurrently, with the Spanish dollar circulating at a premium over the U.S. dollar, with the premium ranging from 0.25 percent to 1 percent. But the occasional circulation of coins according to their intrinsic values does not exclude the possibility that there were deviations from the circulation by weight at other times. In fact, we will see that such deviations are important to understand the observed spread of debasements across regions.

The other strand of the literature on Gresham's Law is based on the assumption of asymmetric information about coin values, generating a problem akin to Akerlof's lemons problem (see, e.g., Aiyagari (1989), Banerjee and Maskin (1996), and Velde, Weber and Wright (1999)). Commodity money has always been plagued by problems of asymmetric information because the intrinsic value of coins, and especially their fineness, could be checked only at relatively high costs. The technologies used to assay the fineness of coins have been described in some detail by Gandal and Sussman (1997, pp. 443–444):[16] The most common, but relatively crude technology was the

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[16]See also the relevant entries in von Schrötter's coin dictionary ("Strichprobe," "Kuppellenprobe").

"touchstone test," in which the trace from rubbing a coin on a special stone was compared with that left by a metal of a known fineness. A higher precision could be obtained only by the assaying by fire (essentially the melting down of the coin), which was much more costly and implied a loss of the coin itself.

In our model, we will follow the literature in assuming that traders are imperfectly informed about the quality of coins offered to them in an exchange. In contrast to the existing literature, we consider a situation of two-sided asymmetric information where each side has better information about its own coins than the other side, but no one has an absolute advantage over the other. More precisely, we assume that money traders within a particular jurisdiction can perfectly observe the quality of coins produced within their own jurisdiction, while they can make only coarse distinctions between foreign coins of differing qualities. The idea is that foreign merchants have to rely on something like the touchstone test, while domestic merchants are more familiar with the quality of coins, due, for example, to the flow of information from near-by merchants who have conducted the more rigorous "assaying by fire." This informational assumption fits nicely a situation where minting activities are fragmented across states, as was the case in the Holy Roman Empire, and will help to explain how the debasement in one state could spread to other states.

### 5.1.2  Debasements

The monetary system worked on the principle that individuals could bring metal to the mint (controlled or authorized by the sovereign) to be made into new coins; this is often referred to as "free minting" or "free coinage" (see, e.g., Redish 1990, Sargent and Velde 2003). In such a system, the quantity

of coins minted is determined by the public's decision to bring silver or gold to the mint. The sovereign determines the prices at which minting is taking place by setting the mint equivalent and the seignorage rate (see Redish 1990, Sussman 1993, Sargent and Velde 2003): The *mint equivalent* (or mint par) was the value of a given weight of precious metal in terms of the numeraire currency; it depended on the number of coins struck from the metal, on their fineness, as well as on their nominal value. A certain fraction of the minted coins – the (gross) *seignorage rate* – was kept by the mint to cover minting costs (brassage) and the seignorage tax. The seignorage tax went to the sovereign and constituted an important fiscal revenue, especially in times of war. Hence, the price at which precious metal could be sold at the mint – the *mint price* – was below the mint equivalent, implying that the minting of new coins was a costly activity for the individual who brought in the metal.

The sovereign could debase his coinage in three different ways (see Sussman 1993): First, by increasing the number of coins struck from the alloy, which would alter the coins' weight and could, therefore, be detected with a scale; second, by increasing the coins' nominal value, which was even more transparent; and finally, by changing the coins' fineness, the detection of which required rather sophisticated technologies, as was described above. In addition, coins could be clipped by the general public, which would again change the coins' weight and could, therefore, be detected by using a scale. In the model, we will focus on debasements where the sovereign changes the coins' fineness, even though other kinds of debasements were also observed in the considered time period.

The new (debased) coins could enter the circulation not only when fresh bullion was minted, but also when old coins were re-minted. Rolnick, Velde, and Weber (1996) point out some telling empirical regularities associated

23

with debasements. Seignorage rates tended to be high during episodes of currency debasement, leading to substantial revenue for the sovereign. However, these periods also saw very large volumes of (re-)minting activity. Rolnick et al. (1996) report that, between 1285 and 1490, France had 123 debasements of silver coins, 112 of more than 5%. In normal years, government revenue due to seignorage constituted less than 5% of the total, but in debasement years, it could be as high as 50% due to increases both in the seignorage rates and mint activity. As discussed above, the same applied to the Kipper- und Wipperzeit: Seignorage was substantial, and so was the re-minting activity.

The question is why there was an incentive to engage in the re-minting of coins in spite of the subtracted seignorage. If coins had circulated according to their intrinsic values, there would not have been an incentive for re-minting older coins due to seignorage. Again, one needs some deviation from the circulation by weight to explain re-minting activities. If, on the other extreme, coins circulated by tale, re-minting would always be profitable if the new mint price exceeded the old mint equivalent (Sussman 1993).

Summing up, a satisfactory theoretical account of the events surrounding the Kipper- und Wipperzeit should be able to explain how the debasements could spread across regional borders and why there was so much re-minting in spite of the substantial seignorage tax. Based on our historical account, our model will incorporate the following important features: The fragmentation of minting across states, the existence of a seignorage tax, the two-sided asymmetric information as described above, and the prevalence of trade in goods and money across jurisdictions.

## 5.2 A Stylized Model

### 5.2.1 Assumptions

Consider an economy with two jurisdictions, denoted by 1 and 2. Both jurisdictions use silver money, and are on the same official coin standard. However, the central authority is too weak to enforce the standard and cannot prevent the debasement of coins by the regional sovereigns. Denote the quality of coins in the two jurisdictions by $v_1$ and $v_2$, respectively. The quality of coins in region $i$, $v_i$, can vary between 0 and 1, and should be thought of as the relative quality of coins compared to full-bodied coins. According to the coin standard, all coins are full-bodied, i.e., the quality of both coins is initially equal to 1. $v_i$ is then just the share of silver contained in a given coin (i.e., the coin's fineness).[17] Assume that in each jurisdiction, there are mints that offer to mint (or re-mint) coins from the metal brought in by any individual. The mint equivalent, $ME_i$, and the (gross) seignorage rate, $\sigma_i$, are set by the regional sovereign in region $i$, yielding a mint price, $MP_i$, at which metal can be sold at the mint, of $(1-\sigma_i)ME_i$.[18] $ME_i$ will be inversely related to the coins' quality, $v_i$. The regional sovereigns can debase their coins by altering $v_i$. For simplicity, we assume that the precious metal content of a region's coins can vary by increments of $c > 0$, a small positive constant. We can characterize the distribution of coins in the two regions in terms of the joint probability $p(v_1, v_2)$ that the quality of jurisdiction 1's coin is $v_1$ and the quality of jurisdiction 2's coin is $v_2$. In the initial situation depicted in Figure 1, $p(1, 1) = 1$, and the probability is zero for any other pair of coinages.

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[17]We will only consider debasements that reduce the coins' fineness. We assume that the weight and the nominal value of coins are kept constant in a debasement.

[18]We do not consider the potential principal-agent problem between the sovereign and the mint master. For such a model, see Gandal and Sussman (1997).
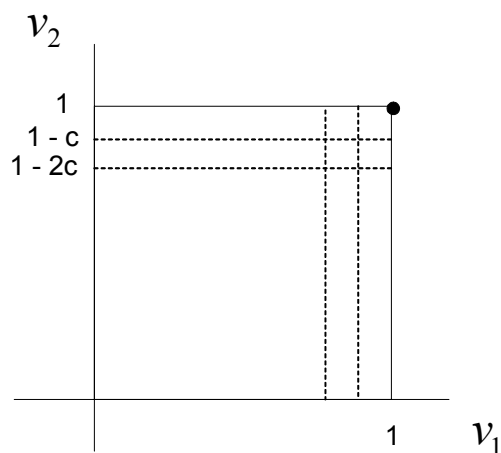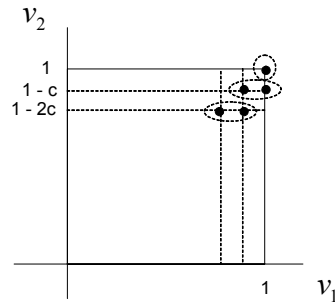
Figure 1: Initial Situation

We assume that, in each region, there are risk neutral traders who would like to buy some goods from the other region. Traders differ with respect to their valuations of the traded goods. Goods prices in terms of silver are assumed to be exogenous. The sellers of the goods accept only coins from their own region. Therefore, the buyers have to exchange domestic coins against foreign ones to be able to trade; one may think of this as a domestic-cash-in-advance constraint. In our model, we will abstract away from the trade in goods to focus on the currency exchange between the two jurisdictions. In a cash-in-advance economy, the trade in goods would be predicated upon the exchange of currency, and so our abstraction can be seen as the reduced form of a more elaborate model that involves both the trade in goods and currency exchange. But one should keep in mind that the primary motivation of the currency exchange between the two jurisdictions is the trade in goods, and the volume of the goods trade will be important for the welfare effects of a currency debasement.

Whether trade is ex-ante beneficial for the traders, depends not only on goods prices (in terms of silver) and on the traders' valuations for the goods, but also on the exchange rate between domestic and foreign coins, and the expected quality of the exchanged coins. We will assume that the traders strictly prefer to trade if it is known that all coins are full-bodied (i.e., $p(1,1) = 1$) and if the exchange rate between the coins is equal to 1. Hence, in the initial situation, trade would be welfare-increasing.

We now come to our key informational assumptions. As already flagged above, we will make the assumption that traders are better able to distinguish the quality of the coins from their own jurisdiction than the quality of foreign coins. Concretely, we will make the assumption that while traders can perfectly observe the quality of their domestic coins, they cannot distinguish small incremental differences of $c$ in foreign coins. We can formalize the informational assumption in terms of the information partitions for the traders from the two jurisdictions. The figures below depict the information partitions of traders from regions 1 and 2, respectively. The ballons indicate the circumstances that cannot be distinguished by the traders.
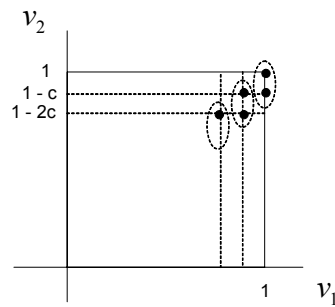


Partition of trader in 1        Partition of trader in 2

This implies that, although the silver price of trading goods is exogenous and constant, the nominal price of trading goods will depend on the quality of coins presented in the exchange; in particular, it will be inversely related to the quality of coins (i.e., it will be equal to the silver price of the good divided by $\nu_i$).[19] In addition, we assume that traders know the *aggregate* incidence of foreign coins (for example, by learning from the aggregate experiences of all other traders in their region). For example, a trader from region 1 knows that a certain fraction of coins has been debased, but he cannot observe the quality of individual coins offered to him in an exchange. Therefore, the willingness to trade will depend on the aggregate incidence of coinage from the other region.

Note that, under the given information structure, a debasement cannot exceed $c$ if it is not to be detected by the other region. Moreover, the re-minting of good coins into bad coins is never profitable if the coins are to be used domestically where they are valued according to their intrinsic value. For interregional trade, re-minting can be profitable only if the seignorage rate, $\sigma_i$, is below $c$.

Assume now that the looming war induces the sovereign of region 2 to debase his coinage by $c$ in order to raise some revenues from seignorage.[20] We will now analyze how such a debasement of coins affects the agents' decision to re-mint old coins into new coins and how it influences the benefits from trade. We will distinguish two different settings: In the first, we will assume

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[19]Competition among sellers ensures that the nominal price cannot rise above this "fair" price. If a seller tried to fool a buyer by claiming that the offered coins are bad even though they are, in fact, good, other sellers would have the incentive to step in and sell at the fair price in order to reap the benefits from the exchange.

[20]Historically, the increase in seignorage taxes seems to have been the major motivation for many debasements, especially in times of war (see, e.g., van Werveke 1949, Sussman 1993). This was certainly also true for the Kipper- und Wipperzeit (see, e.g., Ernstberger 1954, pp. 89, 104, Schneider 1979).

that the exchange rate between the coins is determined by the coins' average qualities. In the second setting, we will analyze the consequences of "fixed exchange rates," where coins are valuated according to their nominal values (i.e., "by tale").

### 5.2.2 Exchange rates reflect average qualities

Here we assume that the exchange rate between the currencies of the two jurisdictions reflects the *average quality* of the coins from the two jurisdictions. Without loss of generality, let us select 1's currency as the numeraire, and denote the price of 2's currency in units of 1's currency as $\pi$. Then, $\pi$ is given by the ratio of the average qualities of the two currencies. Hence, in the initial situation depicted in Figure 1, the exchange rate would be equal to 1.

Consider now a debasement of the coins in jurisdiction 2, in which the sovereign modifies the mint equivalent in a way that reduces the precious metal content of coins from 1 to $1 - c$. Assume that the seignorage rate, $\sigma_i$, is below $c$, such that there is scope for profitable re-minting. If a fraction $\delta$ of the coins is debased, the average quality of coins in jurisdiction 2 is

$$(1 - \delta) \cdot 1 + \delta \cdot (1 - c)$$
$$= 1 - \delta c$$

The rate of exchange between coins will reflect the average quality of the coins, so that $\pi = 1 - \delta c$. Hence, the traders from jurisdiction 1 will be happy to exchange their coins at this rate.

The actual realization of $\delta$ depends on whether the traders in jurisdiction 2 decide to have their coins re-minted. In the absence of seignorage, all traders from region 2 would prefer to have their old coins re-minted and to use debased coins for the exchange. The exchange rate would drop to

$1 - c$, and trade would remain profitable. However, in the presence of non-zero seignorage, re-minting will be beneficial only if the benefit from trade is large enough to cover seignorage costs. Those traders for whom re-minting is not profitable will withdraw their good coins from interregional trade. The average quality of circulating coins will drop to $1 - c$, and the exchange rate adjusts to $1 - c$. Thus, the joint density of coins changes from $(1, 1)$ to $(1, 1 - c)$, as depicted in Figure 2.

Note that, due to seignorage, the traders from region 2 have to pay more for the exchange than before (in terms of silver) when using debased coins. Hence, the benefit from trade is smaller than it would be in the absence of a debasement. The game among the traders in region 2 has the structure of a prisoners' dilemma: It would be socially beneficial to coordinate on not re-minting coins (and saving on seignorage), but it is individually profitable to re-mint coins because the externality on the other traders in the form of a less favorable exchange rate is not taken into account. The only beneficiary of the debasement is the sovereign in region 2 who collects the seignorage tax. In contrast, the traders in region 2 suffer, either because they have to pay seignorage, or because they cannot trade at all. Some trade will not take place even though it would be beneficial in the absence of the debasement. This will tend to decrease social welfare, in addition to the social loss in the form of minting costs (the seignorage tax, in contrast, is welfare-neutral).

If there is no further debasement of jurisdiction 1's or 2's coins, this is the end of the story. In particular, the debasement does not spread to the other region. For the coin quality to decrease in the other region as well, one would need a similar debasement in jurisdiction 1, which would then tend to drive out the good money of jurisdiction 1. It should be stressed that the reason why Gresham's Law operates *within* regions is that the traders in
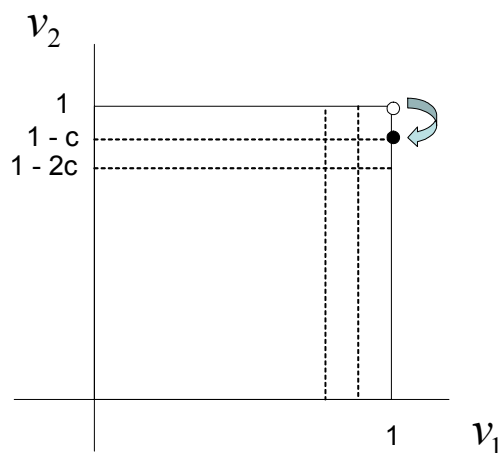
Figure 2:

one region cannot distinguish between the good and bad coins of the other region, although domestic traders can do so. In this sense, trade promotes the operation of Gresham's Law.

### 5.2.3   Fixed exchange rates

Let us now consider the second setting, where the exchange rate of coins is determined by their relative nominal values.[21]   In the model, this would lead to a fixed exchange rate equal to 1. Consider again a debasement of region 2's coins from 1 to $1-c$, which induces the traders to re-mint their coins if this is profitable. Given the exchange rate of 1 and the average quality of foreign coins of 1, re-minting will be profitable even for those traders for whom re-minting was not profitable in the first setting. Hence, in the absence of a

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[21]This assumption is extreme in that it does not allow for *any* adjustment of the exchange rate to a change in the average coin quality. The argument would also go through if the exchange rate did not *fully* adjust to changes in the average coin quality.

debasement in region 1, the average quality of coins drops to $1 - c$ in region 2.

However, the given exchange rate of 1 does not reflect the average quality of the coins, which reduces the benefits from trade for the traders of jurisdiction 1. The reason is that, in expectation, the traders from region 1 will have to pay higher nominal prices for the goods they want to acquire, while the exchange rate is not able to adjust to this change in prices. For some traders, the trade based on good coins is no longer beneficial and they will withdraw their good coins from interregional trade. In contrast to the first setting, the traders and the sovereign in region 2 will benefit from the debasement, whereas the traders in region 1 will suffer.

So far, we have held the quality of coins in region 1 constant. Assume now that the sovereign in region 1 may also decide to debase his coinage. Then the best response of the sovereign in region 1 to the debasement in region 2 is to debase his coinage as well. This is true even if the sovereign maximizes regional social welfare, and not seignorage taxes. If the seignorage rate is not set too high, re-minting will be profitable, such that the quality of circulating coins in region 1 drops to $1 - c$. As above, some traders may decide to withdraw from interregional trade. Given the reduced coin quality in region 1, some of the traders in 2 will no longer find it profitable to have their coins re-minted and will withdraw from trade. As illustrated by Figure 3, the quality of coins presented in exchange will drop from $(1, 1)$ to $(1 - c, 1 - c)$. As the proportion of good coins from region 2 falls to 0, all of the good coins from region 1 will be re-minted as well. Thus, we have $p(1, 1) = 0$. Welfare is lower in both regions than before the debasement. The gain of the sovereigns in the form of seignorage taxes is more than compensated by the loss of the traders.
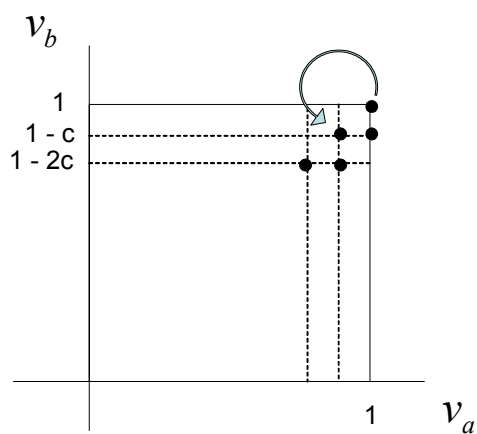
Figure 3: Debasement of 2's currency in response

The argument can now be iterated. Any joint density of coins presented for exchange is vulnerable to further erosion provided that one jurisdiction changes its mint policy to debase its coinage. The coins in the upper end of the quality distribution are no longer offered in exchange. These "good" coins will either be re-minted and then reappear in trade with a smaller precious metal content, or they will be withdrawn from trade altogether. Note that the effects of a debasement are much more severe in this setting than in the other one where the exchange rate was determined by average coin quality. Most importantly, the debasement can spread from one region to the other. Hence, the inability of the exchange rate to adjust to changes in aggregate coin quality may help to explain why the crisis spread so widely across different states, and why so many regions participated in the debasement.

## 5.3  Deposit Banks

Our model has shown how trade and the associated information problems can give rise to a variant of Gresham's Law where good coins are re-minted or withdrawn, even though, in equilibrium, this reduces the traders' profits and social welfare.  We have seen that the inability of exchange rates to adjust to changes in the average coin quality seems to be necessary to explain how the crisis spread across regional borders.  Crucial to our argument is the combination of (i) the fragmented nature of the institutions that allow the incremental debasements to take place, and (ii) the two-sided asymmetric information that follows from cross-border trade.  We will now discuss how the public deposit banks may have served to remedy these problems.

Let us consider the following features of an "ideal" public deposit bank, abstracting from the weaknesses observed in practice:

1. Coins could be deposited at the bank only after the quality of the coins had been verified.

2. The banks created a notional currency ("bank money") to be used for payments.

3. All bills beyond a certain amount had to be paid at the bank.

4. Banks were publicly guaranteed.

We want to argue that the combination of these features generated *common knowledge* about the value of money, and thereby prevented the socially inefficient erosion of coin values.  The first feature was the control of the deposited coins' quality, which made sure that any depositor would be credited the "fair" value of the deposited coins.  Otherwise, the holders of good

34

coins would not have been willing to deposit their coins. The control could take different forms. One was the restriction of the types of coins that were accepted for deposit. Indeed, the Banks of Hamburg and Amsterdam had such restrictions. For example, coins that were known to have been subject to serious debasements were not accepted. In the framework of our model, it would suffice to allow only for the deposit of domestic coins, the quality of which could easily be checked by domestic traders (and, hence, by the bank). In contrast, the lack of such restrictions at the Bank of Nuremberg may explain its limited success. The quality of coins could also be checked by using the assaying technologies described above. It is likely that the relatively cheap tests, such as the use of a scale or the "touchstone test," would always have been carried out for that purpose. However, since the quality of coins would have to be verified only once, even the "assaying by fire" may have been worthwhile, given that it would have to be carried out only at the time of deposit. Hence, the costs would be negligible, relative to the total circulation of money. Ideally, the controls would ensure that the value of coins in the bank's vault – and hence the value of the notional currency – would correspond to that prescribed in the Mint Ordinance.

By depositing the coins at the bank, the traders could commit to not debasing them. The coins were stored in the bank's vault, and payments were carried out in terms of a notional currency, which was backed by the holding of coins in the deposit bank. But how could the deposit bank commit to not debasing the coins, once they were deposited? Here, it is crucial that the traders themselves benefited from not being able to debase their coins. There was no benefit from collectively debasing the coins in the bank's vault. Therefore, the bank's promise not to debase the coinage would be credible, and the asymmetry of information between domestic and foreign traders was

eliminated. When using "bank money" in international transactions, there was no informational advantage that one trader has with respect to another. The observed agio of bank money compared to the circulating money can be seen as evidence of the credibility of the banks' arrangement.

Payments would be executed through cashless transfers or, alternatively, through bills of exchange, denominated in the notional currency. Bills of exchange were particularly important in international transactions between parties who did not both have an account at the same deposit bank (see Schnabel and Shin 2004 for the use of bills of exchange in international trade). In fact, in Amsterdam and Hamburg, only merchants from the bank's jurisdictions were allowed to open an account at the bank. The provision that all bills of exchange above a certain amount had to be paid at the bank implicitly forced all merchants to open a bank account. It provided for a centralization of coins at the deposit bank, and thereby ensured that the network of merchants making use of the bank money was large enough; this raised the bank money's attractiveness due to the existing network externalities in the use of money. Moreover, the willingness of the domestic traders to forego the option to write bills outside the bank was a signal to foreign traders that the payment mechanism was reliable.

The guarantee of the City lent some additional credibility to these arrangement. In fact, it is quite striking that the banks were founded in free cities, rather than principalities. In a free city, the interests of the government and the merchants would be much more aligned than in a principality where the hunger for seignorage taxes may have dominated the interest in maximizing social welfare. While the banks were established primarily to the benefit of the Amsterdam or Hamburg traders, their establishment also benefited their trading partners. Just as the debasements tended to spread

along trade itineraries, the stabilization would spread along the same routes. Hence, the creation of public deposit banks had the character of a public good. At the same time, this may help to explain why there were so few deposit banks created in the Empire. First, the regional benefit had to be large enough to make the costs of establishment worthwhile; this would be true most of all in the major trading cities like Hamburg and Amsterdam. Second, given the establishment of banks at other places, the other regions could free-ride on the stability provided by these banks. However, these other places may have underestimated the impact that the creation of the banks would have on the future economic development of the respective regions.

## 6    Conclusion

Our paper has tried to explain how the creation of public deposit banks may have mitigated the monetary disturbances at the beginning of the seventeenth century. For this purpose, we presented a simple model of debasements in a country with a uniform coin standard, but fragmented minting activities. We have argued that asymmetric information about coin values between trading partners promoted the working of Gresham's Law within regions. However, asymmetric information alone is not able to explain why the debasements spread across regions. In the framework of our model, the progagation of debasements can only be explained if exchange rates between regional currencies do not fully adjust to relative average coin qualities. It is an open question for future research whether the assumption of imperfectly flexible exchange rates can also been confirmed empirically.

Against the background of the theoretical model, we have then described how the institutional arrangements of public deposit banks were able to re-

move the existing informational asymmetries and to generate common knowledge about the value of the money used in exchanges. The mechanism worked as follows: The banks created a notional currency, which was backed by the holding of coins, whose quality had been verified at the time of deposit. Since the traders as a group benefited from not debasing their coinage, the bank could credibly commit to not debasing the stored coins. Public guarantees lent some additional credibility to these arrangements. The institutions proved to be so successful that Amsterdam bank money (and – to a more limited extent – also Hamburg bank money) became the key currency in international finance for almost two centuries.

The role we ascribe to the public deposit banks is akin to the functions typically conducted by central banks. Therefore, our analysis suggests that the early deposit banks should be thought of as early precursors of modern central banks, contrary to the conventional view that such banks were created much later, mainly with the intention to finance wars. At places where the banks were used to this end, such as Nuremberg, they were never able to establish bank money as a key currency for trade transactions. The significance that the foundation of public deposit banks had may be anticipated by looking at the rise of Amsterdam and Hamburg to key trade and financial centers. This points towards a much larger importance of the banks than their immediate impact on the monetary situation of the time, and highlights the importance of financial institutions for economic growth.

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