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

Ben Norman

Rachel Shaw

George Speight

Bank of England, Threadneedle Street, London, EC2R 8AH.

E-mail: ben.norman@bankofengland.co.uk

rachel.shaw@bankofengland.co.uk

george.speight@bankofengland.co.uk

Draft prepared for Past, Present and Policy conference 'The Evolution of Central Banks: Lessons for the Future', 23-24 November 2006

Contents

Abstract		3
I	Introduction	4
II	Interbank clearing and settlement and central banks today	5
III	The development of clearing and settlement arrangements before fiat money	7
	Reducing the costs of payments was an important function of early banks	7
	Advantages of, and costs to banks in, accepting claims on each other	8
	Local bilateral clearing in early banking systems	10
	Move into more formalised arrangements: towards multilateral netting	11
	Inter-regional clearing and settlement	11
	Developments in the choice of settlement asset	15
	State intervention to improve payment, clearing and settlement arrangements	17
IV	Clearing and settlement arrangements and the development of central banking	19
V	Conclusion	27
References		30

Abstract

Central banks have come to view payment systems as a key area of strategic interest, not only for the implementation of monetary policy but also under their responsibilities for financial stability. By considering the evolution of interbank settlement arrangements and central banking functions in a number of diverse examples, this paper seeks to improve understanding of the development of, and reasons for, this current role. Starting from a situation where the earliest banks did not allow for fund transfers, banks introduced a variety of innovations to settle between themselves more efficiently. Focussing particularly on the lender of last resort function – arguably the key characteristic of a central bank – this paper explores whether institutions at the centre of these arrangements had (or developed) central bank-like characteristics.

I Introduction

Central banks have come to view interbank clearing and settlement as a major area of strategic interest, not only for the implementation of monetary policy but also under their responsibilities for financial stability.[1] Reflecting this, they have become increasingly involved in the operation of these systems. By considering the evolution of interbank settlement arrangements and central banking functions in a number of diverse examples, this paper seeks to improve understanding of the development of, and reasons for, this current role.

In the twentieth century, monetary systems converged in their key features: interbank settlement ultimately occurs in state-backed central bank money with no form of commodity-backing. By contrast, before fiat money became standard, there was considerable diversity in the form of clearing and settlement arrangements, and we see a variety of different 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, the key characteristic is their ability to act as lender of last resort by expanding their liabilities. Do historical cases suggest that institutions standing at the centre of clearing and settlement arrangements – providing the settlement asset – will perform, or develop, a lender of last resort function?

The historical evidence is mixed. Where one institution had obtained a dominant position and could act as lender of last resort, it would tend to play a central role in the clearing and settlement system, reflecting the status of its money. 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 adopted other settlement assets.

[1] 'Clearing' is the process of calculating the 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.

The example of the US Clearing Houses suggests the lender of last resort function could grow out of an institution's role in clearing and settlement. There are other cases, however, where the institutions at the heart of a country's payment arrangements did not develop a superior status within the monetary system.

The paper is structured as follows. Section II discusses arrangements for interbank settlement and clearing today and, in particular, central bank involvement in these systems. Section III 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 rich historical information, Section IV considers the link between clearing and settlement arrangements and central banking. Section V concludes.

II Interbank clearing and settlement and central banks today

Over time monetary systems have converged in their 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 most payment systems, obligations are settled directly in central bank money. This is true for almost all large-value payment systems and securities settlement systems and is also the case for some retail payment systems.[2, 3] Why?

[2] Of course, in some payment systems banks do redeem their claims on each other in commercial bank money (for example the large-value payment systems in Hong Kong and the credit- and debit-card systems in the UK). It would also be possible 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.) In both these cases, banks can ultimately convert the assets which they receive in the settlement process into central bank money.

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

Given the status of central bank money in today's monetary systems, banks have strong incentives to want to settle in it. The central bank's creditworthiness, arising from state backing, and, perhaps, the legal tender status of its notes, guarantees that its liabilities are the most reliable medium of exchange and will retain their value in extreme states of the world. And, just as customers have the right to redeem their claims in central bank money, banks have the right to redeem claims on each other in central bank money.

Secondly, for financial stability reasons, central banks are keen that their money is used for settlement – particularly in systemically important systems. 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 multilateral net amounts – minimising the amount of liquidity participating banks need to hold – or gross amounts with cheap liquidity.

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 – in effect, by imposing price constraints on these accounts to affect the price of overnight money. It is also across these same accounts that central banks would provide emergency liquidity assistance.

For all of these reasons, payment systems are a key area of strategic interest for central banks. Reflecting this, they 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.

From this perspective, it is natural to ask how clearing and settlement arrangements operated before there were modern central banks operating under fiat standards. This is now explored in some detail.

III The development of clearing and settlement arrangements before fiat money

Clearing and settlement arrangements developed as banks began accepting claims on each other and looked for ways to reduce both the costs of interbank clearing and settlement, and the amount of the asset they needed to hold in order to effect settlement. 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 development of the banking system, from countries including England, Scotland, the United States and Canada, plus a number of non-Anglo Saxon countries including the Dutch Republic, German States / Germany, Belgium, Sweden, Norway and Spanish and Italian city states.

Reducing the costs of payments was an important function of 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)), for instance in 13th 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 (i.e. allowing payment 'in bank'); and they could lend the funds out – typically by issuing paper against them – since they would not have to pay them all out at once. (The lending business would in many cases grow out of the deposit business – extending overdrafts to those who had deposited.)

Banks could also develop from the asset side – the 'delegated monitoring' story, which is perhaps the more traditional account of how banks developed. 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.

Advantages of, and costs to banks in, 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. While, for example, in Venice, by the start of the fourteenth century, account holders at the same bank could transfer funds by book-entry, the fact that a number of merchants held accounts at several Venetian banks (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. This impression is reinforced by the proportion of cash deposits and withdrawals in some of the extant accounting records from early fourteenth century Venice (Mueller (1997)). Nevertheless, a number of banks do appear to have held correspondent accounts with each other, thereby enabling some means of transferring claims between banks. Similarly, 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).

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 (a cheque). 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 did not redeem each others' claims, such instances appear to have been relatively short-lived, such as in the case of the Société Generale and Banque de Belgique refusing to accept each other's notes prior to the crisis of 1848 (Buyst & Maes (2006)); or they arose in the context of a trading area that was too politically fragmented, for instance, in the case of a number of mid-nineteenth century German states, where, notwithstanding the *Zollverein* (customs union) of 1834, legal restrictions regarding the acceptance of notes issued by a bank from a different state were imposed during the 1850s (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 payer. Since these would fund interest-earning assets, this was profitable business (Selgin and White (1987)). In addition, where banks freely accepted claims on each other and returned them swiftly for redemption, this restricted the ability of any one bank to over-issue.[4]

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

[4] See, e.g., Goodhart (1988). Gaskin (1965) specifically mentions this as a factor in the development of the note exchange in Scotland. The larger banks were keen to bind the smaller banks into the system.

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 conditions (for instance the forms of liability issued by banks), the regulatory environment[5], and the structure of the banking system. 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, certain broad developments recur across the different countries, including netting (bilateral then multilateral), the formalisation of clearing and settlement in clearing houses, and efficiency gains in the choice of settlement asset.

Local bilateral clearing in early banking 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 others' notes, redeeming them with each other on a bilateral basis every few days, and settling only the difference in specie to save 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 1752 between the two largest banks (Gaskin (1965)) and between other pairs of banks (usually within the same geographical area) from the 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, informal mutual acceptance arrangements emerged, resulting in savings in the quantity of settlement asset they 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 1887-8) the intervals at which settlement took place were determined by the creditor (Crawford & Falconbridge (1986), Daniel (1996)) and again presumably reflected their perception of the credit risk involved.

[5] For instance, legal restrictions on joint-stock banking in England and on branching the United States.

Move into more formalised arrangements: towards multilateral netting

Further innovations followed the development of more formalised clearing arrangements, i.e. with bankers clearing their claims in a coordinated manner and settling up according to a pre-agreed schedule, typically more frequently than before. This was desirable as the volume and value of inter-bank payments increased, since it reduced credit exposures.[6] 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, this arrangement was soon revived by the Bank of Scotland in 1774 (Checkland, 1975). This met on a twice-weekly basis – initially settling on a bilateral basis (Kroszner (1997)). In London, the Bankers' Clearing House settled on a daily basis from 1775 onwards, also bilaterally.[7]

In time, the formal processes put in place by clearing houses allowed for the introduction of multilateral netting, whereby banks which were short overall for the day would pay in their position and the clearing house would pay out to each long bank[8]. Such multilateral netting had the advantage over bilateral arrangements (whether informal or formal) of further reducing the banks' opportunity costs, i.e. 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.

Inter-regional clearing and settlement

So, it was relatively common practice for banks to accept claims on other banks in the same locality, and over time these arrangements became more formal. Banks also looked for ways to reduce the cost of settling payments beyond the local areas.

---

[6] 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. Deposits made for much greater demands on clearing and settlement arrangements, since on most occasions when a customer 'spent' his deposit, via cheque of draft, banks would have to clear and settle the payment. (This was not the case only when payer and payee were customers of the same bank.) In contrast, a banknote could circulate as money outside the banking system for quite some time. See e.g. Gorton (1985), pp.277-8.

[7] Matthews (1921) is the key source on London clearing and settlement arrangements.

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

Indeed, in the case of Scotland, although the distances involved were relatively small, banks developed exchanges in provincial towns 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 latter development enabled each bank to maintain the preferred settlement asset of Canadian Government-issued Dominion Notes to meet debit balances in just one central clearing fund (Royal Commission (1933)).

In more dispersed 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, bank notes in some cases 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 New England, where the banking system was well developed relative to much of the country, this gave rise to the situation where country banks' notes were widely used as currency in Boston, their holders being reluctant to deposit them with Boston banks because of the large discount. As well as (as they saw it) reducing the scope for the Boston banks to issue their own notes, this gave the country banks a certain scope to over-issue. The problem arose from the costs of clearing and settling country banks' notes.

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.[9] 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 with security against any risks incurred in the clearing process, as well as 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 scheme, but rather in the 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.

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

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 one centre developed a deeper market for bank claims (that is, a money market), only accentuated this tendency towards centralisation.

Notably, in England, while the need for regional banking services increased in line with increasing economic activity from the middle of the eighteenth century, restrictions on the formation of joint-stock banks remained in place, so that a large number of small banks outside of London ('country banks') developed in the late eighteenth and early nineteenth centuries. For the purpose of clearing local notes, the country banks presumably developed local arrangements.

English country banks needed to hold a correspondent account in London both to pay to, and to receive from, London banks and banks in other regions, in particular in respect of bills of exchange. A good proportion of the claims which they held (in particular, bills which they had discounted and which they 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.'[10] Banks needed a London correspondent to present for payment bills which they held and to issue bills payable on London. Along with the strong position of the Bank of England (discussed further below), these factors all help to explain why London became the centre of the English payments network. As deposits became increasingly widely used, banks used the same correspondent network for clearing inter-regional cheques, through the 'Country Cheque' clearing (from 1858).

[10] Hawtrey (1938), p.5.

Similar correspondent banking arrangements developed in the United States. As the economy became more advanced from the middle of the nineteenth century, 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, which they could use 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 New York City, so that New York sat at the top of the 'pyramid' for inter-regional payments.

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 to the asset in which banks chose to settle. Initially, settlement was usually in specie. But this was cumbersome and costly to transport and exchange. 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. In the details, the assets differed in important ways. Banks' choice of asset was affected (obviously) by what was available to start with, as well as any legal requirements.

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.[11] Such claims were a superior form of money. 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, enabling it to expand its note issue and generating widespread acceptability for its notes. Bank of England money was not only used as the settlement asset in London, since country

[11] 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.

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

In Scotland, both specie and drafts on London were initially used to effect final settlement (Graham (1886), White (1984)). As volumes and values increased in the Scottish clearings in the nineteenth century, so exchequer bills[12] seem to have become the main settlement asset. This was formalised in an agreement of 1846 under which final settlement occurred in £1000 exchequer bills recorded in a dedicated book kept by the Bank of Scotland (notes of the three public Banks and of the Bank of England, and gold were used for fractional parts of £1000). This had the advantage of limiting the cost of settlement, since it was only necessary to draw upon London agents 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 toke place through these London offices. Ultimately, London sat at the apex of the Scottish banking arrangements.

In the United States under the National Banking System, New York (and to a lesser extent Chicago) sat at the top of the banking pyramid. Although the US Treasury issued paper money, it was not used as the settlement asset. Rather, banks deposited specie with one dedicated bank on a custody-type basis and drew certificates against this, which they used for settlement.[13] Later, they did something similar but with the US Treasury acting as custodian. This was in contrast to neighbouring Canada, where 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)).

[12] Short-term securities issued by central government, analogous to today's Treasury bills.
[13] Andrews (1942), p.594.

Further efficiency gains could be realised by settling inter-bank obligations over accounts (rather than in paper claims) of one institution. There were precedents for this, for instance among some of the early (fifteenth, sixteenth and seventeenth century) public banks (see below), where effectively this innovation was imposed by the public authorities. Nevertheless, settlement over accounts could develop naturally, such as in the 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 held at the Bank of England in 1854.

State intervention to improve 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 influenced by the regulatory environment and the banking structure (e.g. the restrictions on joint-stock banking in England and on branching in the United States). There are many examples of the state intervening even more directly to facilitate payments, often through settlement across the books of a single institution. 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 with the capacity to make payments (Luzzatto (1934), 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), Riu (1979)). For a while, the Taula enabled banks to hold deposits as reserves and to use these to clear inter-bank payments, though this proved short-lived in the case of Barcelona, as the authorities banned this function in 1437 (Kohn (1999)).

In 1609 the exchange bank model was adopted in Amsterdam, to address the problems of debasement and monetary confusion which characterised the Dutch Republic. The desire for settlement on the books of a bank of 'superior authority' to private cashiers may have provided additional impetus for its adoption: it certainly seems likely that the convenience of the Venetian system was noticed by merchants in Amsterdam.[14] Recent analysis of the Bank of Amsterdam has focussed on its role in enforcing minting ordinances and its success in blunting the incentives to debase (e.g. see 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[15] – provisions adopted from the regulations of the *Banco di Rialto*. 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 Wisselbank had no obligation to redeem deposits in coin on demand (Quinn and Roberds (2006)).

Following this model, other exchange banks were set up in 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 giro-business) was absorbed into the newly-formed Reichsbank, itself a metamorphosis of the Prussian Bank (Sieveking (1934)). By contrast to the local scope of the Hamburg Bank's business, the Reichsbank introduced a nationwide giro system, in the process also overtaking an initiative among banks within the German co-operative movement, which during the 1860s had 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, introduced in 1883-4 at key centres of German

[14] Van Dillen (1933);

[15] 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. Initially the trade of private cashiers was prohibited (Van Dillen, 1933).

economic activity, and allowing local payment instructions to be netted off. This was expanded to 27 such Clearing Houses by the eve of the World War I in 1914, 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 (1816-1836) was founded primarily to maintain convertibility and assist in funding of federal government debt. Nevertheless, it also played an active role in providing inter-regional payment services.[16] 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, which was set up in 1913 following the crisis of 1907, and provided a unified nationwide inter-bank settlement system, based on the Gold Settlement Fund and telegraphic wire transfers.

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 into the role of central bank (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. So, when it was set up as a central bank in 1935, the Bank of Canada simply took over the settlement arrangements from the Royal Trust.

IV Clearing and settlement arrangements and the development of central banking

As described in section II, settlement in today's 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. Reflecting the importance of payment systems to monetary and financial stability, central banks are often also closely involved in the operation of payment systems and oversee them to ensure that the risks are appropriately managed. That central banks stand at the centre of the payment system is closely bound up with being a modern central bank, reflecting that

[16] See for example Garbade and Silber (1979).

a central bank's liabilities are the unit of account as well as that central banks deliberately make it easy for banks to use their liabilities to settle up.

This is very much seen as the natural order of things. But of course it is predicated on having an established central bank operating under a fiat standard. As section III showed, banks developed sophisticated clearing and settlement arrangements before there were modern central banks operating under fiat standards. This section explores whether the institutions at the centre of these clearing and settlement arrangements had (or developed) central bank-like characteristics.

Some of the literature on the development of central banking is marked by a lack of clarity about what the term means. One textbook, for example, suggests 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.[17]

A range of 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.[18] 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 a key 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 'larger, centralized' banks than holding gold in their vaults. (In the classic case of reserves being centralised, though, namely that of New York under the National Banking system, state intervention also played an important role in the form of reserve city legislation.)

These pressures for centralisation did not necessarily hold sway in banking systems with large, branched and properly capitalised banks. Here, the pressures for reserves

[17] White (1999), p.71.
[18] Goodhart (1988), chapter 3, especially pp.32-34.

to be centralised within certain institutions were held in check. As a result, there was no ‘nascent’ central bank. Scotland and Canada are examples of this.

Nevertheless, where there were pressures towards the centralisation of reserves, Goodhart 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, ‘…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, e.g. acting as a bankers’ bank and undertaking certain forms of supervision.’[19] And for Vera Smith, the fact that 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’.[20]

For Goodhart, 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 – could they fully develop into central banks.

Do the historical examples analysed in this paper suggest there is such a 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 ‘money’ balances with the bankers’ bank for the purposes of

[19] Goodhart (1988), p.32. In addition, Trivoli (1979), cited by Goodhart, describes the bank as ‘acting in some limited respects as a central bank for New England’ (pp.18-19). And Shenfield (1984) goes further, viewing the Suffolk as ‘a successful central banking system’ (p.74).
[20] Smith (1936), pp.137-8.

making payments, standing in the same relation to it as non-bank customers do to their banks. This was the case not only at the 'top' of the payments pyramid: correspondent banks are bankers' banks for their correspondent network. However, acting as a bankers' bank in this very limited way is hardly a sufficient criterion for a central bank.

It is also true that some kind of supervisory function would 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.[21] The regulating functions of the New York Clearinghouse Association and the Suffolk Bank have both been well documented.[22] However, this type of supervision – focussed on mitigating credit risks between participants – is very different to (and much narrower than) the prudential supervision undertaken by modern central banks or specialised supervisory agencies.[23] Indeed, commercial banks still carry out this type of 'supervision' today, e.g. through membership criteria for private clearing houses. So it is not clear that in monitoring or supervising its members, clearing houses were developing a 'central banking' function.

What about the other characteristics identified above? Arguably the key characteristic of a central bank is the lender of last resort function. In the classic sense, a 'lender of last resort' is an institution whose own liabilities function as outside money in a crisis. A lender of last resort can supply liquidity by expanding its own balance sheet, by buying assets from the banking sector (directly or indirectly). Monetary policy and 'bankers' bank' are arguably facets of this (if 'bankers' bank' is interpreted more broadly than above to mean an institution which can supply the banking system with

[21] 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 duration. The obvious response to this risk was to accept liabilities only of banks which were in the clearing house.
[22] See e.g. Gorton (1985), footnote 7, p.279.
[23] Modern central banks (or prudential supervisors) supervise to mitigate market failures, not least of moral hazard resulting from the central bank's ability to supply emergency liquidity and the pressure on it to do so when a failure would be damaging to the financial system.

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.

Do historical cases suggest that institutions standing at the centre of clearing and settlement arrangements – providing the settlement asset – will perform, or develop, a lender of last resort function? The historical evidence is mixed. The classic case of a lender of last resort, the Bank of England, supports the case in that claims on the Bank were from an early stage of superior quality to those of the rest of the banking sector, and banks adopted them as settlement asset. As explained, London banks began to settle in Bank of England notes sometime between the Bank's founding (1694) and the 1770s. And as country banks and the correspondent system centred on London developed, so Bank of England notes became the ultimate settlement asset for banks across the whole country.

Claims on the Bank of England appear to have been *de facto* high-powered money from relatively early on, as illustrated during the suspension from 1797.[24] That is to say, from early on the Bank's credit in the eyes of bankers and the commercial classes was sufficient that they were content to hold claims on the Bank rather than specie itself, with back-up liquidity 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 governments were willing to protect the Bank from default by suspending its obligation to pay in specie, and from 1833 by formal legal tender status.

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 cheap to exchange. Indeed, 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 which settled for it, that would facilitate the process of paying its funds away. The counterfactual would have been for banks to have turned

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

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.

In Canada, there was also a superior form of money: Dominion Notes. These were issued by the state, and convertible into gold. They 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)). So, notwithstanding the fact that the superior form of money was a direct creation of the state, in important ways, the Canadian case is similar to the English.

In Norway, the Norges Bank had been set up by Act of Parliament in 1816. During the nineteenth century, the Norges Bank enabled money to be transferred from one of its branches to another, to start with 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 (clearing house) 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 (2006)).

There are other cases where there was a superior form of money available, but where banks adopted other settlement assets. In Sweden between the mid 1850s and 1901, for example, the Riksbank's involvement in clearing and settlement seems to have fairly been limited[25] – despite the fact that its notes were (voluntarily) used as reserves

[25] Ogren (2005) argues that it is likely that the Riksbank engaged in some clearing activities.

by the banking system (Ögren (2006)). Instead, the Stockholms Enskilda Bank 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)).

In the United States, starting during the Civil War, the US Treasury issued 'greenback' notes which circulated as currency. However, banks did not use these for settlement. This may have had something to do with the fact that during the period when greenbacks were not convertible, their value against gold varied.[26] It may also have been affected by the requirements of the reserve city legislation. 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.[27] These certificates were valid only for payments directly between members of the clearinghouse.

As explained above, inter-regional payments were settled through a network of correspondent relationships, with New York standing at the head. Under the National Banking System, reserve-city legislation and efficiency of inter-regional clearing and settlement worked together so that the banking system genuinely did hold its reserves with the members of the New York Clearinghouse Association. 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.[28]

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 loans 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 increasingly they also paid them out to

[26] On this phenomenon, see Friedman and Schwartz (1963), pp.26-7.
[27] Andrews (1942), p.594.
[28] 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.

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 quasi-currency 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.

This function did grow 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 only supply liquidity 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 clearinghouse liabilities to good effect at the outbreak of World War I.

A more interesting point perhaps is that 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 clearinghouses and groups of banks adopted it as well. As such, 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 – would perform, or develop, a lender of last resort function.

By contrast, the Suffolk system lends no support to this contention, despite the attention it receives as evidence of the natural development of central banking. Although the Suffolk Bank played a crucial role in the clearing and settlement arrangements, it was not a lender of last resort. In fact, it is not even clear that other banks centralised their reserves with it. Rather, they just held clearing balances. There is evidence that it supplied liquidity to individual banks by lending to them, but this was really just interbank lending, with the Suffolk in the best position to act as counterparty.

Another prominent case is afforded by the earlier public / municipal banks. In the case of the Bank of Amsterdam, for instance, the quality of Amsterdam bank 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: in the heyday of the Bank, its money was the key currency in international finance. However, the Bank did not act as a lender of last resort during this period. Most obviously, in the crisis of 1763, 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)).

Overall then, the evidence is rather mixed. 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. However, as the examples of the Riksbank and the US Treasury demonstrate, even this was not always the case. The New York Clearing House provides an example of a lender of last resort function growing out of an institution's role in clearing and settlement. However, this does not imply that banks needed some kind of superior claim for the purposes simply of settling up. Elsewhere, institutions at the heart of the clearing and settlement arrangements did not develop a superior status within the monetary system.

V 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. In this way, innovations in clearing and settlement arrangements were a crucial, but easily overlooked, factor in the ability of the monetary system to support economic growth.

The market threw up a wide 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 were heavily affected by state interference in the market, e.g. the restrictions on branch banking in the United States and on joint-stock banking in England. There are also several instances where direct (state) intervention by-passed the evolutionary cost-reduction process.

Today, arrangements for interbank settlement are far more uniform. Private banks 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 the fiat standard and typically have some form of legal tender status; they are the most reliable form of money in the economy.

In the context of this current role, this paper argues that the historical link between clearing and settlement arrangements and central banking is an interesting and important area for investigation. Focussing particularly on the lender of last resort function – arguably the key characteristic of a central bank – it has explored whether institutions at the centre of clearing and settlement arrangements had (or developed) central bank-like characteristics.

The historical evidence is mixed. Where there is an institution whose money is of superior standing for exogenous reasons – for example, a privileged position bestowed by the state – then banks will typically (although, not always) use that institution's money to settle up, subject to being able to do so at reasonable cost. This money is of sufficient quality to act as a substitute for the actual commodity behind the commodity standard: banks are confident that in a financial crisis it would retain its value. If the institution is also willing to supply extra liquidity in a crisis, then there may be 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. However, this does not imply that banks needed some kind of superior claim for the purposes simply of settling up, or that an institution standing at the centre of clearing and settlement arrangements would necessarily develop into a lender of last resort.

References

Andrews, F (1942), 'The operation of the city clearing house', *The Yale Law Journal*, Vol.51.

Buyst & Maes (2006), 'Coping with financial crises in nineteenth-century Belgium: the role of the National Bank of Belgium' *mimeo*.

Calomiris, C, and Kahn, C, 'The efficiency of self-regulated payments systems: learning from the Suffolk System', *Journal of Money, Credit and Banking*, Vol.28, no.4, part 2.

Capie, F, Goodhart, C A E, Fischer, S and Schnadt, N (1994), *The Future of Central Banking*, Cambridge.

Checkland, S G (1975), *Scottish Banking: A* History*, 1695-1973*, Collins.

Committee on Payment and Settlement Systems (2003), *The role of central bank money in payment systems*, Basel.

Crawford, B and Falconbridge, J D (1986), *Banking and Bills of Exchange – a Treatise on the Law of Banks, Banking, Bills of Exchange and the Payment System in Canada*, vol.3, Toronto.

Daniel, F (1996), 'The Evolution of the Payments System in Canada', *mimeo*.

Denison (1966), *Canada's First Bank – A History of the Bank of Montreal*, McClelland & Stewart.

Dowd, K (1991), 'The evolution of central banking in England, 1821-90', in Capie, F and Wood, G (ed.), *Unregulated Banking: Chaos or Order?,* London.

Friedman, M and Schwartz, A (1963), *A monetary history of the United States, 1867-1960* (Princeton).

Garbade, K D and Silber, W L (1979), 'The payment system and domestic exchange rates: technological versus institutional change', in *Journal of Monetary Economics*, vol.5.

Gaskin, M (1965), *The Scottish Banks*, London.

Goodhart, C A E (1988), *The evolution of central banks*, London.

Gorton, G (1985), ‘Clearinghouses and the origin of central banking in the United States’, *Journal of Economic History*, vol. XLV no.2.

Gorton, G (1996), ‘Reputation formation in early bank note markets’, *Journal of Political Economy*, vol.104 no.2.

Gorton, G and Huang, L (2002), ‘Bank panics and the endogeneity of central banking’, *National Bureau of Economic Research Working Paper* No. 9102.

Graham, W (1886), *The One Pound Note*, London.

Haare, H (2006), ‘A brief summary of the history of Norges Bank and clearing and settlement in Norway’, *mimeo*.

Hawtrey, R G (1938), *A Century of Bank Rate*, London.

He, P, Huang, L and Wright, R (2005), ‘Money and banking in search equilibrium’, *International Economic Review*, vol.46.

Hortlund, P (2005), ‘The Provision of Liquidity in the Swedish Note Banking System 1878–1901’, *Ratio Working Papers 62*, The Ratio Institute.

Kohn, M (1999), ‘Early deposit banking’, Dartmouth University *Working Paper* No. 99-03.

Kroszner, R (1997), ‘Free Banking: the Scottish experience as a model for emerging economies’, in Caprio, G, *Reforming Financial Systems*, Cambridge University Press.

Luzzatto, G (1934), ‘Les Banques Publiques de Venise (Siècles XVI-XVIII)’, in Van Dillen, J G, *History of the Principal Public Banks*, The Hague.

Matthews, P (1921), *The Bankers’ Clearing House*, London.

Munn, C W (1975), ‘The Origins of the Scottish Note Exchange’, *Three Banks Review*, vol.107.

Munn, C W (1981), *The Scottish Provincial Banking Companies 1747-1864*, Edinburgh.

Mueller, R C (1997), *The Venetian Money Market – Banks, Panics, and the Public Debt 1200-1500*, John Hopkins University Press.

Ögren, A. (2005), 'Financial Revolution, Commercial Banking, Liquidity and Economic Growth in Sweden, 1834-1913', *mimeo*.

Ögren, A. (2006) 'Free or central banking? Liquidity and financial deepening in Sweden', 1834–1913. *Explorations in Economic History*, vol.43.

Quinn, S (1997), 'Goldsmith-banking: mutual acceptance and interbanker clearing in Restoration London', *Explorations in Economic History*, vol.34.

Quinn, S. and Roberds, W (2005), 'The big problem of large bills, The Bank of Amsterdam
and the origins of central banking'. *Federal Reserve Bank of Atlanta Working Paper 2005-16*.

Quinn, S and Roberds, W (2006), 'An economic explanation of the Early Bank of Amsterdam, Debasement, Bills of Exchange and the Emergence of the First Central Bank', *Federal Reserve Bank of Atlanta Working Paper 2006-13*

Reichsbank (undated), *Die Reichsbank 1876-1900*, Berlin.

Reichsbank (1933), *Fünfzig Jahre Abrechnungsstellen der Reichsbank*, Berlin.

Riu, M (1979), 'Late Medieval and Early Modern Aragon', in Center for Medieval and Renaissance Studies, *The Dawn of Modern Banking*, Los Angeles.

Rolnick, A J, Smith, B D and Weber, W E (1998), 'Lessons from a Laissez-Faire Payments System: The Suffolk Banking System (1825-58)', *Federal Reserve Bank of St Louis Review*, vol.80.

Royal Commission (1933), *Report of the Royal Commission on Banking and Currency in Canada*, Ottawa.

Sarto, M S (1934), 'Les banques publiques en Espagne jusqu'à 1815', in Van Dillen, J G, *History of the Principal Public Banks*, The Hague.

Schnabel, I and Shin, H S (2004), 'Liquidity and Contagion: The Crisis of 1793', *Journal of the European Economic Association*, vol.2.

Selgin, G and White, L H (1987), 'The Evolution of a Free Banking System', *Economic Inquiry*, vol.25.

Shenfield, A (1984), 'The Scottish banking system in the eighteenth and nineteenth century', in (ed.) Salin, P, *Currency competition and monetary union*, The Hague.

Smith, B D and Weber, W E, 'Private money creation and the Suffolk Banking System', *Journal of Money, Credit and Banking*, Vol.31, no.3, part 2.

Smith, V (1936), *The Rationale of Central Banking*, London.

Tilly, R (1967), 'Germany 1815-1870', in Cameron, R, *Banking in the Early Stages of Industrialization*, Oxford University Press.

Timberlake, R (1984), 'The central banking role of clearinghouse associations', *Journal of Money, Credit and Banking*, vol.16.

Trivoli, G (1979), *The Suffolk Bank: a study of a free-enterprise clearing system,* London.

Van Dillen, J G (1934), 'The bank of Amsterdam', in Van Dillen, J G, *History of the Principal Public Banks*, The Hague.

Walker, B E (1899), 'A History of Banking in All Nations', *The Journal of Commerce & Commercial Bulletin*, New York, reprinted in *A History of Banking in Canada*, Toronto (1909).

Watts, G S (1993), *The Bank of Canada: Origins and Early History*, Ottawa.

White, L H (1984), *Free Banking in Britain, Theory, experience and debate, 1800-1845,* Cambridge.

White, L H (1999), *The theory of monetary institutions,* Oxford.

Wittner, M and Wolff, S (1911), 'Method of Payment by means of Bank-Account Transfers and the Use of Checks in Germany', in (ed.) Koch, R, *Publications of National Monetary Commission Vol. XI – Articles on German Banking and German Banking Laws*, Washington.