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The history of interbank settlement arrangements: exploring central banks' role in the payment system

Ben Norman, Rachel Shaw and George Speight

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Abstract

Modern central banks have come to view payment systems as a key area of strategic interest, both as part of their responsibilities for financial stability and for the implementation of monetary policy. By considering the evolution of interbank settlement arrangements and central banking functions in the context of a number of diverse historical country case studies, this paper seeks to improve understanding of the development of, and reasons for, central banks' current roles. Starting from a situation where the earliest banks gradually began to accept claims on each other, banks introduced a variety of innovations to clear and settle between themselves more efficiently. Focusing particularly on the lender of last resort function — a key characteristic of a central bank — this paper explores whether institutions at the centre of clearing and settlement arrangements developed central bank-like characteristics.

Key words: Monetary history, central banking, payments, clearing and settlement.

JEL classification: N21, N23.

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Summary

Modern central banks have come to view payment systems as a key area of strategic interest, both as part of their responsibilities for financial stability and for the implementation of monetary policy. This paper seeks to improve understanding of the development of, and reasons for, central banks' current roles, by considering the evolution of interbank settlement arrangements in the context of a number of diverse historical country case studies. There are several definitions of central banking itself – and for the purpose of this paper, we focus on the lender of last resort role. Although the link between historical clearing and settlement innovations and central banking is a complex area for investigation, there are some patterns that we can observe.

The earliest banks – typically late-medieval moneychangers in Continental Europe or, by the seventeenth century, goldsmiths in England – found various ways over time of providing payment services to their customers. Some allowed pairs of customers who were buyer and seller to a transaction to authorise the transfer of deposits from the buyer's to the seller's accounts at the bank. Alternatively, some banks issued receipts for their customers' deposits, and these were then used in trade, effectively becoming an early form of banknote. Others allowed their customers to write instructions when purchasing a good or service, which the recipient could present to the bank in order to receive value from the purchaser's account – in other words, a cheque. Gradually, where buyers and sellers to a transaction held their accounts with different banks, these banks began to accept claims on each other. For instance, when a customer deposited at one bank a banknote or cheque that represented a claim on funds held by another bank, the banks provided a value-added service for their customers by providing funds with which that customer could in turn make payments, while the banks between them sorted out the obligations that they assumed on their customers' behalf.

The benefits to the customers were clear: if banks accepted claims on each other, then their customers no longer needed themselves to transport coin (or other precious metal) when making/receiving payment in settlement of a purchase/sale of goods and services. There were also benefits for the banks: among other things, issuing banknotes was a lucrative business, as the banks were issuing non interest bearing liabilities, which were used to fund interest-earning assets. But offering such a payment service to their customers also entailed costs for the banks: for as long as one bank had a claim on another bank, it could suffer a loss if that other bank defaulted on its obligations. So banks made arrangements to extinguish the claims they had on

each other, by periodically settling them. These arrangements were costly as well: the banks needed to calculate the amounts due to and from each other ('clearing'); and 'settlement' of the resulting obligations itself required them to hold and then exchange a suitable settlement asset.

In response to these costs, mainly during the eighteenth and into the nineteenth centuries, banks introduced a variety of innovations to clear and settle between themselves more efficiently. For example, banks developed ever more sophisticated means for netting off their obligations. They also found ever more convenient assets by which to effect settlement of the residual obligations: early on, settlement was effected with a physical transfer of gold and/or coin; in some cases, banknotes themselves later became the settlement asset. The direction that these innovations took was invariably towards centralisation, including, in some cases, to the development of so-called 'clearing houses', and in other cases to banks that themselves are present-day central banks. These clearing houses/banks held accounts for the banks that were accepting claims on each other, and ultimately interbank settlement was effected by debiting and crediting the accounts of the different banks at the clearing house or central bank.

Was it inevitable, though, that centralising the clearing and settlement functions would spawn the development of modern central banks? Some previous historians imply so. We find that the historical evidence is mixed. Where the institution at the centre of clearing and settlement arrangements also issued liabilities that had a superior standing – in other words, money that would retain its value even during a financial crisis – there were strong efficiencies with that same institution then acting also as a lender of last resort. The evolution, above all during the nineteenth century, of both the Bank of England and the New York Clearinghouse provides the most compelling examples of this connection between clearing and settlement and central banking. However, it was certainly not inevitable that an institution that found itself at the centre of clearing and settlement arrangements would go on to be a lender of last resort. And in several countries the central bank came into being only when the government stepped in to set it up.

1 Introduction

Modern central banks have come to view interbank clearing and settlement as a major area of strategic interest, both as part of their responsibilities for financial stability and for the implementation of monetary policy.[1] Reflecting this, they have become increasingly involved in the oversight of payment and clearing systems and in the operation of settlement systems.[2] By considering the evolution of interbank clearing and settlement arrangements since the late Middle Ages in the context of a number of diverse historical country case studies, this paper seeks to improve understanding of the development of central banks' current roles.

In the twentieth century, monetary systems across the world converged in their key features: interbank settlement ultimately occurs in state-backed central bank money. Prior to this, there was considerable diversity in the form of clearing and settlement arrangements, and we see a variety of innovations designed to reduce the costs associated with interbank settlement.

A number of authors have identified links between these developments and central banking. This is a complex issue, complicated by debate in the literature on how the term 'central banking' should be defined. Although modern central banks perform a number of different functions, we suggest that a key characteristic of central banks is their ability to act as lender of last resort by expanding their liabilities in all but the most extreme states of the world. Do historical case studies suggest that institutions standing at the centre of clearing and settlement arrangements will tend to perform, or develop, a lender of last resort function?

The historical evidence is mixed. Where one institution had obtained a dominant position and by virtue of this could act as lender of last resort, it would tend to play a central role in the clearing and settlement system, reflecting the superior status of its money.[3] However in other examples where there was a superior form of money available (although not necessarily an institution acting as lender of last resort), banks could – and did – also make use of other settlement assets. The examples of the Bank of England and of the US clearing houses suggest that a lender of last resort function could (begin to) evolve from an institution's role in clearing and settlement. There are other cases, however, where neither the liabilities of institutions at the heart of a

[1] 'Clearing' is defined here as the process of calculating amounts due to and from each bank, confirming these amounts, and checking that funds are available for settlement. 'Settlement' is the transfer of funds; this extinguishes banks' obligations.
[2] For instance, the United Kingdom's Banking Act (2009) has, among other things, put the Bank of England's oversight of payment systems on a statutory footing. More generally for the United Kingdom, see Leigh-Pemberton (1989) for an early insight into modern central banks' interests in payment systems; also Bank of England (2005).
[3] By 'superior', we mean that the money issued would continue to be accepted in all but the most extreme states of the world. If not issued/backed by the government itself, such a status might arise, for example, where the issuer enjoyed government privileges.

country's payment arrangements developed a superior status within the monetary system, and nor did those institutions take on the role of lender of last resort.

The paper is structured as follows. Section 2 discusses arrangements for interbank settlement and clearing today and, in particular, central bank involvement in these systems. Section 3 sets out an analytical framework for understanding the evolution of clearing and settlement arrangements and explains the key innovations which banks introduced in different times and places to facilitate the process of exchanging claims. It draws on a range of disparate historical experiences, relating primarily to England, Scotland, the United States and Canada, though also to several non-Anglo Saxon cases. Based on this historical information, Section 4 considers the link between clearing and settlement arrangements and central banking, including some further European case studies. Section 5 concludes.

2 Interbank clearing and settlement, and central banks today

Over time, and in particular through the twentieth century, monetary systems across the world have converged in terms of some key features. Today, the vast majority of money is in the form of claims on banks ('bank money') and most payments are made by transferring these claims. The liabilities of a state-backed central bank have become base money with no form of commodity-backing and, typically, the central bank's notes have been given some form of legal tender status. In many payment systems, obligations are settled directly in central bank money.[4] This is true for almost all large-value payment systems and securities settlement systems and is also the case for some retail payment systems.[5] Why should this be the case?

Given the status of central bank money in today's monetary systems, banks have strong incentives to settle in it. The central bank's creditworthiness, arising from state backing, and, perhaps, the legal tender status of its notes, together with a credible (operationally independent) conduct of monetary policy, guarantee that its liabilities are the most reliable medium of exchange and will retain their value in all but the most extreme states of the world.

[4] The Committee on Payment and Settlement Systems' report *The role of central bank money in payment systems* (2003) explores these issues in some detail.

[5] In some payment systems banks do redeem their claims on each other in commercial bank money (for example the CHATS $ and € payment systems in Hong Kong, or credit and debit card systems in the United Kingdom). Another alternative would be for banks to settle their claims in liquid and low-risk financial assets. In such a system, banks would exchange a bundle of assets, ideally with a short maturity and reliable redemption value, worth just the value to be settled. (An example of this was the Edinburgh note exchange until the second half of the nineteenth century, more details of which are set out in Section 3 below.) Either way, banks can ultimately convert the assets which they receive in the settlement process into central bank money.

Secondly, for financial stability reasons, central banks are keen that their money is used for settlement – particularly in systemically important systems.[6] Using central bank money eliminates the credit risk which would arise from a commercial settlement agent and thereby reduces the risk that payment system networks can act as channels for transmitting problems in the financial system. As a result, central banks have facilitated settlement in central bank money by allowing low-cost transfers across their books, either of gross amounts (above all for wholesale payments, facilitating this by providing banks with cheap intraday liquidity) or of multilateral net amounts (more usually for retail payments, minimising the amount of liquidity that participating banks need to hold).

That banks settle obligations between themselves on a regular basis over accounts at the central bank is key to the way that monetary policy is implemented. It is also across these same accounts that central banks provide additional liquidity in stressed or emergency situations. For all of these reasons, payment systems are a key area of strategic interest for central banks. Reflecting this, central banks have developed increasingly close operational involvement in payment systems, in many cases owning and operating the infrastructure for processing payments, sometimes owning payment schemes, and overseeing privately owned payment systems. It is natural, then, to ask how clearing and settlement arrangements operated before there were modern central banks. This is now explored in some detail.

3 The development of clearing and settlement arrangements

Clearing arrangements first developed as banks began accepting claims on each other, and then evolved as banks looked for ways to reduce both the direct costs of doing this, and the amount of the asset they needed to hold in order to effect settlement. The achievement of greater efficiencies in clearing and settlement was similar in character to that proposed by Menger regarding the evolution of money itself (White (1999); Manning, Nier and Schanz (2009)). This section explains the key innovations which banks introduced at different times and in different places to facilitate the process of accepting and exchanging claims on each other. The analysis draws on a range of stages of the banking system's development, from countries including England, Scotland, the United States and Canada, plus a number of non-Anglo Saxon countries

[6] See for example the Bank for International Settlements' *Core Principles for Systemically Important Payment Systems* (2001), whose sixth Core Principle sets out that 'assets used for settlement should preferably be a claim on the central bank'.

including the Dutch Republic, German States/Germany, Belgium, Sweden, Norway, and Spanish and Italian city states.[7]

3.1 Early banks

'Banks' developed from a number of different starting points. In places where a wide variety of coins of different origins were in circulation, moneychangers expanded their role of valuing specie to offer payment services based on the deposits held with them (Kohn (1999)), as for instance in thirteenth century Venice (Mueller (1997)). Elsewhere, goldsmiths developed a similar banking business based on their safekeeping role. In England, for example, in the mid-seventeenth century, a network of London goldsmith 'bankers' was issuing notes and lending funds (Quinn (1997); He, Huang and Wright (2005)). A key impetus in these early developments was to reduce the costs of payment. In the case of both moneychangers and goldsmiths, the initiative came from the liability side of these early banks: people left specie on deposit; the moneychangers and goldsmiths could in turn reduce their costs/make a profit by allowing transfers of ownership across their books (ie allowing payment 'in-bank'); and they could lend the funds out – typically by issuing paper against them – since they would not be redeemed all at once. (The lending business would in many cases grow out of the deposit business – extending overdrafts to those who had previously deposited.)

Banks could also develop from the asset side – the 'delegated monitoring' story. Merchants, for example, saw trade flows and were in a good position to assess credit risks and spot potential lending opportunities. Some took the opportunity of lending out their own capital. In some cases, others with capital employed them to invest on a delegated basis. The new 'bankers' could reduce the cost of this funding by offering payment services – again, transferring in-bank or issuing paper.

Either way, reducing the cost of payment for those depositing specie was an important economic function of early banks. Depositors valued, and were willing to pay for, these early payment services.

[7] The choice of country case studies is of an 'informed arbitrary' nature – ie the authors have followed leads both in the literature, and in discussion with experts in this field. There are undoubtedly other country case studies that would merit research. Ireland, Australia and Hong Kong for instance have been suggested as being of interest. We acknowledge that the scope of our work – while broader than previous studies – could be expanded still further; but we leave this to other researchers to follow up.

3.2 Costs and benefits of banks accepting claims on each other

In many cases, early banks did not redeem claims on each other, offering to transfer funds only across their own accounts and/or refusing to accept notes issued by other banks. Banks at medieval trade fairs (such as those at Champagne) effected payments almost all in-bank, by initially assigning credits/debts to the accounts of the sellers/purchasers, and then for the most part extinguishing these positions by reflecting purchases/sales in the other direction, with remaining balances settled in specie (Kohn (1999)). Similarly, in Venice, for example, by the start of the fourteenth century, account holders at the same bank could transfer funds by book-entry. But the fact that a number of merchants held accounts at several Venetian banks (according to one argument, to facilitate the collection of receipts) suggests that the banks themselves did not at this time offer a convenient facility to transfer claims between each other. (Alternatively, it may be the case that, in an unregulated banking system with frequent bank failures, these merchants were spreading their credit risk. However, the impression that there was no straightforward means of transferring claims between banks is reinforced by the numbers of cash deposits and withdrawals shown in some extant accounting records from the time (Mueller (1997)).) That said, some banks do appear to have held correspondent accounts with each other, thereby enabling some means of transferring claims between banks. The Banco di San Giorgio in Genoa, for instance, seems to have instigated such correspondent arrangements around the same time (Fratianni and Spinelli (2006)).

Although the ability to exchange claims on a bank clearly reduced transaction costs relative to exchanging specie, further economies were possible if banks would accept claims on other banks in payment: if they would redeem other banks' notes, discount bills of exchange drawn on other banks, or accept signed-over claims on deposits at other banks (cheques). This would make claims on any one bank more widely acceptable, increasing the demand for bank money relative to specie. (Indeed, the ease of redeeming claims on another bank is a central feature of any modern monetary economy: if claims on banks are to fulfil their role as money, then ready acceptance by banks of claims on each other is necessary.)

As trading and financial systems developed, banks would have been under competitive pressure to accept claims on other banks. Where banks still did not redeem each others' claims, such instances appear to have been relatively short-lived, such as in the case of the Société Générale and Banque de Belgique refusing to accept each other's notes prior to the 1848 crisis in Belgium (Buyst and Maes (2006)). Alternatively, they arose in the context of a trading area that was too politically fragmented: for instance, despite the *Zollverein* (customs union) of 1834, in the 1850s

a number of German states imposed legal restrictions on the acceptance of notes issued by banks from a neighbouring state (Reichsbank (undated), Tilly (1967)).

As a general rule, banks had direct private incentives to accept claims on other banks, since they were often able to increase their own non interest bearing liabilities, by issuing deposits or notes to the payees who were depositing those claims on other banks. Since these could fund interest-earning assets, this was profitable business (Selgin and White (1987)). At the same time, where banks freely accepted claims on each other and returned them swiftly for redemption, this restricted the ability of any one bank to overissue.[8]

Set against the commercial pressures, banks also faced *costs* in accepting claims on other banks. So long as they held the claims, they were exposed to credit risk. If this ever crystallised, then it represented a direct loss to the bank. In order to extinguish this risk, banks needed to redeem their claims – in other words, to settle up. However, costs arose in:

- clearing, ie calculating the amounts due to and from other banks, and confirming the availability of the amounts due from banks in a debit position;
- holding a stock of the settlement asset to meet obligations (an opportunity cost); and
- settlement itself, ie of transporting the settlement asset.

Over time, and across countries, a variety of different arrangements emerged which served to reduce these costs. Solutions varied, depending – among other things – on initial local conditions (for instance the forms of liability issued by banks), the regulatory environment, and the structure of the banking system.[9] Of course, as innovations took hold in one financial centre, these were (where appropriate) picked up elsewhere. But in charting these developments there is no simple timeline. Nevertheless, notwithstanding haphazard developments that often characterise history in general, certain broad developments recur across the different countries. These include:

- arrangements, such as the development of correspondent bank relationships, to support long-distance trade;[10]
- netting of settlement obligations (bilateral and, later, multilateral);
- the formalisation of clearing and settlement in clearing houses; and
- efficiency gains in the choice of settlement asset.

[8] See, eg, Goodhart (1988). Gaskin (1965) specifically mentions this as a factor in the development of the note exchange in Scotland, where, as a consequence, it was in the interests of the larger banks to bind the smaller banks into the system.

[9] Examples of regulatory influences include legal restrictions on joint-stock banking in England and on branching in the United States.

[10] Given the distances involved, and the transport technology and infrastructure available in the early period under consideration (sixteenth century), such transactions could take weeks, if not months, to complete (Braudel (1986)).

In the remainder of this section, we examine the impetus for these broad developments, and the form they took, in a variety of historical country case studies.

3.3 The development of local clearing and settlement 'systems'

In early banking systems based on notes and/or bills of exchange, banks typically came to accept claims on other banks within their local area. For example, by the 1660s, goldsmiths in London were carrying out a banking business – issuing notes against specie deposits, and creating money by issuing further notes to borrowers. They accepted each other's notes, redeeming them on a bilateral basis every few days, and settling only the difference in specie, thereby saving on the quantity of settlement asset they needed to hold (Quinn (1997)). The bankers understood the credit risk involved: the more reputable was a banker, the longer other bankers were willing to hold his notes.

The early Scottish, US and Canadian systems were also based on notes. In Scotland, a mutual acceptance agreement was in place from about 1752 between the two largest banks (Gaskin (1965)) and between other pairs of banks (usually within the same locality) from the late 1760s (Munn (1981)). It appears that in early nineteenth century towns in the United States, and by the second half of the nineteenth century in Canada, similarly informal mutual acceptance arrangements emerged, resulting in savings in the quantity of settlement asset that banks needed to hold. Just as in England, in these other systems, credit risks were carefully managed. For example, in Canada (before the emergence of the first clearing houses in 1887-88) the intervals at which settlement took place were determined by the creditor (Crawford and Falconbridge (1986), Daniel (1996)) and again presumably reflected their perception of the credit risk involved.

There followed the development of more formalised clearing arrangements, ie with bankers clearing their claims in a co-ordinated manner and settling up according to a pre-agreed schedule, typically more frequently than before. In Edinburgh, a general note exchange had emerged by 1771 (Munn (1975)). This arrangement embraced provincial banking companies whose notes the two largest banks had not previously accepted. Although briefly falling into abeyance following the Ayr Bank's failure in 1772, it was soon revived by the Bank of Scotland in 1774 (Checkland (1975)), and met on a weekly basis – initially settling on a bilateral basis. The role of government intervention in Scottish banking is a subject of much debate in recent literature. The reality is arguably more complex than some of the 'free banking' literature acknowledges. While it is true that the note exchange system developed voluntarily, the form of

the arrangements was clearly influenced by the structure of the banking system which, itself, was influenced by the legislative environment. In London, the Bankers' Clearing House settled on a daily basis from 1775 onwards, also bilaterally (Matthews (1921)).

In time, the formal processes put in place by clearing houses allowed for the introduction of multilateral netting, whereby all the banks that were short overall for the day would pay in their net position and the clearing house would pay out to each long bank.[11] Such multilateral netting had the advantage over bilateral arrangements of further reducing the banks' opportunity costs by reducing the amount of the settlement asset that they needed to hold to meet their obligations. Thus, the Bankers' Clearing House in London settled on a multilateral basis from 1841 onwards.

3.4 Inter-regional clearing and settlement

Having become relatively common practice for banks to accept claims on other banks, they also looked for ways to reduce the cost of settlement. In the case of Scotland, although the distances involved were relatively small, exchanges in provincial towns proliferated to avoid the need to channel all payments through Edinburgh. The banks set up such exchanges in the late 1780s and 1790s, and by 1826 there were weekly (and later, daily) exchanges in most Scottish towns where two or more of the banks were represented (Checkland (1975)). In order to reduce the number of drafts on Edinburgh issued in connection with the local exchanges, from 1876, provincial exchange vouchers were used to carry claims forward from one business day to the next. Vouchers were only forwarded to Edinburgh for settlement at the end of each week, or during the week if the balance exceeded £100 (Graham (1886)).

In Canada, which also had a branched banking system, multilateral clearing houses were similarly set up in a number of key financial centres. Between 1887 and 1902, ten such clearing houses were established, generally with a different bank assuming responsibility for clearing and settlement in each centre. Daily settlement was made at each of four main centres (Montreal, Toronto, Winnipeg, Vancouver), to which 'lesser' clearing houses would send a bank draft. After 1927, settlement was centralised at the Royal Trust Company in Montreal, which received the results of the daily clearings reported by telegraph from 32 regional centres (Daniel (1996)). This development enabled each bank to maintain just one central clearing fund to meet debit balances and to receive credit balances (Royal Commission (1933)).

[11] With variations in the details of the process; see for example Matthews (1921) on the Bankers' Clearing House in London, and Graham (1886) and Leslie (1958) on arrangements in Edinburgh.

In so-called 'unit' banking systems, where banks were not branched, there was demand for banks to accept claims on other banks within the same currency area yet some distance away. In the United States in the first half of the nineteenth century, banknotes sometimes passed out of their local markets and into circulation in distant towns, and even across the border into Canada (Denison (1966)). Banks would often accept notes issued in different towns at a market-determined discount reflecting both the costs of returning the notes to the issuer for redemption (largely determined by geographical distance) and the status of the issuing institution (notes of new banks that had yet to establish themselves were subject to a significant discount) (Gorton (1996)). Where banks did not do this, commercial note brokers did. This simple market-determined solution required little co-ordination between banks.

In the early nineteenth century, the banking system in New England was well developed relative to much of the rest of the United States. In Boston, notes issued by provincial New England – 'country' – banks became widely used as currency, their holders being reluctant to deposit them with Boston banks because of the large discount. By reducing the scope for the Boston banks to issue their own notes (as the Boston banks saw it), this gave the country banks a certain scope to overissue. The problem arose from the costs of returning the country banks' notes for clearing and settlement.

The solution which the Boston banks hit upon in the mid-1820s (after a number of false starts) was to appoint a single agent for clearing and settling notes redeemed in Boston – the Suffolk Bank.[12] The Suffolk Bank cleared on a multilateral net basis and settled banks' positions in deposits held with it. Participating banks held both a clearing balance, and a larger balance which appears to have provided the Suffolk Bank with security against any risks incurred in the clearing process, as well as with income. The Suffolk accepted at par, or near par, all notes submitted to it by members of the scheme, overcoming the 'problem' (as many saw it) of non-par acceptance. Notes issued by members were cleared in the net clearing round. Notes issued by non-members were returned for redemption. Settlement occurred daily, with a time lag of one day.

The Suffolk pulled out of this business in the late 1850s in the face of competition from a specific-purpose clearing bank set up by banks resentful of the Suffolk's control over the clearing and settlement business and in particular of the profits which it generated (Rolnick, Smith and Weber (1998)). So the problem appears to have been not in the mechanics of the

[12] On the Suffolk system, see Calomiris and Kahn (1996), Rolnick, Smith and Weber (1998) and Smith and Weber (1999).

scheme, but rather in its ownership structure. The mutual replacement – the Bank for Mutual Redemption – had relatively few years to prove itself before the Civil War.

The Suffolk system was appropriate for the specific need to return notes to their issuers some distance from Boston. But a more typical situation was where banks in different areas needed both to pay funds to, and to receive funds from, each other. Correspondent banking was the common solution in this situation. Correspondents gave small local banks access to clearings that would otherwise be too distant to join. Where banks were divided into geographically distinct groups linked by correspondent arrangements, 'pyramids' of correspondent relationships evolved, with one centre typically sitting at the top of the 'pyramid' for inter-regional payments. The correspondent network channelled non-local interbank payments through concentrated channels, minimising the cost for local banks of holding the settlement asset, and benefiting correspondents who could net their own obligations and those of their customer banks. The economies of scale in concentrating liquidity, as a few centres developed a deeper market for bank claims (that is, a money market), only accentuated this tendency towards centralisation.

In England, the need for regional banking services increased in line with increasing economic activity, particularly from the middle of the eighteenth century, but restrictions on the formation of joint-stock banks remained in place into the nineteenth century. To meet the growing demand for banking services outside London, a large number of small banks ('country banks') were established in the late eighteenth and early nineteenth centuries. For the purpose of clearing local notes, the country banks (presumably) developed local arrangements. These English country banks, however, needed to hold a correspondent account in London both to pay to, and to receive from, the London banks and banks in other regions. A good proportion of the claims they held (in particular, bills they had discounted and were holding on behalf of customers) would be payable by a London bank at maturity. Bills were the primary form of trade finance, and 'from the early days of the credit system there was a marked tendency for bills on London to predominate'.[13] The strong position of the Bank of England (discussed further below) helps to explain why London became the centre of the English payments network. Later, as deposits became increasingly widely used, banks used the same correspondent network for clearing inter-regional cheques, through the 'Country Cheque' clearing (from 1858).

[13] Hawtrey (1938), page 5.

Similar correspondent banking arrangements developed in the United States following the National Banking Acts (1863 and 1864) – the 'National Banking Era'. As the economy developed, people needed to make more inter-regional payments, by draft or by cheque. Legal restrictions prevented the development of branching. An additional factor affecting the structure of correspondent arrangements in the United States was 'reserve bank requirements', whereby national banks were obliged to hold reserves in their region's 'reserve city'. They could use these reserves as correspondent banking balances, thereby employing their reserve bank as a clearing agent. The reserve banks in turn would typically clear and settle through local clearing house organisations. And banks in reserve cities in turn had to hold reserves with banks in major financial centres. As a result, New York (and, to a lesser extent, Chicago) sat at the top of the 'pyramid' for inter-regional payments.

3.5 Developments in the choice of settlement asset

To this point, this section has focused on the structure of clearing and settlement arrangements. Cost savings could also be achieved with innovations in the asset in which banks chose to settle. Initially, settlement was usually in specie. But this was cumbersome and costly to transport and exchange.[14] Even in *ad hoc*, bilateral clearing and settlement arrangements banks sought to reduce the costs of settlement by innovating in the settlement asset which they exchanged. Rather than settling directly in specie, they used assets convertible into specie which all banks were willing to accept. Banks' choice of asset was affected (obviously) by what was available to start with, as well as any legal requirements. In the details, the assets differed in important ways.

For instance, sometime between the Bank of England's foundation (1694) and the 1770s, London bankers switched from settling in specie to settling in Bank of England notes.[15] Such claims were a superior form of money to the notes of any other bank. The primary reason for this was the Bank's financial standing relative to other banks. This arose from the legal privilege of being the only joint stock bank allowed to issue notes, which enabled it to expand its note issue and generate widespread acceptability for its notes. Bank of England money was widely used as the settlement asset, since country banks settled inter-regional payments via correspondent relationships which ultimately settled via the London clearing arrangements. And the formal provincial clearings established later in the nineteenth century settled across accounts

[14] As Quinn (1997) notes in his article on the Goldsmith bankers of the mid-seventeenth century, a bag of silver coins worth £100 sterling – a commonly used value for notes – weighed over 30 pounds (more than 14 kilograms).
[15] Matthews (1921) records that in 1774, when banks in the city of London moved their clearing arrangements onto a more formal basis, they were already using Bank of England notes.

at the local branch of the Bank of England (as for example in Manchester, the largest provincial clearing).

In Scotland, both specie and drafts on London were initially used to effect final settlement (Graham (1886) and White (1984)). As volumes and values increased in the Scottish clearings in the nineteenth century, so exchequer bills seem to have become the main settlement asset.[16] This arrangement was formalised in an agreement of 1846 under which final settlement occurred in £1,000 exchequer bills (gold, specie, and notes of the Bank of England, the Bank of Scotland, the Royal Bank and the British Linen Company were used for settling residual obligations below £1,000). This had the advantage of limiting the cost of settlement, since it was necessary to draw upon London agents only when a bank's quota of exchequer bills fell below a certain minimum. However, fluctuation in the interest payable on these bills increased the costs involved in calculating obligations and, as settlement values rose, banks looked for an alternative. Arrangements were made in 1864 for settlement to occur in bills payable in London with a maximum time to maturity. By the mid-1880s, the Scottish banks had opened branches in London and arranged for settlement to take place through these London offices: ultimately, London also sat at the apex of the Scottish banking arrangements.

Among various settlement assets used in the United States under the National Banking System were gold, US Treasury-issued paper money ('greenbacks') and, in times of financial stress, so-called 'clearing house loan certificates' – physical certificates that were a liability of the members that constituted the clearing house.[17] In Canada, the Government's Dominion Notes – which were only partly backed by gold – were the ultimate settlement asset from their inception (1868), alongside gold (Walker (1899)).

Further efficiency gains could be realised by settling interbank obligations over accounts of one institution (rather than in paper claims). There were precedents for this, albeit on a more localised basis, for instance among some of the early (fifteenth, sixteenth and seventeenth century) public banks, where as discussed in the next subsection this innovation was effectively imposed by the public authorities. Nevertheless, settlement over accounts could develop naturally, such as in the localised case of the Suffolk Bank during the first half of the nineteenth century; or in England, where the Bankers' Clearing House switched to settlement over deposits

[16] Exchequer bills were short-term securities issued by government, forerunners of today's Treasury bills.

[17] Andrews (1942), page 594. The authors are indebted to Ellis Tallman (Federal Reserve Board, Atlanta) for guidance on the distinction between clearing house loans (liabilities of a member of the clearing house, who used them to balance positions at the end of the day) and clearing house loan certificates (liabilities of the members of the clearing house jointly, which were used as a settlement asset in times of financial stress). See the discussion in Section 4 for more detail.

held at the Bank of England in 1854. During the nineteenth century, there was a general structural shift across a range of banking systems, including in Britain and the United States, away from banknotes towards deposits as the primary form of bank liability.[18]

3.6 State intervention that improved payment, clearing and settlement arrangements

Although efficiency was a key driver in the evolution of clearing and settlement arrangements in each of these examples, the arrangements which developed were also influenced by the regulatory environment and the banking structure (eg the restrictions on joint-stock banking in England and on branching in the United States). There are many examples of the state intervening more directly still. The reasons for intervention seem to have varied – from a desire to bolster trust in the integrity of the monetary, banking and financial system, to an apparent desire to reap the rewards of greater control over the economy (including via seigniorage) perhaps for political advantage. But whatever the state's motivation, by intervening in the payment, clearing and settlement arrangements, it often had the effect of catalysing the natural forces for centralisation of settlement. In some cases, this brought significant cost savings and efficiency advantages that might otherwise have taken decades or centuries to evolve.

For instance, as early as 1356, in the wake of a number of bank failures, there were calls in Venice for a public bank providing payment facilities (Luzzatto (1934) and Mueller (1997)). While in this case, it was some two centuries in gestation (the public *Banco di Rialto* came into being only in 1587), elsewhere the initiative was picked up and implemented with the creation of municipal 'Taula' banks at the start of the fifteenth century: in Barcelona (and possibly Majorca) in 1401, Genoa (1407) and Valencia (1408) (Sarto (1934) and Riu (1979)). For a while, the Taula enabled banks to hold deposits as reserves and to use these to clear local interbank payments, though this proved short-lived in the case of Barcelona, as the authorities banned this function in 1437 (Kohn (1999)).

The Bank of Amsterdam was founded in 1609 (under the so-called 'exchange bank' model), to address the problems of coin debasement, which then characterised the monetary economy of the Dutch Republic. The desire for settlement on the books of a bank of superior standing

[18] The increasing prevalence of account-based – as opposed to store-of-value (eg banknote) – settlement arrangements may have been due in part to changes in their relative costs: store-of-value settlement arrangements require payees to verify the *bona fides* of the settlement asset, but require no information about the payer. By circulating for some time outside the banking system, they do not need to be cleared and settled immediately. On the other hand, account-based settlement arrangements require verification that the instructions to make payment are coming from an authorised individual and that the individual in question has the credit-worthiness to make the payment; and, unless payer and payee are customers of the same bank, then the cheque/draft needs to be cleared. As the costs of correctly identifying individuals and of maintaining accurate records have fallen over time (and more rapidly than the costs of verifying settlement assets), so the organic development of account-based settlement in more than just local areas became more feasible. See Gorton (1985) and Kahn and Roberds (2009).

compared to private cashiers may have provided additional impetus for its adoption: it certainly seems likely that the creditworthiness (as well as the convenience) of the Venetian system, which by then had been in place for nearly a generation, was noticed by merchants in Amsterdam.[19] Recent analysis of the Bank of Amsterdam has focused on its role in enforcing minting ordinances and its success in blunting the incentives to debase (eg Quinn and Roberds (2005 and 2006)). Of greater interest from the perspective of this paper are the legal restrictions which were placed on settlement outside the exchange bank in order to achieve these goals – provisions adopted from the regulations of the *Banco di Rialto*.[20] Although the restrictions were imperfectly enforced, settlement through the Bank of Amsterdam soon became the norm and the bank was placed at the heart of the payment system. A significant, but unintended consequence was the creation of 'banco money' (exchange bank money): a separate unit of account, operating in parallel with current money. This was enshrined in law by the ordinance of 1659 and a trade in buying and selling banco money began. By the late seventeenth century, the Bank of Amsterdam had no obligation to redeem deposits in coin on demand (Quinn and Roberds (2006)).

Following this model, other exchange banks were set up in some German states. One such was the Hamburg Bank (1619), offering payment services to account holders across its books, which were compulsory for exchanges exceeding 400 Luebische Mark. The Hamburg Bank survived until 1875, when it (and its by then well-established account-based 'giro' business) was absorbed into the newly formed Reichsbank (Sieveking (1934)), as part of a series of Bismarck's initiatives to consolidate the unification of Germany. In contrast to the local scope of the Hamburg Bank's business, the Reichsbank introduced a nationwide giro system, drawing on recent advances in transport and telecommunications, in the process also overtaking an initiative among banks within the German co-operative movement, which during the 1860s had already begun to develop a fledgling payment and clearing system reaching across Germany (Wittner and Wolff (1911)).

From its inception in 1876, the Reichsbank's system was such that accounts at any of its branches could be used to effect payments either locally or nationally. A number of banks, which had themselves developed a giro business for particular, normally localised, circles of clients, attached themselves to that of the Reichsbank, via a system of nine clearing houses,

[19] Van Dillen (1934).
[20] For example regulations required that commercial debts embodied in bills of exchange (the dominant instrument in short-run international finance) over certain limits (initially 600 florin) be settled through the exchange bank. Furthermore, the trade of private cashiers was, initially, prohibited (Van Dillen (1934)).

introduced in 1883-84 at key centres of German economic activity. By 1914, this system had been expanded to 27 such clearing houses, in part as a practical measure to manage the rapid increase in volumes of payments unleashed by the Reichsbank's new nationwide giro payment system (Reichsbank (1933)).

Elsewhere, the Second Bank of the United States (1816-36) was founded by the federal government primarily to maintain convertibility and assist in the funding of federal government debt. Nevertheless, it also played an active role in providing inter-regional payment services.[21] It was in a position to do this because, in contrast to the state-chartered banks, it had branches in a number of different states. In this way it was a forerunner of the Federal Reserve System, which was set up in 1913 in response to the US banking panic of 1907, and which provided a unified nationwide interbank settlement system, based on a 'Gold Settlement Fund' and telegraphic wire transfers.[22]

In Canada, the Bank of Montreal, whose charter was based on that of the Second Bank of the United States, and which acted as the Canadian government's banker with effect from shortly after its inception in 1817, might have evolved along similar lines (Watts (1993)); but because of rivalries among sufficiently strong commercial banks it did not. Instead, the Canadian Bankers' Association arrangements of clearing houses set up in the late nineteenth century worked (and evolved) efficiently, and were subsequently enshrined in legislation passed in 1900. When it was set up as a central bank in 1935, the Bank of Canada took over the centralised settlement arrangements from the Royal Trust, where, as noted above, settlement had been centralised after 1927 (Daniel (1996)).

4 Clearing and settlement arrangements and the development of central banking

As described in Section 2, settlement in modern-day monetary systems ultimately occurs in central bank money, so that central banks stand at the centre of the network of clearing and settlement arrangements in their currency. This is very much seen as the natural order of things. As Section 3 showed, banks had developed sophisticated clearing and settlement arrangements before there were modern central banks. This section explores whether the institutions at the centre of these clearing and settlement arrangements had (or developed) central bank-like characteristics.

[21] See for example Garbade and Silber (1979).
[22] See for example Tallman (2007).

The literature on the development of central banking contains a variety of meanings for the term. One textbook, for example, points out that various authors have identified central banking with at least five major roles: being a bankers' bank, monitoring commercial banks, having a monopoly of note issue, acting as lender of last resort, and conducting monetary policy.[23]

Several economic historians have identified links between clearing and settlement arrangements and these roles. For example, Goodhart suggests that the pressure for banks to establish efficient clearing and settlement arrangements was an important factor in the development of central banking.[24] In his view, the key factor in the development of central banking was the centralisation of the banking system's specie reserves with one bank or group of banks at the centre. There were natural pressures leading banks to do this, including in particular the pressure to reduce the costs of clearing and settling payments. In addition, it was probably more efficient for small banks to hold their reserves in the form of deposits at 'larger, centralised' banks than holding gold in their vaults. And, as also noted above, state intervention played an important role.

These pressures for centralisation did not necessarily hold sway in banking systems with large, branched and well-capitalised banks. Here, the pressure for reserves to be centralised within certain institutions was held in check. As a result, there was no 'nascent' central bank. Scotland is one example of this, as is Canada – although even in Canada, some centralisation eventually occurred with the move in 1927 to ultimate settlement at the Royal Trust Company in Montreal.[25]

Where there were pressures towards the centralisation of reserves, Goodhart (1988) suggests the bank or banks at the centre would naturally take on some of the functions of a central bank. They would become 'quasi', or 'nascent' central banks, the latter term implying that they were on the way to becoming fully fledged central banks. These trends were at work not only in cases where one bank had a privileged position through its relation with the state, such as the Bank of England, but also in other cases where there were pressures for the centralisation of reserves, in particular where banks faced barriers to branching such as in the United States. For example,

[23] White (1999), page 71.
[24] Goodhart (1988), chapter 3, especially pages 32-34.
[25] In the Scottish case, even though there was no strong pressure to centralise reserves, some authors identify examples in which the major banks performed central bank like functions. For example, Munn (1981) notes that, in addition to acting as Edinburgh correspondent for a number of the provincial banking companies, the Royal Bank of Scotland agreed to offer loans in times of stress. In so doing, Munn argues that it adopted a central bank type function as lender of last resort. However, these agreements were relatively short-lived: they were relinquished during the crisis of 1793.

'…the Suffolk bank, in furtherance of its actions to operate the clearing system effectively, was patently beginning to take on several of the functions of a proper Central Bank, eg acting as a bankers' bank and undertaking certain forms of supervision.'[26] And Smith (1936) suggests that the fact New York banks held a large proportion of the banking system's reserves – in turn linked to the correspondent network for routing payments – 'seemed to point to the existence of spontaneous tendencies to the pyramiding and centralisation of reserves and the natural development of a quasi-central banking agency, even if one is not superimposed'.[27]

Goodhart (1988) suggests that what held banks back from becoming full central banks was conflicts of interest between their public roles and their commercial incentives. Only if they could overcome such conflicts of interest – for example, by backing off from commercial activities as the Bank of England did in the late nineteenth century[28] – could they fully develop into central banks. At the same time, the fact that the Bank of England had had commercial relationships with other banks gave it practical experience (for example in discounting bills) that would become part of a modern central bank's standard toolkit for monetary operations.

Do the historical examples analysed in this paper suggest there is such a clear link between clearing and settlement arrangements and the development of central banking? If 'bankers' bank' is defined narrowly as a bank holding accounts for other banks, then it is clear that this characteristic arises directly from the provision of settlement services. Banks held balances with the bankers' bank for the purposes of making payments, standing in the same relation to it as non-bank customers do to their banks.[29] Acting as a bankers' bank in this way is an important step towards being a central bank, not least as a practical pre-requisite for its ability to act as a lender of last resort.

It is also true that some kind of supervisory function could naturally develop within clearing and settlement arrangements: given the risks taken on each other, participants had clear incentives to monitor the creditworthiness of their counterparties. In many cases it made sense to delegate this role, or at least aspects of it (such as enforcing membership criteria) to a central body.[30] The

[26] Goodhart (1988), page 32. In addition, Trivoli (1979), cited by Goodhart, describes the Suffolk Bank as 'acting in some limited respects as a central bank for New England' (pages 18-19). And Shenfield (1984) goes further, viewing the Suffolk as 'a successful central banking system' (page 74).
[27] Smith (1936), pages 137-38.
[28] Although our anonymous referee argued that it was probably not until around the time of World War I (1914-18) that the Bank was viewed by its rivals really as central bank than competitor.
[29] This was the case not only at the 'top' of the payments pyramid: correspondent banks are bankers' banks for their correspondent network.
[30] The clearing house in itself was a way for banks to mitigate risk, relative to the position where they accepted claims on each other but did not have any efficient way of clearing and settling them. In that case, their exposures would typically be larger and of longer

regulating functions of the Suffolk Bank and the New York Clearinghouse Association have both been well documented.[31] To the extent that supervision by the Suffolk Bank earlier in the nineteenth century focused (only) on mitigating credit risks of its participants, then this is much narrower than the prudential supervision undertaken by modern central banks or specialised supervisory agencies. By the time (later in the nineteenth century) the New York Clearinghouse was issuing joint liabilities, though, its monitoring role must have been broader – mitigating credit risks among participants of the clearing house in part through its membership criteria.

The issuance of joint liabilities is discussed below in more detail, as it links to the lender of last resort function as one of the key characteristics of a modern central bank. In the classic sense, a 'lender of last resort' is an institution whose own liabilities can function as outside money in a crisis. A lender of last resort can continue to supply liquidity by expanding its own balance sheet, by buying assets from the banking sector (directly or indirectly), even in the face of acute liquidity pressures within the banking system. The monetary policy and 'bankers' bank' roles are arguably facets of this (especially if 'bankers' bank' is interpreted broadly to mean an institution which can supply the banking system with liquidity). And having a monopoly of the note issue was a contributory factor to institutions such as the Bank of England gaining a superior status for their liabilities.

So do historical cases suggest that institutions standing at the centre of clearing and settlement arrangements – and providing the settlement asset – would perform, or develop, a lender of last resort function? To the extent that it is available, the historical evidence is mixed, but shows some tentative trends to support this hypothesis, at least from the nineteenth century onwards.

Prior to the (middle of the) nineteenth century, even if an institution existed that could fulfil the role, the modern concept of a lender of last resort, with the ability to expand its balance sheet in the face of (acute) liquidity pressures within the banking system, did not really exist. This applies in particular in the case of the early public banks (such as in Amsterdam), and also of the Suffolk Bank. In the case of the Bank of Amsterdam, for instance, the quality of its money was quickly recognised and it was increasingly used as the settlement asset not only in the Dutch Republic, where its use was mandatory for bills over 600 florin, but further afield too: in its heyday, the Bank of Amsterdam's money was the key currency in international finance.

duration. The obvious response to this risk was to accept liabilities only of banks which were in the clearing house. Regular clearances could also act as a control on note issue both by increasing the speed with which notes could be returned and by providing, in the exchange balances, an indicator of banking behaviour (see Checkland (1975), page 127).

[31] See eg Gorton (1985), footnote 7, page 279; also Timberlake (1984).

However, the Bank did not act as a lender of last resort during this period, and nor is there evidence to suggest that it even recognised it might have the capacity to do so. For instance, in the crisis of 1793, the Bank was unwilling to provide official support, even though the crisis seems to have been one of liquidity rather than fundamental solvency (Schnabel and Shin (2004)).

In the case of the Suffolk system, despite the attention it receives as a supposed example of the natural development of central banking, there is no evidence to support any contention linking its clearing and settlement function to a lender of last resort role. Clearly the Suffolk Bank played a crucial role in the clearing and settlement arrangements. But, notwithstanding the clearing (and other) balances that they held with the Suffolk Bank, it is not obvious that other banks centralised their reserves with it. And while there is evidence that it supplied liquidity to individual banks by lending to them, this was really just interbank lending, with the Suffolk in the best position to act as counterparty.

So this 'early' evidence is not supportive of a link between the provider of the ultimate settlement asset and its emergence as a lender of last resort. But during the course of the nineteenth century and into the twentieth, in some cases, the provider of the ultimate settlement asset did also develop a lender of last resort role. Where the provider of the settlement asset was a private institution, the function of lender of last resort could emerge more clearly only once conflicts of interest had been overcome. This applies specifically to England and Norway.

In the classic case of a lender of last resort, the Bank of England's notes were, from an early stage, regarded as being of superior quality to those of the rest of the banking sector, and banks adopted them as settlement asset. Claims on the Bank of England appear to have been *de facto* high-powered money from relatively early on, as illustrated during the suspension of their convertibility to gold, from 1797 for much of the period of the Napoleonic wars.[32] That is to say, that, from early on, the Bank's credit was sufficient, in the eyes of bankers and the commercial classes, that they were willing to hold claims on the Bank rather than specie itself. Backup liquidity was held in the form of accepted bills, which the Bank – by established practice – stood ready to buy. The status of the Bank's liabilities was reinforced over time as successive governments were willing to protect the Bank from default by suspending its obligation to pay in specie, and from 1833 by granting its notes formal legal tender status.

[32] Indeed Dowd (1991) suggests that the Bank had acted as a lender of last resort at some time before this.

Given the status of Bank of England money, it was very likely that banks would perceive it as being good enough for day-to-day settlement purposes. It was also (increasingly) cheap to exchange in settlement. Furthermore, there were economies of scope for banks in holding settlement balances with the institution to which they would turn for emergency liquidity. Namely, if a bank needed to use its reserves in order to meet a run, a good part of the run would take the form of adverse clearing balances. If a bank accessed emergency liquidity from the institution that settled for it, it could more easily pay its funds away.[33] Bagehot (1873) describes how, during the course of the nineteenth century, the Bank developed, somewhat by trial and error (as it grappled with conflicts of interest) its role as lender of last resort.

Similarly, in Norway, following its inception in 1816, the Norges Bank enabled money to be transferred from one of its branches to another, initially following delivery of Norges Bank notes at the sending branch, later via account balance transfers. As cheques became more popular through the nineteenth century, so, even in the absence of a clearing house, outstanding obligations between banks were partly cleared through the Norges Bank. When, in 1898, the Christiania Afregningskontor (the clearing house in modern-day Oslo) was established, it was natural for the Norges Bank to enter the balance on each bank's account that it held. Yet it was the state bank Hypotekbanken (intended to give loans for housing) rather than the Norges Bank, which, during a period of financial difficulty in 1875-81 for the Norwegian savings banks, stepped in with financial support. (It may be that the conflicts of interest for the Norges Bank as a bank with commercial incentives were at this time too strong.) It took a new Act of Parliament in 1892 to weaken the Norges Bank's commercial interests, and during crises among Christiania banks in both 1899-1900 and the 1920s, the Norges Bank did then act as lender of last resort (Haare (2007)).

An intermediate case study emerges in Canada: the state there issued a superior form of money – Dominion Notes. These were used for settlement from their inception in 1868. The government showed itself willing to issue more in crises, most clearly so in 1914 (Denison (1966)). But it was the banking system that developed the clearing arrangements, and eventually centralised these on the Royal Trust Corporation, which did not have lender of last resort responsibilities or a lender of last resort capability.

[33] The counterfactual would have been for banks to have turned to the Bank of England to supply liquidity in extreme circumstances, but then to have needed to transform this liquidity into some other asset for the purposes of interbank settlement.

There are still other cases where there was a superior form of money already available, but where banks adopted other settlement assets. Back in the 1860s, the US Treasury had started to issue 'greenback' notes which circulated as currency. Banks did not immediately use these for settlement (in part, possibly because greenbacks were not convertible at the time – indeed, their value against gold varied).[34] Instead, banks settled using certificates issued by a member bank, and later by the US Treasury, fully backed by specie, which the bank/Treasury appears to have held on a custody-like basis.[35] These certificates were valid only for payments directly between members of the clearing house.

Reserve-city legislation had the effect (together with efficiencies to be gained in the inter-regional clearing and settlement arrangements) that the banking system ultimately held its reserves with the members of the New York Clearinghouse Association. The New York Clearinghouse evolved towards the end of the nineteenth century to be at the centre of clearing and settlement arrangements. Liquidity pressures would therefore fall on the New York banks. This fact alone was not sufficient to give them lender of last resort status. But in the absence of any higher issuer of liquidity, they developed an ingenious solution – issuing joint liabilities of the whole clearing house during times of financial stress – clearing house loan certificates – that were used as settlement asset during their period of issuance. This was a role akin to that of lender of last resort – albeit with limits.[36]

In successive crises in the late nineteenth century, the members of the New York Clearinghouse Association pre-committed to providing liquidity to members which found themselves under pressure, so long as they were solvent. The clearing house's loan certificates to members (all secured against collateral) were joint obligations of all members. Initially, the banks used these newly created clearing house liabilities only for paying each other in the clearing. But they sometimes also paid them out to customers, presumably including customer banks, who wanted to redeem their claims on the clearing house banks. Timberlake (1984) recounts how clearing house associations issued increasing amounts of these clearing house loan certificates in successive crises, and how clearing house members paid out claims on the clearing house, although they still had large stocks of gold. The liabilities of the Clearinghouse Association, actually mutualised liabilities of the clearing house banks, had become a form of 'high-powered' money.

[34] On this phenomenon, see Friedman and Schwartz (1963), pages 26-27.
[35] Andrews (1942), page 594.
[36] Gorton (1985) and Timberlake (1984) are the classic references on the US clearinghouses' function of providing emergency liquidity. Gorton and Huang (2002) develop a formal model.

This function grew out of the position of the New York banks at the centre, as that is where the demand for liquidity ultimately fell. There were important shortcomings in their ability to supply liquidity, notably conflicts of interest which meant they would supply liquidity only to certain kinds of monetary institutions (notably not to Trusts), and the fact that the emergency paper was technically illegal. But these issues could have been addressed, and indeed were, temporarily, under the Aldrich-Vreeland Act (1908). Under the terms of this Act, banks issued clearing house liabilities to good effect during the financial turmoil at the outbreak of World War I.

The practice of banks coming together in times of liquidity pressure to issue joint liabilities was not unique to New York. New York may have pioneered it, but other clearing houses and groups of banks in the US adopted it as well. It is not clear that the status of claims on the New York Clearinghouse rose to a status so clearly above claims on other associations. Whether or not it did, the example of the US clearing houses does lend support to the idea that institutions standing at the centre of clearing and settlement arrangements – providing the settlement asset – could perform, or develop, a lender of last resort function.

But other historical case studies are much less compelling in terms of institutions at the heart of the clearing and settlement process taking on a central bank's lender of last resort role.

In Belgium, it was one of the country's main private banks – the Société Générale – which set up a giro payment system in the late 1860s and early 1870s, and performed support operations during some though not all Belgian banking crises of the later nineteenth century (Buyst and Maes (2006)). The National Bank of Belgium, which had been set up as a private joint-stock company in 1850, later had responsibility for the smooth operation of the payment systems (Capie *et al* (1994)), and also stepped in during some but not all of the banking crises. To what extent either bank was acting truly as lender of last resort – with an ability to expand its balance sheet as necessary – is not clear.

In Sweden between the mid-1850s and 1901, the Riksbank's involvement in clearing and settlement seems to have been fairly limited[37] – despite the fact that its notes were (voluntarily) used as reserves by the banking system (Ögren (2006)). Instead, the Stockholms Enskilda Bank

[37] Although Ögren (2005) argues that it is likely that the Riksbank did engage in some clearing activities.

and, later, the Skandinaviska Kreditaktiebolaget (a non-issuing joint stock bank) acted as clearing banks for the system, and offered settlement across their accounts (Hortlund (2005)).

Overall then, based on evidence from a number of countries, where one institution had a dominant position, it would tend to play a central role in the clearing and settlement system, reflecting the status of its money. In some cases, this institution was then, at least in theory, able to step up to act as lender of last resort; and in practice, its willingness to do so became greater through the (latter half of the) nineteenth century, in particular where conflicts of interest (as competing private institutions) were overcome. The Bank of England is the prime example of this. The New York Clearinghouse also provides an example of a lender of last resort function growing out of an institution's role in clearing and settlement. In a number of other cases, though, institutions at the heart of the clearing and settlement arrangements did not develop a superior status within the monetary system.

5 Conclusion

In the early stages of the development of banking, there were strong pressures on banks to accept claims on each other. Arrangements for clearing and settlement developed as banks looked for ways to reduce the costs of accepting these claims, and the amount of the asset they needed to hold in order to effect settlement. Across countries and across time, there were a range of responses, including a variety of innovations in both the structure of the arrangements and in the settlement asset used. The nature of these innovations depended in part on initial conditions in each banking system. These could be heavily affected by regulation, and there are several instances where direct (state) intervention bypassed the evolutionary cost-reduction process.

Today, arrangements for interbank settlement are far more uniform. Private banks generally settle obligations between themselves (sometimes at one remove, through correspondents) over accounts at state-owned central banks. Claims on these state-owned central banks are no longer commodity-backed and typically have some form of legal tender status; they are the most reliable form of money in the economy.

This paper argues that the historical link between clearing and settlement arrangements and central banking is a complex area for investigation. Focusing particularly on the lender of last resort function – one of the key characteristics of a central bank – it explores whether

institutions at the centre of clearing and settlement arrangements had (or developed) central bank-like characteristics.

The historical evidence is mixed. Where there was an institution such as the Bank of England whose money was of superior standing for exogenous reasons – for example, a privileged position bestowed by the state – then banks would typically (although not always) use that institution's money to settle up, subject to being able to do so at reasonable cost. This money was of sufficient quality to act as a substitute for the actual commodity behind the commodity standard: banks were confident that in a financial crisis it would retain its value. If the institution was also willing to supply extra liquidity in a crisis, then there were potential economies of scope. The position of central bank money in modern payment and settlement arrangements is exactly analogous (minus the commodity base).

In banking systems where no one institution stood above the others, banks innovated to find other solutions, such as the Suffolk system or the arrangements between Scottish banks (before 1844). In one case – that of US clearing houses under the National Banking System – banks developed the ability to create emergency liquidity by acting in concert. This was a response to the need for a provider of emergency liquidity in a system weakened by regulatory constraints. In this example, the ability to create emergency liquidity grew out of the structure of the payment system.

So some institutions at the heart of the historical evolution of clearing and settlement began to perform lender of last resort functions. Others did not, or at least not without government action to impose the model of the central bank as lender of last resort and at the heart of clearing and settlement arrangements. Once an institution was in the position of preferred provider of the settlement asset, the economies of scope with the lender of last resort function are strong; and, in practice, during the twentieth century, central banks' involvement in the payment system was consolidated.

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