

# **“Show me the money” – or how the institutional aspects of monetary policy implementation render money supply endogenous**

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## **Abstract**

The paper presents a historical account of the evolution of modern financial systems. It is argued that money supply had been exogenous for the most part of history, but the demise of gold standard and the development of central banking have rendered it endogenous. The analysis is supported by a review of the monetary policy implementation framework of the National Bank of Poland. Causality test results show that the degree of the banking system's liquidity did not Granger-cause credit expansion in the decade 1998–2008.

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## 1. Introduction

The paper is an attempt to investigate the process of money supply in modern economies. The motivation to study the topic follows from the remark made by Charles Goodhart (2001) who expressed his concern that even though it is often claimed that economics is built around two key concepts, demand and supply, the supply of money is generally treated somewhat less attentively than the demand for money. Indeed, in the economic literature, the supply of money is usually viewed simplistically from the perspective of the IS-LM framework as a variable determined exogenously by the central bank, which through its open market operations determines the level of commercial banks' reserves, and then *via* the money multiplier also mechanistically controls the broader monetary aggregates.<sup>1</sup>

The view propagated by monetary theoreticians, which sees the central bank as a body essentially exogenous to the economic system and possessing a fair deal of control over the supply of money, has recently been challenged by the central bankers themselves who express concern that economic theory disregards some of the crucial aspects of the modern institutional setup of monetary policy. For example, Charles Goodhart, both an economist and one-time member of the Bank of England's Monetary Policy Committee stated (Goodhart 1994, p. 1424):

Virtually every monetary economist believes that the CB can control the monetary base... and, subject to errors in predicting the monetary multiplier, the broader monetary aggregates as well... Almost all those who have worked in a CB believe that this view is totally mistaken.

The central problem addressed below is whether, and in what circumstances, the multiplier model of the money-supply process, understood as an institutional setup where broad money is causally determined – with a fair deal of accuracy – by the monetary base, can be a good approximation of reality. Two hypotheses are put forward and considered.

First, it is claimed that though the exogenous money view, incorporated in the money multiplier model, constitutes a largely accurate description of the financial system until the first half of the twentieth century, modern institutional conditions, as well as the monetary policy framework currently in operation are much better described by the assumption of endogenous money. To investigate this hypothesis, the historical evolution of the Western financial system is considered from the perspective of the money supply process. A conceptual distinction of four stages of development is applied to demonstrate how particular institutional changes have influenced the transformation of the nature of the supply of money from exogenous to endogenous.

Secondly, the hypothesis is put forward that the money multiplier does not adequately explain the money supply process in the modern Polish economy. The hypothesis is verified with the use of an econometric model, which tests whether an increase in the supply of bills issued by the National Bank of Poland (used as a proxy for excess liquidity) automatically leads to the creation of broad money and credit. It is found that the degree of the banking system's liquidity did not Granger-cause credit expansion in the decade 1998–2008. The result obtained strengthens the argumentation that

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<sup>1</sup> For example, Kashyap and Stein say: (1997, p. 3): "When the central bank wants more money in the economy, it provides the banks with more currency that can be used as reserves (say by trading reserves for other bank securities). Banks then lever up the reserves through lending and crediting the checking accounts of the borrowers who receive the funds."

money supply is endogenous in Poland and provides a new ground for analyzing the challenges for monetary policy under the current credit crunch. Specifically, it is remarked that given the endogenous nature of the money supply process, greater weight should be placed on bank capital rather than bank liquidity understood as possession of base money.

The review of the literature on the issues presented below reveals that they have so far received a relatively narrow treatment. Chick (1986; 1993) and Niggle (1993) stand out as those who have analyzed the institutional determination of the historical change from exogenous to endogenous money. Tobin (1963) deserves mentioning for realizing very early the money-creating potential of commercial banks and for drawing some theoretical conclusions from that observation. Moore (1988; 1989) has contributed to the framework for an empirical analysis of the money supply process and has shown by means of Granger causality tests the endogeneity of broad money supply in the UK. Goodhart (1987; 1994, 1989, 2001), Bindseil (2004) and Meulendyke (1993) have offered descriptions of the endogenous money-supply process from the perspective of central bankers. Finally, Howells and Bain (2005) have managed to incorporate the main points of the endogenous view on the money-supply process into a macroeconomics textbook. To the best of the author's knowledge, Kot and Rozkrut (2004) and Borowski, Kot, Rozkrut and Szpunar (2005) are the only attempts (the latter unpublished) to argue that the money supply in Poland is endogenous. This project extends the previous treatment by offering an empirical analysis of money endogeneity as well as a detailed description of the model for monetary policy implementation in Poland.

## **2. Money exo- and endogeneity in the evolution of financial institutions and monetary policy implementation**

Before we move on, it is necessary to explain the precise meaning of exo- and endogenous money. Yeager (1997, p. 131) explains that the money supply is exogenous “if its nominal size is or can be controlled by the monetary authorities and does not automatically change as people make payments or try to build up or run down their money holdings.” Hence, exogeneity of the money supply means simply that it can be determined at the discretion of the central bank, independently of the financial system.<sup>2</sup> By contrast, endogeneity implies that the supply of money is determined within the financial system by the demand for bank lending (Howells 2001, p. 134). The very root of the divergence between the two theories of the money supply process seems to lie in a different perception of the central bank and its role as the supplier of liquidity. Proponents of the exogenous view – implicitly or explicitly – ascribe to the monetary authority the ability to control the money supply, while adherents to the endogenous view hold that central bank does not and, in fact, cannot control the money supply. In the former view a central bank supplies the banking system with liquidity (in the form of reserves in excess of the mandatory minimum) which then works its way through the rest of the system roughly in accordance with the so-called money multiplier

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<sup>2</sup> A similar definition is given by Goodhart (2001): “An exogenous variable is one which is not set in response to other current, or past, developments in the economy, e.g. it is fixed at some level irrespective of other developments, or is varied randomly according to the throw of dice, or the occurrence of sunspots, or whatever.”

mechanism.<sup>3</sup> In the latter view, which might also be called bank-centric, it is the expansion of credit by commercial banks that ignites the money supply process, with the central bank stabilizing the interest rate and supplying the monetary base on demand of the banking sector.

In what follows we shall take heed of Hicks (1967, p. 153) who advised that “monetary theory... cannot avoid a relation to reality. It belongs to monetary history in a way that economic theory does not always belong to economic history.” Accordingly, this section reviews the evolution of monetary and financial institutions of the Western world and argues that the assumption of exogenous money and the multiplier model of the money-supply process constitute a largely accurate description of the financial system up to the first half of the twentieth century. However, modern institutional conditions, as well as the monetary policy framework in operation, are much better understood from the perspective of endogenous money view in the vein of the bank-centric model of money supply process.

Of course, it is next to impossible to divide Western (i.e. European and American) financial history of the last ten centuries or so into sequences following one another both logically and chronologically, not least because the specificities and timing of the process varied from country to country and because some changes were of quantitative rather than strictly qualitative character. Moreover, even though financial institutions can be fairly easily divided into strict analytical categories, it is much harder, perhaps even impossible, to map those categories onto historical evidence. Nevertheless, it seems that using a little abstraction – as does e.g. Chick (1986; 1993) and Niggel (1993) – it is possible to pinpoint several most significant stages of money and banking development, marking gradual enhancements in the ability of the banking system to create credit. Although Chick (1993) distinguished six such stages of development, it is sufficient for our present purpose to turn the attention to only four of them: stage one during which organized financial activity in its most primitive form develops; stage two, in which the principle of negotiability is recognized; stage three, in which an interbank market along with a central bank are established; and finally, stage four, in which the gold standard is abolished and the central bank becomes effectively the lender of last resort.

## 2.1. Stage one – the beginnings of banking

Stage one of banking development lasted from the beginnings of organized financial activity to sometime around the seventeenth century, though the timing of its finish varied (in Venice, for

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<sup>3</sup> The money multiplier approach to the supply of money was originally proposed by Phillips (1920) and subsequently developed by other authors in the 1920s and 1930s. Since then, it has become a major pedagogical tool in monetary economics, dominating not only textbooks but appearing also in scholarly publications (for textbooks see most notably Mishkin (2004, pp. 375–381) and Mankiw (2007, pp. 514–515); for scholarly publications see e.g. Brunner (1961), Brunner and Meltzer (1964)). The multiplier itself is simply defined as the ratio of the total money supply ( $M$ ) to the monetary base ( $B$ ) which consists of cash in circulation ( $C$ ) and commercial banks' reserves in the central bank ( $R$ ). Let  $b$  denote the portion of the money supply which people prefer to hold in cash, so that  $bM = C$ , and let  $r$  be the reserve requirement ratio held against deposits  $D$ , so that  $R = rD$ . By simple manipulations we obtain:

$$m = \frac{M}{C+R} = \frac{M}{bM+rD} = \frac{M}{bM+r(M-C)} = \frac{M}{bM+r(M-bM)} = \frac{1}{b+r(1-b)}$$

From the perspective of the multiplier model it makes perfect sense to argue that the money supply is in fact exogenous, for it is the changes in the monetary base as well as in the reserve-deposit ratio, both of which are assumed to be controllable directly by the central bank, that cause changes in the broader monetary aggregates.

example, checks were generally not permitted even as late as in the eighteenth century). The somewhat vague term “beginnings of banking” corresponds in Europe roughly to the twelfth century, as historical evidence from Genoa (Hall 1935), Bruges (de Rover 1942; 1974) and Barcelona (Usher 1934; 1943) suggests that already at that time a variety of what would be called today banking activities were carried out professionally and concurrently on a noticeable scale, yet with different legal status. About the same time when, as Usher (1934) reminds us, Henry II of England deposited funds for safekeeping with the Templars (at least twice: in 1282 and 1286, as – ironically enough – did his adversary Philip II Augustus), lombards (pawnbrokers) and money-changers operated in Bruges (de Rover 1942, pp. 64–65). The former would offer typical loan services, which involved only a transfer of purchasing power, whereas the latter developed a system of local payments by book transfer with the concept of overdraft.

A similar pattern of specialization is found by Hall (1935, pp. 75–76) who argues that although according to Genoese notarial records from the late twelfth and early thirteenth centuries instances of typical borrowing and lending were still somewhat sporadic at the time (for example, between 1179 and 1186 only three loans were extended in the city of Genoa), many merchants did already have bank accounts which they used to make payments by transfer during trading fairs, such as those held in the Champagne region of France. Importantly, the accounts served not only as a clearance system but also as a vehicle of credit, as they were oftentimes allowed to be overdrawn and settled only at the next fair. Bankers, of course, were desirous of making profit with the money entrusted to them and invested their resources directly in business ventures without depriving depositors of their right to claim the deposits any time they may have seen fit. Hall (1935, p. 77) recounts two interesting examples from the Genoese notarial records:

In 1186, Rubeus Bancherius acknowledged that he had £7 belonging to Andreas, a servant of one of the members of the great Fieschi family. He promised to pay the capital fifteen days after demand; and, he said, “if God should give any profit on those pounds, I will give you as much of it as seems best to me.”... [In 1186] Bernardus Bancherius acknowledged that he had received from one Maria Sarda £11, which he was holding in his bank. He promised to return the £11 eight days after demand and to pay her in addition 10 per cent a year on her capital as long as he held it.

It is hard to estimate exactly the level of reserves held against deposits of the earliest medieval banks but thanks to the ledgers of two money-changers, Collard de Merke and Guillaume Ruyelle, preserved in the municipal archives in Bruges and covering the period 1366–1371 (kept in single entry), we know that cash reserves could amount to about thirty percent of liabilities, part of which were demand accounts (de Merke had about two hundred regular clients). A similar picture emerges from the books of the fifteenth-century Bank of Deposit in Barcelona which held reserves in specie coming to about 29% of its liabilities. There is, then, little doubt that – as Usher (1943, p. 181) explains – the early medieval bank could extend credit of the volume significantly greater than the cash it held at hand via the multiplier model. The reason why it makes sense to refer to the multiplier mechanism as the driving force of credit expansion is that banks’ ability to extend credit is conditioned upon their prior possession of deposits/reserves. As Chick (1993,

p. 84) puts it: “bank lending... depends on exogenously-given deposits, which at this stage are a form of saving.”

It should be stressed that though the process of credit expansion was evidently possible, its extent, from the perspective of an early medieval bank, was significantly limited. First of all, banking constituted only a very small segment of the medieval economy and concentrated almost exclusively in large urban areas. Munro (1994, p. 152) reports, for example, that even in Venice and Bruges only about 10% of adult males had bank accounts. Second, banking contracts were, at the time, almost exclusively oral due to the much restricted knowledge of writing and reading and, consequently, should anyone want to settle their payments by a book transfer, they would have to take the recipient of funds to the bank and request that a specific amount of money be transferred from one account to the other.<sup>4</sup> Third, a loan extended by one bank was unlikely to return to that bank as a deposit, and since the vast majority of transactions required metal coin (Spufford 1986), it might even leave the system altogether.<sup>5</sup> Fourth, even though simple credit instruments already existed, such as e.g. bills of exchange (instruments sold for ready cash, which were exchangeable into foreign currency at some later point abroad<sup>6</sup>), there were at the time no legal provisions ensuring protection for the holders of such loan contracts, which effectively restricted their use to a small community of merchants, and, incidentally, led to their effective ban by the Hanseatic League in 1370 on account of their fraudulent nature. Last but certainly not least, there was the possibility of a bank run:

A bank run occurs when the clients of a bank – its depositors or noteholders – lose confidence in their bank, and begin to fear that the bank does not really have the ability to redeem their money on demand. Then, depositors and noteholders begin to rush to their bank to cash in their receipts, other clients find out about it, the run intensifies and, of course, since a fractional reserve bank is indeed inherently bankrupt – a run will close a bank’s door quickly and efficiently (Rothbard 1986, p. 113).

Runs were all the more probable due to a still relatively minor size of the early medieval banks which corresponded to the relatively small size of the communities they served (in the early fourteenth century Venice was the only commercial center with population above 100,000) and undeveloped accounting methods. Kohn (1999a) reports, for example, that in mid-fourteenth century Bruges, the typical bank had fewer than 100 depositors, a dozen major of whom accounted for as much as two-thirds of deposits. Thus, it was relatively easy to coordinate a run – a sudden withdrawal of cash – which would leave the bank broke.

Even though from a historical point of view there is scarcely any basis for assessing the quantitative importance of credit in the first stage of banking development, it is probably safe to say that the net credit creation was rather negligible. Thus, while it does seem that from very early

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<sup>4</sup> Interestingly, this method was resorted to even if only one party to the transaction had a bank account. See Usher (1943, pp. 184-185), de Roover (1942).

<sup>5</sup> In the early Middle Ages gold and silver coins were the predominant media of exchange, though Usher (1943, p.12) argues that at times coins – produced by mints invariably subordinated to the local authorities – were so badly clipped that merchants actually considered bank accounts as more reliable, since bankers, unlike monarchs, were severely punished if they failed to meet all the claims of their depositors.

<sup>6</sup> The intricacies of the bills of exchange have been thoroughly studied by de Roover (1944).

on lending exceeded banks' holdings of high-powered money, it was nonetheless limited by the flow of new deposits and the existing depositors' willingness to hold money substitutes rather than money proper. The latter in turn was related to the acceptability of deposits as means of payment which brings us to the second stage of banking development.

## 2.2. Stage two – the principle of negotiability

Stage two brings one qualitative difference which, in turn, signals important quantitative changes. Around the sixteenth century the principle of negotiability became gradually recognized, which led to further development of clearance and fostered banks' integration into a more coherent system. As argued above, possibly the most significant impediment to the expansion of credit in the Middle Ages was that debt instruments (e.g. letters obligatory or checks) were not generally acceptable as means of payment, as the law gave little legal and financial protection to their accepters.

Medieval law recognized the difference between assignable and transferable claims. An instrument is said to be assignable, if B who received a letter obligatory acknowledging A's liability can, before maturity, assign the right to collect the debt to a third party, C, without giving notice to A (see e.g. Kohn 1999). If additionally C retained the full rights of B *vis-à-vis* A, then the instrument would be transferable. Thus, writes Kohn (1999, p. 24):

Unlike an instrument expressing a debt to a specific person, a transferable instrument is impersonal: it is evidence of the debt on the part of the issuer to anyone who acquires the instrument. In this way, it is like currency.

According to Munro (1994, p. 174), England was the first to introduce the new regulations on transferability when law-merchant Mayor's Court famously ruled that the “bearer presenting a bill for collection on its maturity had as much right to the payment as the original payee in the bill.” The problem was that while some small merchant communities recognized full transferability of letters obligatory it was not so with civil courts. Van der Wee (1977) provides an interesting account of how with the expansion of trade centers in Bruges and Antwerp newcomers would often issue debt instruments as a form of payment but then avoided responsibility and refused payments to third parties seeking refuge in civil courts:

In the budding new trading centers in the North... prosecutions were legion; the merchants' circle was not as close or intimate as in the traditional centers of the South; unknown, unreliable newcomers kept on turning up. (p. 325)

Soon however, civil courts in major centers of commerce recognized the transferability of debt instruments: Lübeck in 1502, Antwerp in 1507, and – with the Habsburg edicts of 1537 and 1541 – the whole of Netherlands.

We should stress again that what this recognition meant in practice was that checks, bills of exchange, and promissory notes could become par excellence generalized media of payment and the whole procedure of interbank transfer could be greatly simplified. More importantly perhaps,

to the extent that banks started holding accounts with one another, it were no longer cash reserves of the individual bank but total reserves of the slowly emerging banking system that limited credit expansion, since in times of distress less prudent banks could, in principle, borrow reserves from the more prudent ones. Documents from sixteenth-century Venice, for example, reveal it was not uncommon that when a person came to demand his money, the bankers would take him to another bank and transfer credit to him only at that other bank. The broad significance of the practice of banks making use of each other's notes was fully appreciated by Usher (1943, p. 25):

When notes are used in this fashion, the credit of one bank becomes in fact part of the effective "reserve" of the issuing bank. Functionally, this use of credit does not differ from the use of deposit credit in another bank as means of payment. In practice, however, such a use of bank notes increased considerably the total lending power of the group or system of banks. The specie basis needed to support credit structure was significantly diminished.

Thus, we see that stage two – with the changes it brings about – really does considerably extend the total lending power of the financial system. Nevertheless, for reasons astutely described by Rothbard (1986, pp. 111–124), there were still significant limitations to credit expansion. The centralizing trends notwithstanding, banks had little interest in indefinitely holding on to checks issued by their competitors and "adding them to their reserves." After all, keeping other banks' liabilities was equivalent to allowing the money to lay idle, for even if such interbank deposits brought interest, more could be earned by calling for redemption and lending the money out. This means, however, that if a bank started to expand credit, and consequently, its clients through increased volume of purchases started to raise prices all around (using bank liabilities as means of payment), then rival banks would most likely call for redemption of its demand liabilities, which in turn would drain its reserves and enforce a curtailment of lending.<sup>7</sup> In fact, as Schuler (1992, p. 81) documents, this was not merely a theoretical possibility but an aggressive competitive strategy called "note picking" or "note duelling", whereby banks would first willingly accept and accumulate large quantities of notes issued by rival banks and then simultaneously present them for redemption hoping to force the unprepared bank to suspend payments and go into liquidation. Munn (1981, pp. 23–24, 141) finds evidence that the fear of raids conducted by rival banks forced one of the Scottish provincial banking companies in the late 18<sup>th</sup> century to hold reserves of up to 61.2% of its liabilities.

Given, then, that any individual bank had no guarantee that the secondary deposits it created would remain with it or even with the banking system as a whole, its willingness to lend beyond the cash it held on hand was determined by its forecast liquidity position. Specifically, credit expansion depended on the prospect of new reserves, either from an entirely new deposit of gold

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<sup>7</sup> This argument follows the lines of the famous "specie flow price mechanism" developed originally by Richard Cantillon in his *Essai sur la nature du commerce en general* in 1730 and later ironed out by Hume and Ricardo. Writes Rothbard (1995, pp. 358–359): "No one was more lucid about the problem of money and international payments than Cantillon. He pointed out that specie can either be acquired within a country by mining ore, or ... a favorable balance of trade with other countries. But then, in the Cantillon process analysis, either the mine owners or the exporters would spend or lend the money. Part of the expenditure of the new money would surely be spend abroad, and furthermore the increased stock of money would raise prices at home, making domestic goods less competitive. Exports would fall and imports of cheaper foreign products would increase, and gold would flow out of the country, reversing the favorable balance of trade."



or silver or from capital inflows, as well as on what we have termed in Section 1 the leakage coefficient, the estimate of which depends on the micro level on the individuals' preference for cash and on the macro level on the degree of integration of the banking system.

The crucial aspect of the institutional arrangements characteristic of stage two of banking development is still the exogenous nature of money and a multiplier-like process of its supply. According to Chick (1993, p. 81):

In the second stage, claims on deposits are widely used as a means of payment. This is, historically a new role for deposits, with a far-reaching implication. Holdings of bank liabilities now represent money used to support consumption as well as representing saving. Mainly for that reason, the redeposit ratio from bank lending will be high. Reserves, rather than the acquisition of savings, become the constraint on lending. Given an addition to reserves whether from a deposit new to the banking system [or]... capital inflows, banks taken as a whole can lend out a multiple of this amount, creating secondary deposits as they do so. This is the stage to which the deposit multiplier begins to apply [emphasis added].

### **2.3. Stage three – interbank market and central banks**

We have argued above that one important determinant of an individual bank's willingness and ability to extend credit was the degree of integration of the banking system. Thus, the novelty of stage three, which – though analytically distinguishable – historically coincided at least partly with the emergence of stage two, is the rise of interbank lending and the forging of banks into a coherent system. What this means in practice is that instead of fighting one another by “note picking”, banks started to generally accept one another's notes and checks at par. Nonaggression seems to have followed as a result of banks' recognition that the tit-for-tat competition, which consisted in insisting on note-redemption by other banks and replenishment of own reserves when rivals retaliated, was more costly in the long run than cooperation. The resulting build-up of trust and confidence among banks allowed also the development of interbank lending thanks to which reserve deficits of some banks did not necessarily have to lead to bankruptcy, but could be offset by reserve surpluses of other banks.

Naturally, this process of mutual note acceptance improves the market for any bank's notes and, if unintentionally, for the notes of its competitors. The result is a marked increase in note circulation and a gradual displacement of commodity money by bank-issued money. However, according to Selgin and White (1985, p. 14):

A large part of specie formerly used in circulation to settle exchanges outside the banks may still be needed to settle clearings among them. The banks can substantially reduce their prudentially required holdings of commodity money by participating in regular note exchanges which allow them opportunities to offset their mutual obligations. Only net clearings rather than gross clearings are then settled in commodity money. The probability of any given-sized reserve loss in any given period is accordingly reduced (by the law of large numbers) and each bank can prudently reduce its ratio of reserves to demand liabilities.

Thus, even though the final total of credit creation is evidently still dependent on the amount of reserves available to the banking system, the multiplier process, initiated in stage two, becomes in the current stage more rapid and there remains less excess liquidity in the system (Chick 1993, p. 82).

Banks soon learn also that the gains from bilateral note exchange described above could be greatly enhanced by implementing a system of multilateral note exchange. To give just a rough idea of the possible scale of such gains consider the following simplistic example.<sup>8</sup> Suppose there are only three banks A, B, and C, and that A has collected GBP 20,000 of B's notes, B has GBP 20,000 of C's notes and C has GBP 10,000 of A's notes. If the banks were to settle the exchanges bilaterally, then depending on the chronological order of the exchanges, they would need between GBP 20,000 and GBP 40,000 worth of gold reserves. If, however, balances are settled multilaterally, then the amount of gold reserves needed drops to only GBP 10,000, since A's net balance to B and C is GBP 10,000, B's net balance to A and C is GBP 0, and C's net balance to A and B is minus GBP 10,000 – hence all the dues may be settled by a transfer of GBP 10,000 worth of gold from C to A.<sup>9</sup> In practice, the advantages derived from multilateral note exchange were even more pronounced, for if banks could agree on settling their debts in one place and at a given time, they saved not only reserves, but also time and transportation costs. Thus, the institution of clearing houses came into being, the original purpose of which was to serve as a convenient debt-settlement place. Bisschop (2001 [1896]) offers an account of the formation of the clearing house in London which seems worth quoting at length:

Whilst therefore the banks followed a system of compensation whenever possible, the clerks on their part, being obliged to run backwards and forwards to the various offices, gradually saved each other the trouble of demanding payment at the offices of the respective bankers. The majority of them belonged to offices which were situated in Lombard Street, which caused the clerks to meet each other frequently. This led to interchange of information regarding the mutual demands on each others' houses, and the subsequent exchange of the documents which represented the respective demands. Soon these occasional encounters developed into daily meetings at a certain fixed place in order to save each other as much inconvenience as possible. At length the bankers themselves resolved to organise these meetings on a regular footing in a room specially reserved for this purpose.

While initially an outgrowth of chiefly practical concerns, the clearinghouses soon became also the media of unification and coordination of the individual banks' actions facilitating the process of credit supply and protecting the banks from fraud and forgeries. For example clearing houses started to serve as primitive credit information bureaus, since to the extent that they operated by pooling and investigating the records of the member banks, they could also readily check credit histories of particular debtors, their debt-exposition to respective banks in the system and the like. More importantly perhaps, clearinghouses took up the role of policing the soundness of member banks' balance sheets to assure that the notes presented for clearance did not involve undue risk. Thus write Selgin and White (1994, p. 1732):

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<sup>8</sup> The example is borrowed from Selgin and White (1985).

<sup>9</sup> De Soto (2006, p. 467) attests to this: "Furthermore, bank consolidation makes it possible to better manage fractional cash reserves, allowing banks to satisfy normal withdrawals with lower central cash balances."

[Historical] experiences suggest that member banks of a *laissez faire* clearing system would jointly agree to conform to clearinghouse liquidity and solvency standards, and to allow their enforcement via audits, because each bank wants credible assurance that notes and deposits issued by the other members (which it is accepting at par) will be redeemed in full.

Clearinghouses, with their organizational framework and outreach, were oftentimes also the bases of cartel-like arrangements regarding the interest and exchange rates or fees charged by the member banks.<sup>10</sup> However, their most important role stemmed from the capacity to help the members meet their contractual obligations in times of stress. If a bank was temporarily unable to pay its clearing balances, or if it faced a sudden run on its gold reserves, the clearinghouse was a medium through which more liquid banks could lend to the less liquid ones for the sake of preserving the stability of the whole arrangement. The clearinghouse's role was crucial since it authorized the issue of special loan certificates by the failing bank, judged the quality of assets submitted by the latter as collateral, and specified the haircut, or discount rate, to be applied to the collateral. The loan certificates, which had a fixed maturity of typically one to three months, circulated among the creditor banks and could be used by them later on in the clearing process.<sup>11</sup>

What should be obvious by now is that clearinghouses had many characteristics of modern central banks: besides their obvious role as centers of clearance, they admitted, expelled, and fined members; they imposed price ceilings, audited the members and reviewed their balance sheet reports; last but certainly not least, they provided insurance during panics. By pooling reserves and issuing loan certificates clearinghouses were well-prepared to stave off asymmetric reserve shocks, i.e. sudden drains of cash (stemming e.g. from an increased demand for cash) hitting one bank or a minor group of banks, however they were in principle unable to deal with a symmetric reserve shock – i.e. a general rise in the demand for cash, directed simultaneously at all member banks. As Smith (1990 [1936], XI.34) notes, bankers soon became well aware of that:

Both the successes and the failures of the clearing-house loan certificate device gave force to the conclusion, firstly, that there should be somewhere an adequate reserve of lending power for use in the crisis, and, secondly, that this should be available for the collective benefit of all banks. Further, the idea was gaining ground that it could only be provided by an organisation in some manner aloof from the operations of ordinary commercial banks. It must be a bank that was in normal times not fully “lent up.”

Little wonder, then, that as Gorton (1985, p. 283) notes, the Federal Reserve System, the American central bank set up in 1913, was simply the nationalization of the private clearinghouse system.

The centralization of clearance under the auspices of the government meant unquestionable favors and usually entailed also granting to the most influential, or the biggest, bank the monopoly

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<sup>10</sup> Thus, “...entry to the clearinghouse was screened, and then members were regulated. There were capital requirements, reserve requirements, interest rate restrictions, and ongoing audits and reporting forms to ensure compliance” (Gorton 1985, p. 279).

<sup>11</sup> For an excellent, concise account of the working of American clearinghouses see Gorton (1985).

of note issue.<sup>12</sup> Under such an arrangement, smaller banks would deposit their reserves with the stronger central bank (privately owned but state-chartered), which in turn would issue notes redeemable in gold (sometimes deposits were interest-bearing) and offer liquidity assistance to the others in time of asymmetric reserve shocks. Most importantly, however, government protection solved also the problem of symmetric reserve shocks: should the banking system as a whole face a run on its gold reserves, the government could declare central bank notes to be the legal tender and temporarily suspend their convertibility into gold.<sup>13</sup> Admittedly, such remedy was still perceived as a short-term one at the time, but it seemed to have worked fairly well. In return for the privileges granted to them, the newly founded central banks were expected to relieve the government from its financing problems by subscribing their capital to the purchase of sovereign bonds.<sup>14</sup>

The creation of a central bank pushes the limits of credit expansion even further, since – by imposing enforceable reserve requirements – it encourages banks to expand credit at the same pace and it institutionalizes the lender of last resort facility. Importantly, it is at this time that the term “central bank money”, referring to banks’ reserves held with the central bank, gains significance, as it is central bank notes and deposits that begin to serve as the vehicle of clearance centralized under the auspices of the central bank. Though the transformation of money into central bank liability might seem to put the latter in the position to control the economy’s general credit situation, central bank’s actual power to influence the national money supply was rather limited and constrained by the obligation to keep its notes and deposits redeemable.<sup>15</sup> As Goodhart (1995, p. 249) notes:

The Central Bank under a specie standard aims to maintain convertibility of local money into specie according to the “rules of the game.” These were simple: the Central Bank should raise interest rates, when the proportion of the metallic reserve to its own notes

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<sup>12</sup> Indeed, writes Smith (1990 [1936], XII.4):

“The guardianship of the bulk of the gold reserves of the banking system is obviously an accompaniment of the monopoly in the note issue: the holding of a large proportion of the bankers’ cash reserves is also bound up with the same factor – it is a matter of convenience for the banks to keep their surplus balances at the central bank but it is safe for them to entrust a major part of their cash reserves to a single outside establishment only if they can be absolutely certain that this authority will be able in all circumstances to pay out such reserves in a medium which will be always acceptable to the public. This can only be guaranteed if the notes of this authority can be given forced currency in time of need”.

<sup>13</sup> Laidler (2004) provides an interesting case in point: “In 1797, the war was not going well for the opponents of Revolutionary France, and in February of that year a small French force landed on the coast of Wales. Though this event was of nomilitary significance, since the force in question was soon rounded up, it precipitated a run on the British banking system that was only halted by the suspension of the Bank of England’s obligation to convert its notes on demand into gold bullion. This “temporary” suspension was to remain in place until 1821...”

<sup>14</sup> On this aspect of the bargain see in particular Goodhart (1987).

<sup>15</sup> One channel of the equilibrating mechanism was the specie-flow mechanism referred to earlier and nicely elucidated by Bagehot (1873, pp. 58–59):

“If a bank with a monopoly of note issue suddenly lends (suppose) 2,000,000£ more than usual, it causes a proportionate increase of trade and increase of prices. The persons to whom that 2,000,000£ was lent, did not borrow it to lock it up; they borrow it, in the language of the market, to “operate with” that is, they try to buy with it; and that new attempt to buy that new demand raises prices... A rise of prices, confined to one country, tends to increase imports, because other countries can obtain more for their goods if they send them there, and it discourages exports, because a merchant who would have gained a profit before the rise by buying here to sell again will not gain so much, if any, profit after that rise. By this augmentation of imports the indebtedness of this country is augmented, and by this diminution of exports the proportion of that indebtedness which is paid in the usual way is decreased also. In consequence, there is a larger balance to be paid in bullion; the store in the bank or banks keeping the reserve is diminished, and the rate of interest must be raised by them to stay the efflux.”

and deposits was falling, and vice versa... the Central Bank, under such a metallic standard, cannot create gold (or silver), but it can attract reserves by using its open market operations to adjust relative interest rates [emphasis added].

Hence, all the important institutional changes notwithstanding, the central bank was still held in check by the country’s commitment to gold standard. And even though it may seem that money slowly becomes endogenous at this stage, thanks to the lender of last resort facility available on the discretion of banks in need, it is in fact still exogenous – determined by the total supply of gold in the system. As a matter of fact, under such circumstances – i.e. as long as the country remains politically committed to preserving the gold standard – the central bank’s lender of last resort function cannot be exercised in a credible way. For example, Wigmore (1987) argues that the Fed’s failure to protect the banking system between 1932 and 1933 stemmed from its fear – admittedly not irrational – that significant lender-of-last-resort borrowing by failing banks (via the discount window) would undermine the dollar’s link to gold. Sachs (1998) and Caprio et al. (1996) make a more general point that a credible lender of last resort is incompatible with currency boards, i.e. regimes where the domestic notes and coins in circulation are fully backed by foreign currency reserves and are convertible into a foreign “reserve” currency on demand at a fixed rate (see e.g. Hanke and Schuler, 1991) – a point explicitly recognized in the formal definition of a currency board regime adopted by the IMF.<sup>16</sup> Consequently, under such conditions the stock of money is determined essentially outside the banking system.

## 2.4. Stage four – demise of gold standard and modern central banking

We have seen how in the course of the three stages outlined above, banking developed by progressively reducing the amount of reserves held against liabilities and by relaxing the constraints on credit expansion (Usher 1943, pp. 183–184). This process ends, both logically and historically, with the creation of a central bank equipped with the function of the lender of last resort for the inherently unstable fractional reserve system (Bagehot 1873, p. 58). We have argued that, though the reality and the institutions of the money-supply process changed drastically over the three stages, money remained largely exogenous for the whole time – i.e. its stock was effectively constrained by the amount of specie for which deposits, notes and checks were only substitutes. The nominal supply of money did not vary with people’s preferences – a precondition of endogeneity as described by Yeager (1997, p. 131). To the contrary, it was inextricably tied to the stock of gold in the economy and increased multiplier-like only via the original increase of gold reserves in the banking system. This setup changed only quantitatively after the creation of the

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<sup>16</sup> IMF defines a currency board as: “A monetary regime based on an explicit legislative commitment to exchange domestic currency for a specified foreign currency at a fixed exchange rate, combined with restrictions on the issuing authority to ensure the fulfillment of its legal obligation. This implies that domestic currency will be issued only against foreign exchange and that it remains fully backed by foreign assets, leaving little scope for discretionary monetary policy and *eliminating traditional central bank functions, such as monetary control and lender-of-last-resort* [emphasis added].” Such an arrangement should not be confused with a currency peg. A country’s commitment to fix the exchange rate, i.e. to maintain a specific price of foreign currency in terms of domestic currency, may be compatible with providing last resort assistance to its banks, and consequently with the money supply being endogenous.

central bank (reserves could then be used much more efficiently) since the latter, too, was limited by the existence of the international gold standard and, according to Bagehot (1873, p. 155), its “first duty... was to protect the ultimate cash of the country and to raise the rate of interest so as to protect it”.<sup>17</sup>

Stage four indicates the birth of modern reserve banking and begins with severing the link between national currencies and gold which, in most countries happened with the outbreak of World War I.<sup>18</sup> Unconstrained by the specie flow mechanism inherent in the gold standard, central banks emerge now as sovereign players in the interbank market and their *modus operandi* becomes the key to understanding the nature of the supply of money. Smith (1990 [1936], XII.42) observes that:

The policy of the central bank is no longer conceived to be automatic in the manner envisaged by the founders of the currency school. The volume of circulating media does not change in response to specie movements. These may be ignored or offset as the central bank management thinks fit. With the aid of discount rate and open market operations it adopts an active policy of increasing or decreasing the cash reserves of the money market and the total volume of credit.

Smith correctly perceives the enormous extension of monetary power facilitated by the demise of the gold standard, but she seems to somewhat hastily infer that just because central banks become unconstrained in their reserve management, they must also manipulate the supply of money at will. As a matter of fact, such a state of affairs would not be fundamentally different from the one prevailing in the era of metallic money – the only distinction being that before the overall stock of money was fairly rigidly set by the supply of gold and now it is fairly rigidly set by the discretion of monetary authorities. This, however, seems to be an inaccurate simplification which overlooks the reason why central banks were established in the first place: “for the purpose ... of increasing the liquidity of member banks by providing for the rediscount of their eligible paper” (report of the Federal Reserve System on Bank Reserves presented in 1931, quoted in Goodfriend, Hargaves 1983, p. 37). Recall, that under a fractional reserve system banks are exposed to the so-called maturity mismatch: they borrow short and lend long, which essentially translates into offering long-term loans and financing them with demand deposits (Heffernan 2005, pp. 105-106). This renders the money market inherently unstable since both the supply of cash reserves, i.e. the available stock of specie, and the short-term interest rate is volatile and inelastic. As Bagehot (1873, p. 58) goes on to explain:

But though the value of money is not settled in an exceptional way, there is nevertheless a peculiarity about it, as there is about many articles. It is a commodity subject to

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<sup>17</sup> See also Goodhart (1995, p. 249).

<sup>18</sup> Admittedly, the transition from metallic money, characteristic of the *ancien régime*, to purely fiat currencies, typical for stage-four banking systems, involved the passage through various sub-stages (domestic convertibility, suspended during World War I, international convertibility, i.e. the gold-exchange standard when only large international payments could be settled in gold – this scheme operated briefly in the 1920s – and the so-called Bretton Woods system which was essentially a watered down version of the gold-exchange standard operative from 1945 to 1971), yet each of those sub-stages moved the banking system further away from an exogenously driven money supply, and thus is omitted here for the sake of brevity. A detailed treatment of the demise of the gold standard see Rothbard (2005).

great fluctuations of value, and those fluctuations are easily produced by a slight excess or a slight deficiency of quantity. Up to a certain point money is a necessity. If a merchant has acceptances to meet to-morrow, money he must and will find today at some price or other. And it is this urgent need of the whole body of merchants which runs up the value of money so wildly and to such a height in a great panic. On the other hand, money easily becomes a “drug,” as the phrase is, and there is soon too much of it [emphasis added].

The conditions related by Bagehot implied that the money market was plagued by extreme movements of short-term interest rates. Indeed, according to the findings of the U.S. Senate Banking and Currency Committee, which prepared a report in November 1913 on the money market conditions prior to the establishment of the Federal Reserve System, during the single year 1907 interest rates varied from 2 to 45% in January, from 3 to 25% in March, from 5 to 125% in October, from 3 to 75% in November, and from 2 to 25% in December (quoted in Burgess, 1946, pp. 278–279). With the development of financial instruments, and in particular of convertibility of time deposits into demand deposits and demand deposits into cash, the transitory supply shocks to bank’s balances with the central bank have been possibly even aggravated. The problem with thus produced fluctuations of short-term interest rates is that they tend to be transmitted to longer-term rates and eventually translate into movements of the whole yield curve.<sup>19</sup> While short-term rates have, by themselves, little economic importance, medium- and long-term rates – influenced by short-term rates – determine the economy’s saving/investment patterns, i.e. underlie such crucial decisions as: how much to save, how much to invest, how much to consume. Erratic behavior of those rates introduces noise into economic agents’ decision-making and pushes it away from the equilibrium. So developed the argument that the central bank should neutralize such transitory shocks and use its discount rate (i.e. the rate at which it discounted bills) as an operational target, the proper choice of which could provide a sound economic environment:

A bank rate that is thus regulated [so as to ensure price stability – J.J.] comes as near to the equilibrium rate of interest as it is practically possible to ascertain. With such a bank rate... the whole economic life is approximately regulated as if the bank rate were at every moment kept exactly equal to the theoretical equilibrium rate of interest. By applying this practical rule, therefore, we secure the highest possible stability both for the general process of price-fixing and for the whole economic life. In fact, we eliminate as far as possible all the disturbances arising out of deviations of the actual rate of interest from the equilibrium rate... any deviation of the actual rate of interest from the true equilibrium rate may be the cause of very serious and very widespread disturbances (Cassel 1928, pp. 518–519).

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<sup>19</sup> The expectations theory of the term structure of interest rates states that the interest rate on a long-term bond equals an average (e.g. an arithmetic or geometric mean) of short-term interest rates that investors expect to occur over the life of the long-term bond. See e.g. Mishkin (2004, pp. 129–132).

Thus, central banks gradually began concentrating – initially only in practice, not necessarily in the way they communicated their monetary policy implementation – on short-term interest rates as variables they wished to control on a daily basis.<sup>20</sup>

Central banks have conventionally three main tools, or instruments, at their disposal to reach the operational target: (1) open market operations, i.e. conditional or outright purchases and sales of securities at the interbank market undertaken at the initiative of the central bank itself; (2) standing facilities, which have the same economic effect of liquidity provision (or in the case of deposit facility – subtraction) as open market operations but are undertaken at the initiative of the commercial banks; and (3) reserve requirements, i.e. ratios of deposits that must be held as vault cash or balances with the central bank (known to banks in advance and typically binding, possibly on average, over some specified maintenance period). Bindesil (2004, pp. 77-102) presents a detailed model of central bank control of short-term interest rates. We need not bother here about the specifics of his exposition, but just to get an idea of how central banks go about their business, let us inspect a typical central bank balance sheet, as it is the most concise source of information of the latter's activities (Table 1).

Table 1

An ideal central bank balance sheet

Assets	Liabilities
<b>Autonomous factors</b>	
Gold and foreign currency	Banknotes in circulation
Investment and other assets	Government deposits
Capital and reserves	Other liabilities
<b>Monetary policy operations</b>	
Liquidity injecting standing facility	Liquidity absorbing standing facility
Liquidity injecting open market operations	Liquidity absorbing open market operations
Operational reserves	Commercial banks' balances (including required reserves)

Source: Bindseil (2004, p. 48), rearranged.

<sup>20</sup> Historically, largely under the influence of the multiplier model developed by Phillips (1931 [1920]) and the academic contributions of the monetarist school, some central banks claimed to pursue a strategy of monetary targeting, i.e. strived to attain a particular growth rate of some measure of the money supply. The most notable example was the U.S. Fed led by Paul Volcker in the period 1979–1982 when attempts were made to practically define the central bank's target in terms of a reserve quantity. However, Mishkin (2004, p. 425) argues that the Fed was never truly committed to attaining its targets (in fact, it successively failed to drive M1 into the target range) and used the monetary targeting rhetoric only to avoid responsibility for drastic interest rate hikes that were needed to bring down inflation. Goodhart (2001) goes even so far as to call the Fed's approach "play-acting." Later on, we shall return to the question of why it is in practice very difficult, not to say impossible, for monetary authorities to control the monetary base (as is required by the multiplier model).



The logic of central bank’s liquidity management can be understood as provision of liquidity through open market operations in a way that, after taking into account the effects of autonomous liquidity factors (e.g. changes in the amount of banknotes in circulation or changes in government’s deposits with the central bank), commercial banks can fulfill their reserve requirements on average over the maintenance period.<sup>21</sup> For example, when the demand for notes and coins increases, as it does for example before Christmas or weekends – when people rush to ATMs to draw down their demand accounts – commercial banks’ reserves with the central bank decrease because their holding of cash is usually included in reserves (as “vault cash”) and because banks obtain cash by drawing down their balances with the central bank. By a similar token, government deposits usually rise causing a corresponding decline in the banking system’s deposits outstanding, which in turn renders the reserves insufficient, puts upward pressure on the interest rate, and requires an addition of liquidity either through open market operations or standing facilities. We shall trace this reasoning on a simplified example (borrowed and slightly modified from Foot et al., 1979).

Consider an economy characterized by the following properties:

- a) banks maintain 4% of deposits taken from the public as vault cash to meet immediate operating needs and 1.5% of deposits as balances with the central bank;
- b) the 5.5% specified in (a) constitutes the required reserve imposed by the monetary authorities on the banking system;
- c) cash in circulation amounts to 15% of deposits; and
- d) the central bank strives to control the short-term interest rate, i.e. the rate it charges commercial banks for liquidity.

The equilibrium of the economy is presented in Table 2.

Table 2  
The economy in initial equilibrium

Central bank		Banking sector		Non-bank private sector	
assets	liabilities	assets	liabilities	assets	liabilities
Banks’ balances	1.5	Balances with CB	1.5	Deposits	100.0
Vault cash	4.0	Vault cash	4.0	Equity in banks	10.0
Cash in circulation	15.0	Other assets	104.5	Cash	15.0
Government deposits	5.0	Deposits			100.0
		Capital			10.0
Total	25.5	Total	110.0	Total	125.0

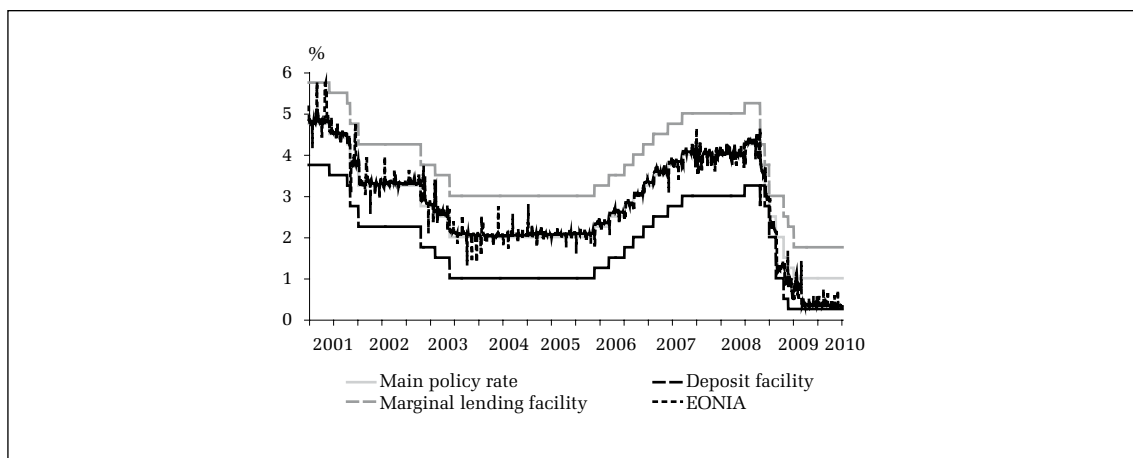
<sup>21</sup> Some central banks, e.g. Australia Canada and New Zealand, abstain from imposing reserve requirements on commercial banks. This, however, as proved by their good track record and scholarly contributions such as e.g. Woodford (2003, does not significantly impair the ability to control short-term interest rates, since as long as banks inelastically demand clearing balances from the central bank (and the abolishment of reserve requirements does not change that), the latter is in the position to charge any price it thinks fit for them.

Now suppose that in a given period the public sector is a net recipient of one unit from the non-bank private sector (a situation which might occur e.g. when tax receipts exceed the volume of government expenditures) and that the payment is made by a reduction of 0.9 in the cash they hold and 0.1 in their bank deposits. The payment in cash is straightforward, whereas the payment with deposits is processed by transferring 0.1 of commercial banks' balances with the central bank to the government's account. This leaves the non-bank sector's money holdings with 99.9 in deposits and 14.1 in cash. For the banking sector the situation is more complicated, as the payments resulted in a reduction of required reserves to 5.4 and a reduction in deposits held to 99.9, which leaves banks (in the aggregate) with a reserve deficiency of  $99.9 - 0.055 - 5.4 = 0.0945$ . If – as is typically the case – the reserve requirements are imposed on a lagged-accounting basis, which means they are predetermined by the initial level of deposits and equal 5.5, there is nothing banks can do to fulfill the requirement which would not in the same time drastically increase the interest rate (and even if a deficient bank were to sell its most liquid assets, e.g. treasury bills, then this would increase its balance but only at the expense of balances of the banks of those who buy the assets). This is astutely observed by Goodhart (1989, p. 323):

If the required reserves were to be based on a previous, known deposit base, a lagged accounting rule, then there would be nothing the banks could do by their own actions, e.g. by running down current assets, to lessen their need for reserves. Under such circumstances the authorities really have no alternative to giving them the reserves the banks require; ... they can only choose the interest rate, or penalty, for providing the required reserves.

It is important to understand that net additions of liquidity by the central bank are needed only if there is an aggregate deficiency of reserves, i.e. when the banking system as a whole cannot

Figure 1  
Euro area money market and policy rates



Note: main policy rate; deposit and marginal lending rates – the rates on the ECB overnight deposit and lending facility, respectively; EONIA – Euro Overnight Index Average, the average overnight rate weighed with the interbank deposit market transaction volume.

Source: based on Reuters data.

fulfill the reserve requirement. In turn, the fact that the amount of reserves suffices to fulfill the regulatory requirement does not imply that the reserves are adequately spread among individual banks, and in such a case individual deficiencies can be made good by individual surpluses. Since central bank’s lending and deposit facilities are available only at “penalty rates”, any bank with excess reserves can profit by lending them at a higher rate than the one offered by the central bank at its deposit facility to a bank with reserve deficiency, and the latter will gladly pay anything below what it is likely to be charged at the lending facility. Thus, the three central bank rate rates, the open-market-operations rate and the two standing facilities rates, form a corridor for the volatility of market rates. In that sense we can speak of central bank’s control over the money market rates.

Consider now another example: a client of one bank makes a payment of one unit to a client of another bank, and does so by taking a loan from his bank or utilizing a previously extended line of credit (Table 3).

Table 3  
Accounting changes resulting from credit extension by individual banks

<b>Bank A</b>		<b>Bank B</b>	
<b>assets</b>	<b>liabilities</b>	<b>assets</b>	<b>liabilities</b>
+1 credit	+1 deposit	+ 1 CB balances	+1 deposits
-1 CB balances	- 1 deposit		

The immediate effect of extending credit is growth of the balance sheet of Bank A and a corresponding growth of the money supply (by one unit). When the credit is used to make a payment to a client of Bank B, Bank A’s balance sheet declines to its initial size following a transfer of the deposit and central bank money to Bank A. The end result is an increase in the balance sheet of Bank B and no net change in the liquidity position of the banking system.

Perhaps a more interesting case is one when credit is extended in cash. Consider again the example from Table 2 and assume that the banking system makes a loan of one unit in cash to the non-bank sector. The immediate result is presented in Table 4.

Cash holdings of the non-bank public have increased by one and, naturally, so has the amount of cash in circulation on the central bank’s balance sheet. To extend the loan, the commercial bank needed to either buy physical notes and coins from the central bank by running down its balances or decrease its vault cash holdings. In either case, since the volume of deposits did not change, neither did the required reserve, and – given that in the initial equilibrium no other bank had excess reserves – the bank extending the loan must approach the central bank and request a provision of liquidity which would allow it to satisfy the reserve requirement.

The examples discussed above illustrate the single most important aspect of banking practice in stage four, namely the endogeneity of money. Unlike in the earlier periods, there is no close causal relationship between changes in the monetary base and bank deposits. High correlation between the two aggregates can be explained by the fact that they indeed tend to move together,

Table 4  
The economy after the extension of credit

Central bank			Banking sector		Non-bank private sector	
assets	liabilities		assets	liabilities	assets	liabilities
Banks' balances	1.5	Balances with CB	0.5		Deposits	100.0
Vault cash	4.0	Vault cash	4.0		Equity in banks	10.0
Cash in circulation	16.0	Other assets	105.5		Cash	15.0
Government deposits	5.0	Deposits		100.0	Loan in cash	1.0
		Capital		10.0		
Total	26.5	Total	110.0	110.0	Total	126.0

however now it is the change in the broader aggregates that drives the monetary base, not the other way around. We have seen that reserve requirements are calculated with reference to the previous month's (or in any case previous period's) liabilities, and in case of deficiencies, the authorities seeking to avoid drastic movements of short-term interest rates are left with no other choice but to supply the needed liquidity. If they overdo it, i.e. if they supply more reserves than the banking sector actually needs they will end up sterilizing excesses via the deposit facility or else putting up with rates falling virtually to zero. Thus attests Holmes (1969, p. 73), at the time Senior Vice President of the Federal Reserve Bank of New York responsible for open market operations:

The idea of a regular injection of reserves... suffers from a naïve assumption that the banking system only expands loans after the System (or market factors) have put reserves in the banking system. In the real world, banks extend credit, creating deposits in the process, and look for reserves later. The question then becomes one of whether and how the Federal Reserve will accommodate the demand for reserves. In the very short run, the Federal Reserve has little or no choice about accommodating that demand...

Moreover, to the extent that, as we have argued, monetary base consists by and large of notes and coins in the hands of the public, it is plausible that there exists not a unidirectional but bivariate causality pattern between money and nominal income. Since monetary base is determined by the demand for banknotes, and the demand for banknotes is determined by current and past consumers' expenditures (Foot et al., 1979), then money supply growth can trigger growth of nominal income, which eventually feeds back into the growth of notes and coins in circulation.

The short account of banking history presented in this section was meant to give a vague idea of how the key monetary institutions have developed and how they influenced the money– supply mechanism. We have argued that for the most part of history money was, as a practical matter, exogenous, i.e. its supply was more or less anchored by the stock of gold in the economy, and remained so until the creation of central banks and the fall of the gold standard. Freed from the necessity to peg the price of gold and limit their issue of reserves accordingly, central banks have started to control the short-term interest rate by accommodating the needs for cash of the banking system at the price of their own choosing. Now, it could be asked whether the development of banking could have conceivably followed a different path – one which would keep the money supply exogenous, fixed according to the wishes of the monetary authorities. The problem is that if the central bank is supposed to be an institution which facilitates the “smooth functioning of the payment system” and performs the function of a lender of last resort, then such control is hardly imaginable. Thus, Von Hagen (1999, pp. 685-686) is worth quoting to this effect, as he provides an interesting account of monetary targeting by the Bundesbank:

... the Bank’s instruments consisted only of lending to commercial banks under automatic-access facilities (discount and Lombard credit), offering short-term paper at preset interest rates, and foreign exchange market interventions. Importantly, these instruments left the initiative for creating central money largely with the banking system. Bundesbank Council members were often frustrated by the impression that they had much less control over central bank money growth than the banking industry. One indication of this frustration is the frequent description of the Bank as a self-service store for central bank money’ used in Council meetings in the early 1970s [emphasis added].

Goodhart (1994, p. 1425) concurs and explicitly states that even “if the central bank tried to run a system of monetary base control, it would fail”. Meulendyke (1988, p. 392), at the time Senior Economist at the Open Market Department at the New York Fed, observes that though it is theoretically possible to conceive of a situation in which the central bank could refuse to provide the reserves, in practice, even during the so-called Volckerian episode of 1979–82, when the Fed was most serious about controlling the supply of money, it processed instructions to pay out reserve balances even if the action put the sending bank into overdraft (idem, 1993, p. 10). In any case, it is perhaps safest to conclude these considerations by observing that though it might be possible for the central bank, by closing its lending facility, to strictly control the money supply, rendering it exogenous *vis-à-vis* the economic system, historically this has not been how central banks and banking systems operated.

### **3. Money endogeneity in Poland**

In the preceding section we have analyzed the endogeneity of money from a historical perspective, tying its evolution to the historical development of banking and financial institutions. In contrast, the main focus of this section is an empirical investigation of the money supply process in Poland. We shall first present the current monetary policy implementation strategy of the National Bank

of Poland (NBP) to unravel the connection between the central bank's actions and the liquidity conditions of the banking system. We will then develop a simple model to test for Granger causality between the liquidity of the banking sector and the credit expansion process. Finally, we will consider some implications of the obtained results for monetary policy and the current crisis.

### 3.1. Monetary policy implementation in Poland

Bindseil (2004) defines monetary policy strategy as the specification of: (1) the final (or medium-term) target that the monetary authorities are striving to achieve; (2) the operational target that the monetary authorities want to control – and indeed can control – on a daily basis; (3) the set of instruments, or tools, that the monetary authorities want to use to control the operational target; (4) the model of the transmission mechanism that links the behavior of the operational target to the final target of monetary policy; and finally (5) the actual process of adjusting the operational target on the basis of new information and changes in the underlying economic conditions, as well as communicating the monetary policy decisions to the public in order to achieve the medium-term or final target. Our focus in this section will be primarily on points (2) and (3), i.e. we shall look at how the NBP defines its operational target and to what instruments it resorts to control it.

The Act on the National Bank of Poland of January 31<sup>st</sup> 1989 defined the goal of the NBP as strengthening the “domestic money,” which comprised currency in circulation and private sector deposits.<sup>22</sup> As the definition seemed obscure and too general, the NBP would specify every year (from 1990 to 1997) an inflation target, agreed upon with the Ministry of Finance and accepted

Table 5

The realization of the indirect target

Year	Pre-determined target (in PLN billion)	Realization (in PLN billion)	Deviation (% of target)
1990	4.1	10.3	151
1991	8.5	9.0	6
1992	12.7	15.0	18
1993	15.0	14.8	-1
1994	15.5–16.9	21.4	27
1995	17.1	26.9	57
1996	23.0	30.2	31
1997	27.4–28.6	39.4	38

Source: Polański (1998), rearranged.

<sup>22</sup> The historical account of the NBP's monetary policy implementation strategy presented below is based on Zatorski's (2005) concise but highly informative discussion of the subject.

by Parliament. Apart from the final goal, the NBP was additionally legally obliged to strive to achieve a so-called “indirect target,” which the Act specified as the supply of money. Initially, in 1990, it was the “domestic money,” and from 1991 to 1997 the definition was extended to include also currency deposits. In 1996, the NBP formally introduced an operational target, defining it as a predetermined growth in the monetary base (currency in circulation and commercial banks’ balances with the central bank). Though the operational framework of monetary policy has changed significantly since that time, and hence those developments could be seen as irrelevant, they do in fact provide an excellent starting point for the discussion of money endogeneity in Poland. For despite explicitly stating its commitment to control – and thus render exogenous – the supply of money, the NBP can now safely be judged to have largely failed in this endeavor. Tables 5 and 6 present the track record with regard to the indirect and the operational target respectively.

Table 6  
The realization of the operational target

Year	Pre-determined target (in PLN billion)	Realization (in PLN billion)	Deviation (% of target)
1996	7	5.8	-17
1997	6.6	8.1	23

Source: Polański (1998), rearranged.

As Polański (1998) explains, the reason why the NBP did not succeed in controlling monetary aggregates was not related to its incompetence or inefficiency but to the fact that the factors directly influencing the growth of the aggregates it strived to control – government indebtedness, increase in net foreign assets, and credit extension to the non-bank private sector – were largely outside of the central bank’s control. In particular, under a fixed exchange rate regime, effectively abandoned in July 1998 but formally in place until April 2000, the central bank’s balance sheet had to grow in accordance with the supply of net foreign assets. Similarly, the amount of banknotes and coins in circulation, traditionally the largest component of the monetary base, was in the short perspective purely demand-driven and the NBP had little choice but to accommodate their growth.

In 1998 the NBP gained formal institutional independence and the newly created Monetary Policy Council, following the example of most notably the Reserve Bank of New Zealand, Bank of Canada and the Bank of England, adopted the strategy of direct inflation targeting, whereby the monetary policy was targeted solely at attaining a given rate of inflation (since 2004 the target has been 2.5% with a symmetrical range for deviations of  $\pm 1$  percentage point), with no indirect targets. As the Council made clear, the NBP would strive to

maintain interest rates at a level consistent with achievement of the inflation target adopted, acting to influence the level of nominal short-term money market rates. Money market rates impact lending and deposit rates at the commercial banks. In turn, commercial bank rates affect the savings, consumption and investment decisions taken by households and corporate (NBP 2001, p. 7).

Though the Council does not explicitly mention that within the new strategy it has, next to an inflation target, adopted also an operational target (possibly the reason was not to confuse the public which could have then missed the whole point of the central bank's new approach), it is clear from this and the Council's later statements, that from now on the operational target was to lie within the sphere of "short-term money market interest rates" rather than monetary aggregates. One other reason why the Council may have initially decided not to communicate its operational target directly was the ongoing transformation of the Polish financial sector and the gradual development of the various niches of the money market which would naturally force frequent changes of the target and introduce unnecessary noise in the central bank's developing communication strategy. Thus, for example, in 2006, the guidelines stipulated that the NBP will conduct its open market operations so as to assure that the WIBOR SW (1-week Warsaw Interbank Offered Rate) would stay close to the policy rate. In 2007, the Council changed slightly the operational target offering the following clarification:

The central bank will conduct basic operations on the scale that will enable the level of the POLONIA [Polish Overnight Index Average, the average overnight rate weighed with the interbank deposit market transaction volume – J.J.] rate to settle around the NBP's reference rate. The transition from influencing the level of the WIBOR SW rate to the POLONIA rate results from the tendencies taking place in the term structure of the money market. Over the recent years there has been a rise, among others, in the share of overnight deposits in the total turnover of the market of unsecured interbank deposits. They currently account for the major part of all transactions. Thanks to the transition to the overnight rate, the NBP will be able to more effectively affect the economy through the monetary policy transmission mechanism (NBP 2007, p. 13).

The following quote sheds some light on how the NBP intended to control its operational target:

The principal instrument of monetary policy are short-term interest rates. Changes in the NBP's reference rate define the direction of the pursued monetary policy. The NBP's deposit and lombard rates set the fluctuation band for overnight interest rates in the interbank market (NBP 2007, p. 12).

Hence, the framework for attaining the desired level of money-market interest rates, which the NBP has no direct control over, consists essentially in steering a set of policy rates:

- the lombard rate – which determines the maximum costs of obtaining funds from the central bank;
- the reference rate – which determines the minimum yield obtainable on the basic open market operations;
- the deposit rate – which determines the interest on overnight deposits made with the central bank;

and keeping the equilibrium amount of liquidity within the system via the open market operations (OMO). Importantly, nowhere does the Council say that the reserve requirements can be effectively used to control the money supply process. Instead, it is asserted that the role of required reserves



(averaged over the maintenance period) is to stabilize the liquidity conditions in the banking sector (NBP 2007, p. 14). It should be mentioned that due to the accumulation by the NBP of gross official reserves resulting from FX interventions, the Polish banking sector has had a structural liquidity surplus since 1995, which means that commercial banks in the aggregate<sup>23</sup> have balances in excess of the monthly reserve requirement. Thus, unlike in most developed countries, e.g. the euro area, the Polish central bank conducts liquidity absorbing open market operations and is, as a result, a permanent net borrower from the banking sector.

To organize thinking about how the control of short-term interest rates at the NBP works in practice, consider the following simple model, along the lines of the analysis presented in the preceding section. From the perspective of the central bank’s balance sheet, the following equality must hold:

$$\begin{aligned} &\text{Reserves of banks with the central bank} = \\ &= \text{net open market operations} + \\ &+ \text{net use of standing facilities} + \\ &+ \text{net autonomous factors.} \end{aligned}$$

Though the equality above is strictly speaking a tautology, it can be rearranged to become a modeling tool provided that the residual items – i.e. the variables that are endogenous and can be considered to balance the balance sheet – are singled out. Note first, that in the short term autonomous factors ( $A$ ) are exogenous (to represent the fact that the Polish banking sector has a structural liquidity surplus, we shall assume that net autonomous factors are positive). Similarly, in a lagged reserve accounting scheme, required reserves ( $RR$ ) are fixed over the maintenance period. Without the loss of generality we can assume for simplicity that reserves are made up only of  $RR$  and that  $RR = 0$ .<sup>24</sup> Since the NBP requires that commercial banks satisfy the reserve requirement only on average over the maintenance period, this can be interpreted as allowing banks to overdraw their accounts at end-of-day and “average around zero.” Hence, denoting by  $B$  and  $D$  the aggregate recourse to the borrowing and deposit facility respectively and by  $OMO$  the liquidity absorbing open market operations, we obtain:  $B - D = A - OMO$ , and thus:

$$OMO > A \Rightarrow (D = 0; B = OMO - A; i_1 = i_2 = \dots = i_T = i_B)$$

$$OMO < A \Rightarrow (B = 0; D = A - OMO; i_1 = i_2 = \dots = i_T = i_D)$$

What the equations above say is simply that if the NBP absorbs too much liquidity, commercial banks will be left below the reserve requirement and will be forced to approach the borrowing facility. Conversely, if the NBP fails to fully absorb the positive autonomous factors, this will leave the banking system with liquidity in excess of the reserve requirement and push them to deposit their funds at the central bank’s facility. If there were no uncertainty regarding the scope of the

<sup>23</sup> Aggregate liquidity surplus does not necessarily mean that every single bank has a liquidity surplus, since surplus liquidity might be unevenly spread across the system.

<sup>24</sup> Otherwise, balancing liquidity conditions in the system would require absorbing the liquidity left after the fulfillment of reserve requirements, i.e. setting  $OMO = A - RR$ , instead of  $OMO = A$ , as above. Since the required reserves are considered to be exogenous in the short term, their exact level is immaterial for the discussion at hand.

NBP's absorbing operations or the autonomous factors, money market rates would tend to correspond throughout the entire maintenance period to either the lombard ( $i_b$ ) or the deposit ( $i_d$ ) rate.

In a more interesting case where both the liquidity supply and the rates of standing facilities are subject to uncertainty, the overnight interest rate on each day of the maintenance period is given by the following equation:

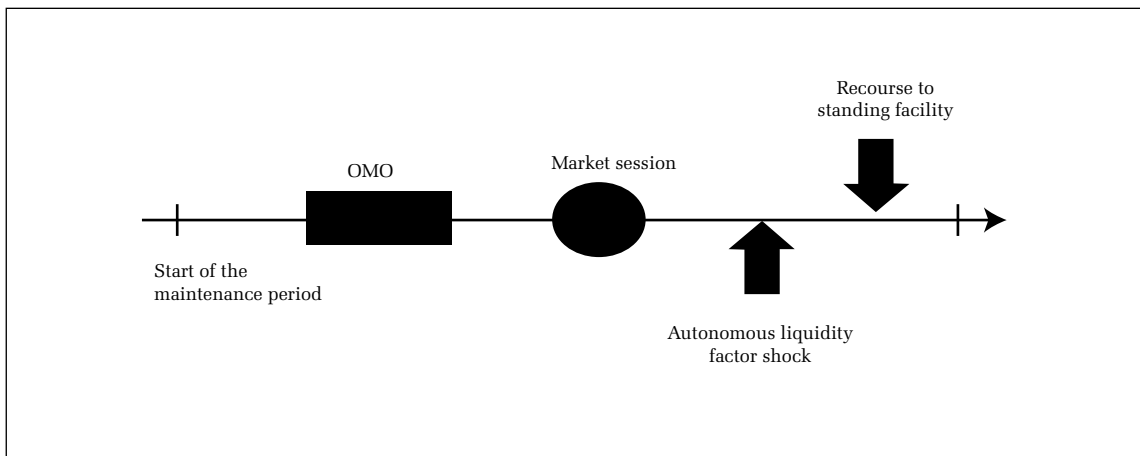
$$\forall t = 1, \dots, T: i_t = E[i_B | I_t]P(\text{short}) + E[i_D | I_t]P(\text{long}) = \\ E[i_B | I_t] \int_{-\infty}^0 f_{(A-OMO | I_t)}(x) dx + E[i_D | I_t] (1 - \int_{-\infty}^0 f_{(A-OMO | I_t)}(x) dx)$$

where  $I_t$  is a homogenous set of information available to commercial banks at day  $t$  and  $f_{(A-OMO | I_t)}(x)$  is the probability density function that banks assign to the random variable  $A - OMO$ , which yields the difference between the autonomous factors and the absorption of liquidity. The equation states that the overnight interest rate on each day of the maintenance period will equal the weighted expected rates of the two standing facilities. The weights are simply probabilities that at the end of the reserve maintenance period, after the market session, the banking sector will be in the aggregate "short" or "long" of reserves, and thus will approach either the borrowing or the deposit facility.

The dynamics behind the equation is presented schematically in Figure 2, where the maintenance period has been shortened for simplicity to just one day.

Figure 2

The sequence of events in a stylized reserve maintenance period

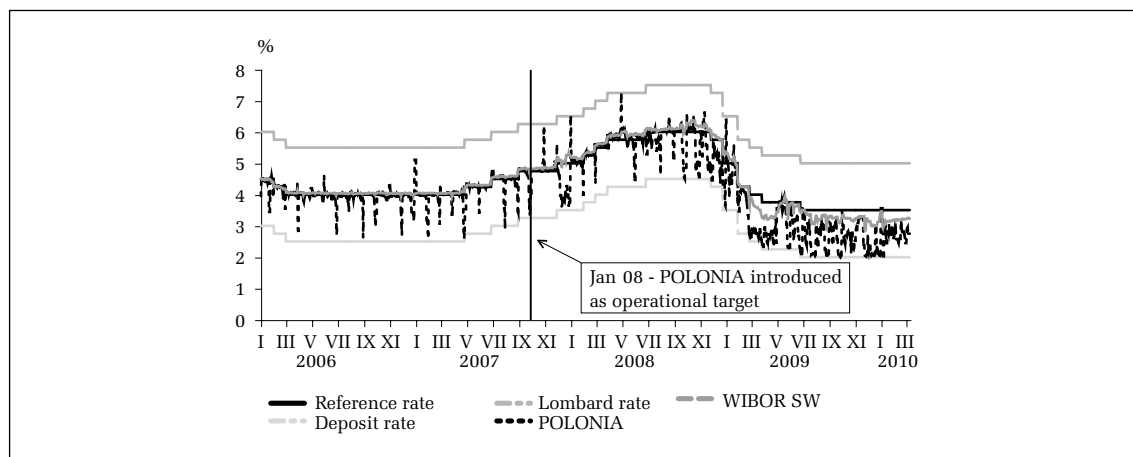


Source: Adapted from Bindseil (2004), rearranged.

The following sequence of events takes place. First, the central bank enters the market and conducts liquidity absorbing operations with a fixed allotment  $OMO$  of bills that the commercial banks can bid for. Then the market session takes place, with the market clearing at some equilibrium rate. Finally, towards the end of the session comes the autonomous liquidity factor

shock (examples of which were described in the preceding section), which forces the adjustment of commercial banks’ balances held with the central bank and induces recourse to one of the standing facilities. Now, if the NBP wants to achieve a given money market interest rate, it should only set the rates it charges on the standing facilities symmetrically around the target and offer such a volume of bills as to keep the money market conditions neutral. For example, if  $A$  is  $N(10,1)$ , i.e. the autonomous factors have a normal distribution with a mean 10 and standard deviation 1, then keeping the overnight rate at 5% requires issuing bills to the tune of 10 and setting  $i_B = 6\%$  and  $i_D = 4\%$ .<sup>25</sup> In such a setup, any change in the desired level of the operational target must be coupled by a corresponding shift of the standing facilities corridor, so that if the interbank interest rate target is hiked from 5% to 6%, the deposit rate must rise from 4% to 5% and the lombard rate from 6% to 7%. It should be stressed, however, that interest rate changes *do not require* corresponding changes in the volume of open market operations. After all, the relationship  $OMO = E(A) \Rightarrow (i_B + i_D)/2$  is independent of the level of the operational target and thus the amount of liquidity that the central bank must absorb or provide is likewise independent of the current monetary policy stance.

Figure 3  
The control of short-term interest rates by the NBP



Note: reference, deposit and lombard rates are the NBP’s policy rates; POLONIA, WIBOR SW and WIBOR 3M are the overnight, spot week and three-month interbank interest rates respectively.

Source: based on Bloomberg data.

From the mathematical point of view, the fact that in the examples described above the overnight rate was constant over the whole maintenance period ( $t = 1, 2, \dots, T$ ) means that the stochastic process  $i_1, \dots, i_T$  is a martingale, i.e.  $E(i_{t+1}|I_t) = i_t$  (see especially the path breaking study of Hamilton, 1996). The

<sup>25</sup> The width of the corridor created by the standing facilities is a secondary technical matter. Generally, the wider is the spread between the borrowing and the deposit rate, the bigger the market and the greater the potential variance of the overnight rate. If the central bank wanted to completely eliminate the volatility of the overnight rate, it could narrow the spread down to zero, however this would be tantamount to effectively shutting down the interbank market.

property follows from the fact that commercial banks only need to satisfy the reserve requirement on average, and thus can freely reallocate the funds between particular days in the maintenance period. Knowing that  $i_T$  will be equal  $(i_B + i_D)/2$ , no bank would pay a higher price for liquidity than  $i_T$  also on day  $T-1$ , since it could simply wait until the next day and only then make up for any reserve deficiencies. Similarly, no bank would be willing to sell funds at a rate below  $i_T$  on day  $T-1$ , since any excesses could be more profitably lent out on the next day. Thus,  $i_T = i_{T-1}$ . Reasoning recurrently in exactly the same way, we obtain that indeed  $i_1 = i_2 = \dots = i_T = (i_B + i_D)/2$ .

Obviously, the critical assumptions that banks have a homogenous set of information and that the interbank market is frictionless are rather strong and need not be satisfied in practice. The timing and maturity of open market operations can also make a difference. Nevertheless, as evidenced by Figure 3, over the whole period investigated, the NBP has been quite successful in controlling the short-term interest rates and in so doing it has by and large followed the approach outlined above.<sup>26</sup>

### 3.2. Empirical analysis of money endogeneity

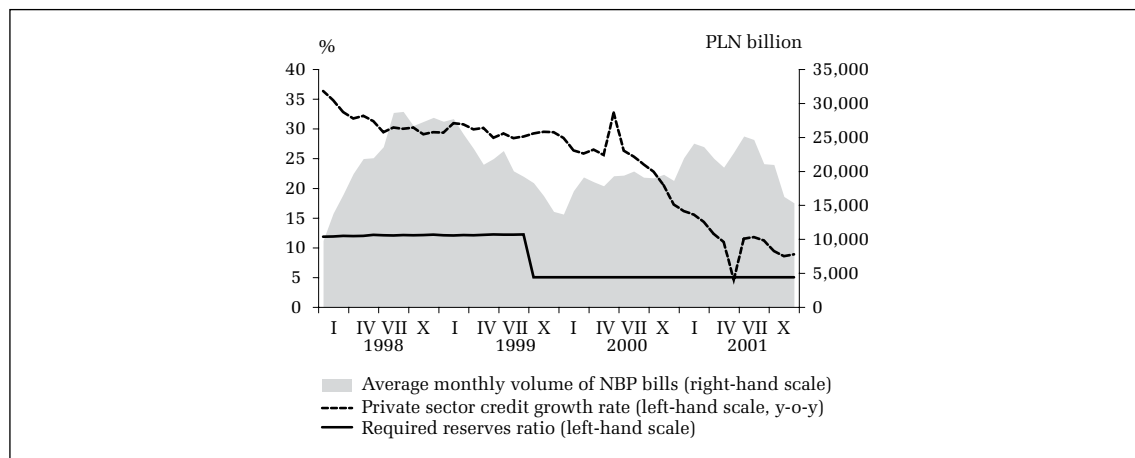
In section 2 we have suggested that the evolution of the financial system led to the transition from exogenous to endogenous money supply processes. The exogenous money supply was associated with a multiplier model according to which a lowering of the required reserve ratio would increase the multiplier and contribute to increasing the supply of broad money and credit since commercial banks would then use the additional amount of freed up liquidity for the expansion of loans and deposits. In contrast, according to the endogenous money view, the volume of credit extended depends on the central banks' interest rate, but it is independent of the required reserve ratio or the amount of liquid reserves that a bank holds. To illustrate the point that the money supply process in Poland can be more closely described as an endogenous process, in what follows we shall consider the possible effects of lowering the required reserve ratio and provide some evidence that the amount of interbank liquidity does not Granger-cause credit expansion in Poland.<sup>27</sup>

As we have already noted above, the Monetary Policy Council aims to preserve a given level of money market interest rates, consistent with the adopted inflation target. Since the Polish banking sector has a structural liquidity surplus, the central bank's operations consist in issuing bills (currently of 7-day maturity) and absorbing the liquidity in excess of reserve requirements. It is therefore hard to imagine that lowering the required reserve ratio should cause money market interest rates to fall, as the NBP is at all times ready to step in and mop up any surplus liquidity in order to preserve the desired level of market rates. Hence, the immediate result of lowering the reserve requirements would be an increase in the issuance of the NBP's bills. If indeed the Council

<sup>26</sup> Admittedly, the recent crisis has introduced some "noise" to the behavior of the POLONIA rate. In the first quarter of 2009, POLONIA deviated from the reference rate by about 120 basis points, approaching the deposit rate. This reflected the NBP's modification to the standard approach, which consisted in cutting the supply of NBP bills and leaving the system with excess liquidity.

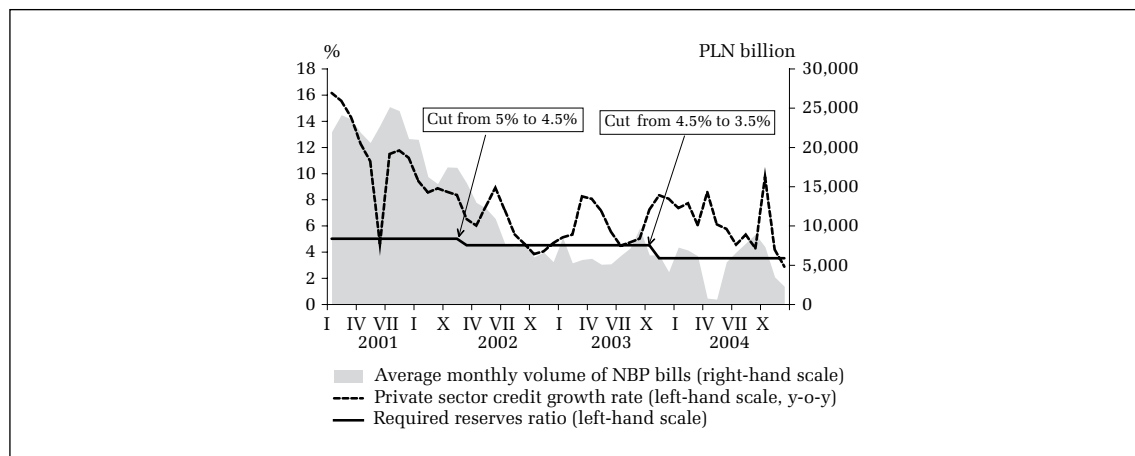
<sup>27</sup> The multiplier model is static in nature and, as such, cannot be subject to empirical testing using time series data. Nevertheless, the model is often (cf. Brunner and Meltzer (1964), Mankiw (2007, pp. 514–515)) used to support the argument that a given increase in commercial banks' reserves with the central bank will produce a corresponding increase in commercial banks' credit. The following reasoning is meant to provide evidence against that conclusion.

Figure 4  
Changes in required reserve ratio and monetary conditions



Source: based on NBP data.

Figure 5  
Changes in required reserve ratio and credit conditions



Source: based on NBP data.

wanted to change the level of market interest rates, it would do so by shifting the entire corridor of policy rates, not by changing the liquidity conditions in the banking system.

It should be mentioned though, that even if the lowering of reserve requirements would not impact the money market interest rates, it would increase commercial banks’ profits and thus could possibly affect their markups which, next to the interbank rates, are the second most important determinant of non-bank lending rates.<sup>28</sup> Currently, commercial banks’ required reserves are

<sup>28</sup> Of course, it should not be taken for granted that banks, as profit-maximizing institutions, would indeed respond to increased profits by lowering their markups and thus put up with lower profits on their lending activity.

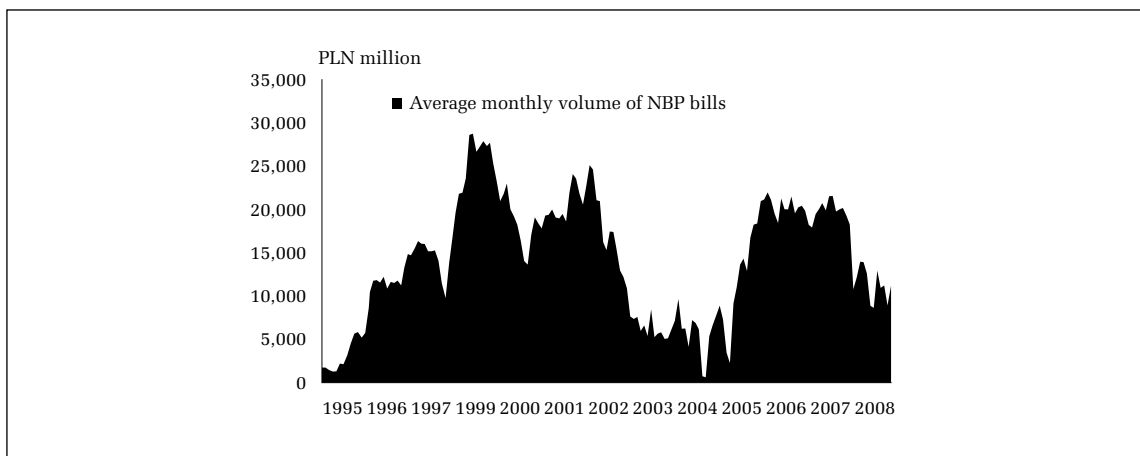
remunerated at 0.9 the rediscount rate which is 25 basis points higher than the reference rate. If the required reserve ratio were to be changed from the present 3.5% to, say, 2% (as in the European Central Bank), then with the total level of deposits at PLN 570 billion, the issuance of NBP's bills would *ceteris paribus* have to increase by  $0.015 \times 570$  billion = PLN 8.55 billion, leading to an overall increase in commercial banks' profits of roughly PLN 15 million per year (assuming the reference rate at 4%). The scale of the potential effect that such an increase in profits might have on banks' lending rates is not clear. However, assuming that banks would use all of the extra profits to compensate for the lowered markups, we may estimate that with the total supply of credit at PLN 600 billion, the change in the markup would most likely be smaller than  $0.015/600$ , that is less than one basis point.

The foregoing considerations shed some light on why, historically, changes in the required reserve ratio failed to produce a noticeable expansion of lending. Indeed, in September 1999 the required reserve ratio was reduced by seven percentage points from slightly over 12% to just 5%. However, as we can see in Figure 4, even though the average volume of NBP bills increased steadily in the following months (with deposits at roughly PLN 215 billion, the liquid funds freed up amounted to PLN 15 billion), the change had no effect on the growth of private sector credit. Later reductions of the required reserve ratio, in February 2002 and October 2003, also did not feed through to credit growth (Figure 5).

Obviously, such simple graphical analysis does not warrant any strong inference as to the lack of causal relationship between the reserve ratio and credit expansion (perhaps without the lowering of the reserve ratio, credit growth would have declined even more?). Thus, we shall now formally investigate the relationship between the liquidity position of the banking system and credit expansion using a simple econometric model. Figure 6 shows the average monthly supply of bills issued by the NBP to mop up the surplus liquidity of the banking system in the years 1995–2008. As suggested above, throughout the whole analyzed period the NBP has been the net debtor of commercial banks (the supply of bills dropped to just PLN 700 million in mid-2004 but remained

Figure 6

The volume of bills issued by the NBP to mop up liquidity in excess of reserve requirements



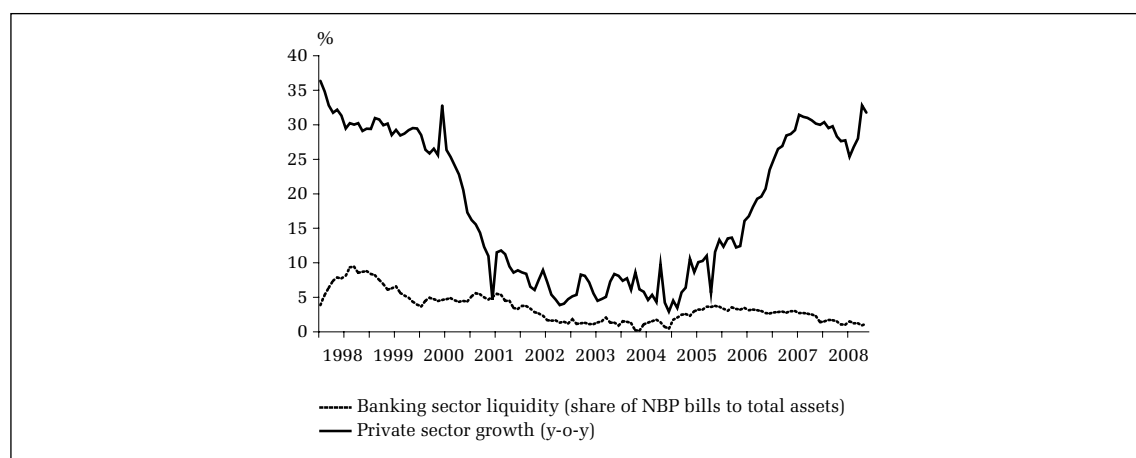
Source: based on NBP data.

positive). However, to eliminate the potential noise introduced by the unsuccessful episode of monetary base targeting in 1996–1997, we shall focus on the pattern of the series since January 1998. It seems that in assessing the liquidity situation of commercial banks it would not be proper to focus only on the absolute level of NBP bills in their possession since, obviously, the size of their balance sheets varied over time (increasing almost fourfold from roughly PLN 270 billion in 1998 to a over PLN 1,000 billion in the end of 2008). Thus, we define the degree of commercial banks’ liquidity as the share of NBP bills in their total assets.<sup>29</sup>

To measure credit expansion we simply look at the year-on-year growth of the sum of commercial banks’ loans to (and other claims – such as securities other than shares – against) the non-banks. Similarly as with the liquidity conditions, we use monthly data ranging from January 1998 to November 2008 to exclude the possible effects of the recent global financial crisis of which we shall have more to say in the subsequent section.

Figure 7

Surplus liquidity (proxied by the share of NBP bills in banks’ balance sheets) in the banking system plotted against the year-on-year credit growth rate



Source: based on NBP data.

Figure 7 plots the year-on-year growth of credit against the degree of surplus liquidity in the banking system. The marked fall in the rate of credit expansion in the second half of the year 2000 is mainly attributable to a general slowdown, during which the Polish economy went from a 4.5% and 4.3% growth in 1999 and 2000 to a mere 1.2% in 2001 and 1.4% the following year. Despite a substantial decrease of the NBP policy rate, from 19% in February 2001 to 5.25% in mid-2003, the flow of credit did not resume to an above-10-percent pace until the third quarter of 2004. In the whole period, the degree of banks’ surplus liquidity was positive, albeit seems to have exhibited a general declining trend. Nevertheless, no straightforward relationship can be identified between the growth rate of credit and the liquidity situation of the banking sector, since even though the initial decline of

<sup>29</sup> Strictly speaking, we subtract from total assets the reserves set aside for specific provisions, write-downs and revaluations.

credit growth might plausibly be linked to a decline in the degree of surplus liquidity between 1999 and 2003, the latter can hardly be squared with the strong pick-up of credit expansion in 2005.

To formally investigate the relationship between the degree of banking system's surplus liquidity and the credit expansion process we shall use the standard econometric technique called the Granger causality test. It should be mentioned at the outset that the test does not establish causality in any philosophical sense of the term, but merely captures statistically the phenomenon of precedence. As Diebold (2001, p. 254) lucidly explains:

... the statement “ $y_i$  causes  $y_j$ ” is just shorthand for the more precise, but longer-winded, statement, “ $y_i$  contains useful information for predicting  $y_j$  (in the linear least squares sense), over and above the past histories of the other variables in the system.” To save space, we simply say that “ $y_i$  causes  $y_j$ .”

Thus, in asking whether the degree of liquidity of the banking system causes credit expansion, we will simply be looking at whether including past values of liquidity in the regression of credit growth on its lagged values improves prediction of future values of credit growth in a statistically significant way. Before moving on, however, we must check whether the two series are stationary – i.e. simply put, whether their means and variances do not vary systematically over time. Figure 7 suggests both a trend-like pattern and significant variability, but to be sure we run the standard augmented Dickey-Fuller unit root test (Table 7).

Table 7  
Augmented Dickey-Fuller unit root test results

<b>Null hypothesis: variable has a unit root</b>	<b>t-Statistic</b>	<b>Probability</b>
Credit growth	-1.406081	0.5775
Credit growth 1-st difference	-13.66261	0.0000
Liquidity	-0.960817	0.7657
Liquidity 1-st difference	-9.488120	0.0000

The results of the test indicate that for both credit growth and liquidity the hypothesis that the series have a unit root cannot be rejected (at 5%), but it can be rejected when the two are first-differenced.<sup>30</sup> After testing for stationarity, we can proceed to test for Granger causality. The procedure follows the well known pattern.<sup>31</sup>

In the first step, we shall run a series of regressions of the form:

$$DC_t = \alpha_0 + \sum_{i=1}^n \alpha_i DC_{t-i} + \sum_{j=1}^n \beta_j DL_{t-j} + \varepsilon_t \quad (*)$$

<sup>30</sup> Though the results of the ADF test are conclusive, it seems surprising from an economic point of view that both series turned out non-stationary, perhaps due to the relatively short time span considered. If the series really are stationary, then taking first differences might bias the causality test results, hence below we shall also provide Granger test result for the unchanged series. I am grateful to Michał Brzoza-Brzezina for pointing this out to me.

<sup>31</sup> See Gujarati (2003, pp. 696–700) for a concise introduction to testing Granger causality.



where the first-differenced credit growth (*DC*) is explained by the past values of itself and the past values of the first-differenced liquidity (*DL*) series for different lag lengths. In the second step, using the estimated equation, we perform a Wald test for the joint hypothesis that all the lagged *DL* terms do not belong in the regression, i.e.  $\sum \beta_j = 0$ .

Tables 8 and 9 summarize the results of the procedure for the lag length 2. The *F* statistic from the Wald test equals 0.67 and the high probability of 0.51 indicates that the null hypothesis that the lagged liquidity terms do not belong in the regression cannot be rejected. The same procedure is then repeated for other lag lengths but to save space we only present the results of the final *F* test. Formal purity would require using the Akaike or Schwartz information criterion to make the choice on the number of lagged terms to be introduced in the causality tests, nevertheless as we believe twelve months to be the maximum reasonable time over which surplus liquidity could influence credit conditions, Granger causality tests are performed for up to 12 lags (Table 10)

Table 8  
Coefficients estimated from regression (\*) with two lags

<b>Regressors</b>	<b>Coefficient</b>
DC (lag 1)	0.182903** (0.0426)
DC (lag 2)	0.076584 (0.4075)
DL (lag 1)	0.315312 (0.4614)
DL (lag 2)	0.280628 (0.4873)
Constant	0.000107 (0.9527)
adj. R-squared	0.021697

Table 9  
Results of the Wald test that the coefficients by the lagged liquidity terms, DL(lag 1), DL(lag 2), are jointly statistically insignificant

<b>Test Statistic</b>	<b>Value</b>	<b>df</b>	<b>Probability</b>
F-statistic	0.668820	(2, 123)	0.5142
Chi-square	1.337641	2	0.5123
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
DL (lag 1)		0.315312	0.426745
DL (lag 2)		0.280628	0.402773

Table 10

The results of Granger causality tests for 2–12 lags

<b>Null hypothesis: DL does not Granger cause DC</b>		
<b>No. of lags</b>	<b>F-Statistic</b>	<b>Probability</b>
2	0.67	0.51
3	0.96	0.41
4	0.89	0.47
5	1.24	0.30
6	1.13	0.35
7	0.79	0.60
8	0.74	0.65
9	0.65	0.75
10	0.53	0.86
11	1.53	0.13
12	1.67	0.09

The results obtained suggest that the hypothesis that the coefficients on the lagged liquidity terms in the series of regressions (\*) are jointly statistically insignificant – and thus that the lagged liquidity terms do not really belong in the regression – cannot be rejected for any number of lags studied.<sup>32</sup> This provides an argument against the money multiplier model, the basic prediction of which is that lowering the required reserve ratio can stimulate bank lending. As we have argued above, under a monetary policy framework currently operative in Poland, a lowered rate of required reserves would not influence the short-term interbank interest rates – i.e. the most important determinants of non-bank credit rates – and could only increase commercial banks' profits, albeit to an extent that would hardly suffice to lower banks' loan markups and increase the availability of credit. As we have seen in a series of examples in section 2, banks can extend credit without there necessarily being a net change of liquidity in the banking system, and even should they temporarily fall short of balances with the central bank, the latter – as a last-resort lender – would lend them the funds both to preserve its predetermined interbank interest rate target and to guard financial stability. Hence, the foregoing analysis provides some empirical confirmation that in Poland – to use the words of King (1994, p. 264), then chief economist with the Bank of England and currently its Governor – “money is endogenous: the Bank supplies base money on demand at its prevailing interest rate and broad money is created by the banking system.”

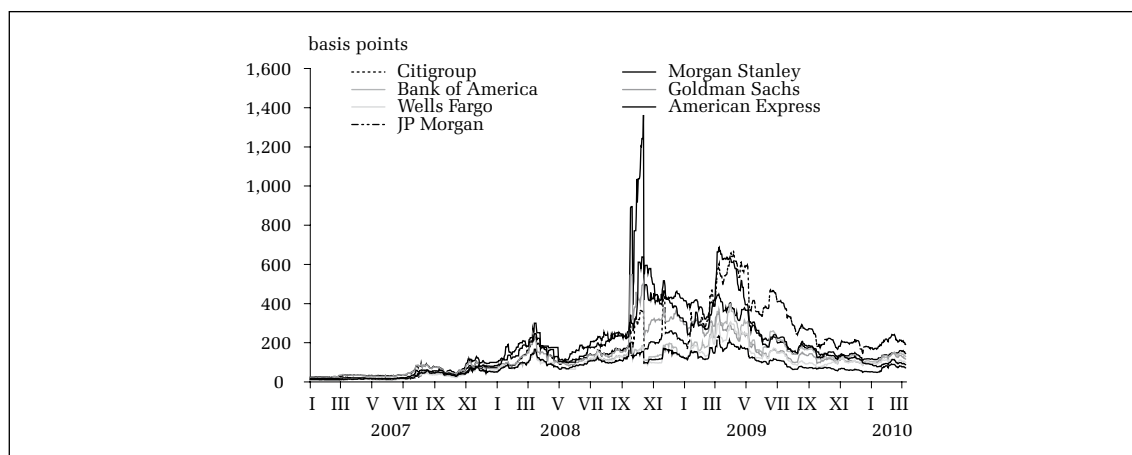
<sup>32</sup> The values of the F-statistic and p-values for the original series, not first-differenced, are (lags 2-12): 0.26 (0.78), 0.59 (0.62), 0.86 (0.49), 0.75 (0.59), 0.95 (0.46), 0.87 (0.53), 0.6 (0.77), 0.58 (0.81), 0.53 (0.86), 0.48 (0.91), 1.28 (0.25). Hence, we cannot reject the hypothesis that banking sector liquidity causes credit growth.

### 3.3. Endogeneity and the financial turmoil: the case of Poland

The reasoning presented above is based on a longer time series and does not explicitly address the situation as it evolved after the collapse of the American investment bank Lehman Brothers in September’08, which has significantly destabilized the global financial markets. Specifically, it could be argued that even though the hypothesis regarding the endogeneity of money in Poland is quite convincing when applied to the banking system in “normal conditions,” it loses much of its validity under times of stress, such as the current financial turmoil. There is as yet no scholarly presentation of such a view, but a variety of articles in the financial press stresses the liquidity nature of the current credit slowdown in Poland. For example, in their widely discussed article, Pruski and Bielecki (2009), the CEOs of the two largest Polish commercial banks, have recently argued that with the drying up of liquidity and a massive global deleveraging, credit expansion will be significantly curtailed in Poland. While – much like in other countries – some sort of credit crunch is indeed likely to happen in Poland in 2009, possibly even 2010, we shall argue using the insights developed above that its fundamental reason will be related to capital and credit risk rather than liquidity per se. It hardly needs pointing out that a proper understanding of the underlying nature of the problem is crucial for effectively remedying it. Hence, in what follows we shall very briefly review the impact that the fall of Lehman Brothers has had on the Polish banking system, show how some of the suggested remedies are likely to be ineffective as they fall prey to the exogenous money fallacy, and finally discuss what in our view could be a real constraint on credit expansion.

It is beyond the scope of this paper to analyze in detail the causes and consequences of the global financial crisis. Suffice it to say, however, that the bankruptcy of Lehman Brothers – at the time of its fall the fourth largest investment bank in the United States – in combination with the deteriorating American housing market and persisting problems with valuating many exotic financial assets that were on financial institutions’ balance sheets, raised counterparty risk and hence also the price of liquidity.

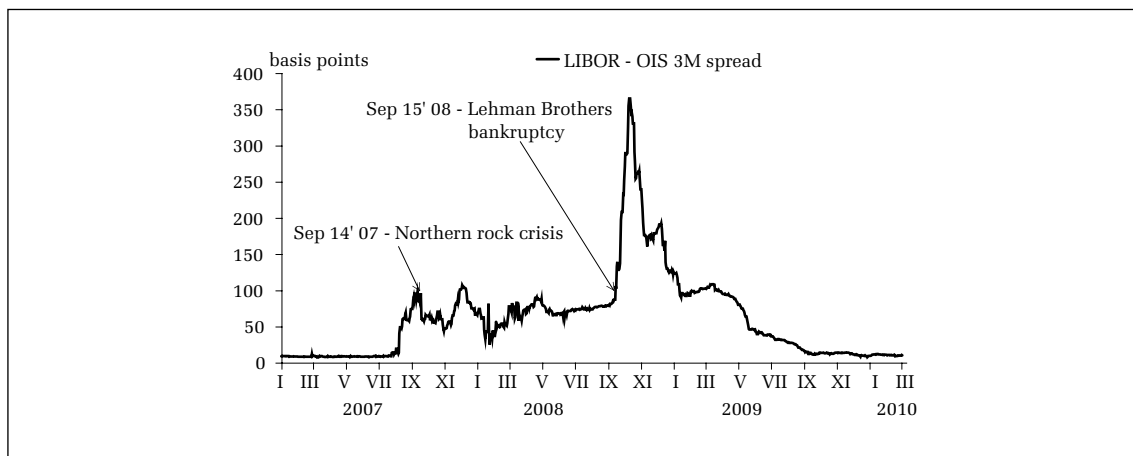
Figure 8  
5-year credit default swap spreads on financial institutions’ debt



Source: based on Bloomberg data.

Figure 9

The differential between US dollar 3-month Libor rate and 3-month overnight indexed swap rate OIS



Source: based on Bloomberg data.

Figures 8 and 9 illustrate the two effects. Figure 8 shows credit default swap spreads for the largest American banks.<sup>33</sup> The clearly visible spike in CDS spreads in mid-September means that the cost of insuring USD 1 million bonds issued by, say, Morgan Stanley jumped to 1,400 basis points times USD 1 million, or USD 140,000, from just above USD 10,000 per year in September'07, indicating that the market's assessment of probability that Morgan Stanley will go bankrupt rose to 14%.

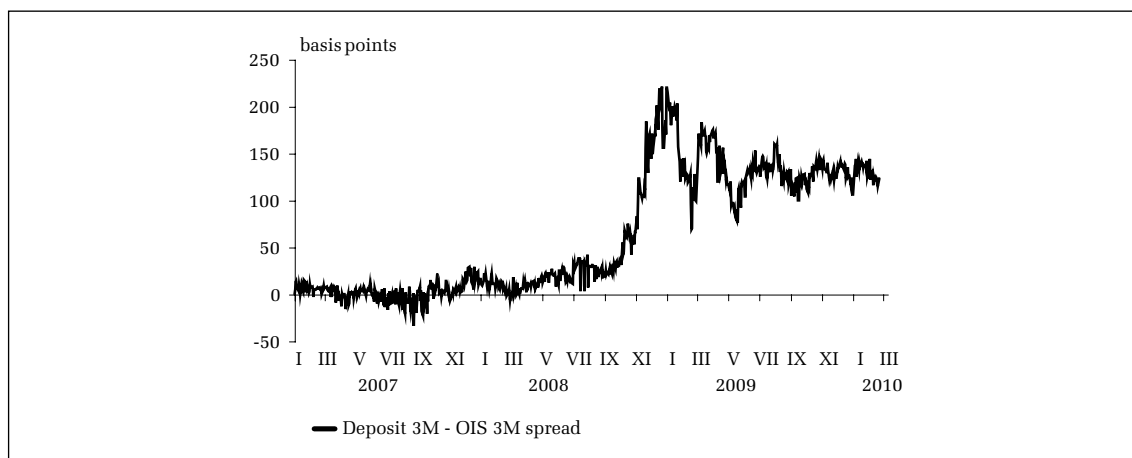
Figure 9 plots the difference between the three-month LIBOR (London Interbank Offered Rate), i.e. the cost of an uncollateralized three-month loan in the wholesale money market, and the overnight indexed swap rate, essentially the average of overnight rates expected over the next three months.<sup>34</sup> The LIBOR-OIS spread indicates what part of the rise in the LIBOR is due to credit and liquidity risk. Hence, even without knowing exactly what level the interbank rates stood at following the collapse of Lehman Brothers, we learn from Figure 9 that borrowing longer-term became much more expensive than short-term, pointing to a significant impairment of money markets.

<sup>33</sup> Briefly, a credit default swap (CDS) is a derivative instrument which allows a buyer to insure against the credit default risk of the underlying instrument (e.g. corporate or sovereign bonds): the buyer makes periodic payments to the seller and the latter is obligated to pay the buyer for the loss should the underlying instrument default in the duration of the contract. Since the price of the CDS is quoted in basis points over the notional value of insured bonds, it can be thought of as the market's assessment of the probability of default of the issuer (though, strictly speaking, the derivation of probability of default from CDS prices is not trivial and depends i.a. on the structure of the contract).

<sup>34</sup> Technically, an overnight indexed swap is a transaction whereby the parties exchange fixed for variable interest rates. If two banks enter into an OIS, then one is entitled to receive a fixed interest rate on some agreed upon notional amount (the OIS rate), but in exchange it will have to pay to the counterparty a compound interest payment on the same notional amount determined by the overnight rate over the horizon of the swap agreement. The contract involves no initial cash flows, only a transfer of the difference between the predetermined OIS rate and the average of overnight rates over the 3-month period. Hence, the OIS rate involves little counterparty risk and can be thought of as the good approximation of the path of overnight rates over the maturity of the swap.

Figure 10

The spread between 3-month interbank deposit rate and a 3-month OIS rate



Source: based on Reuters data.

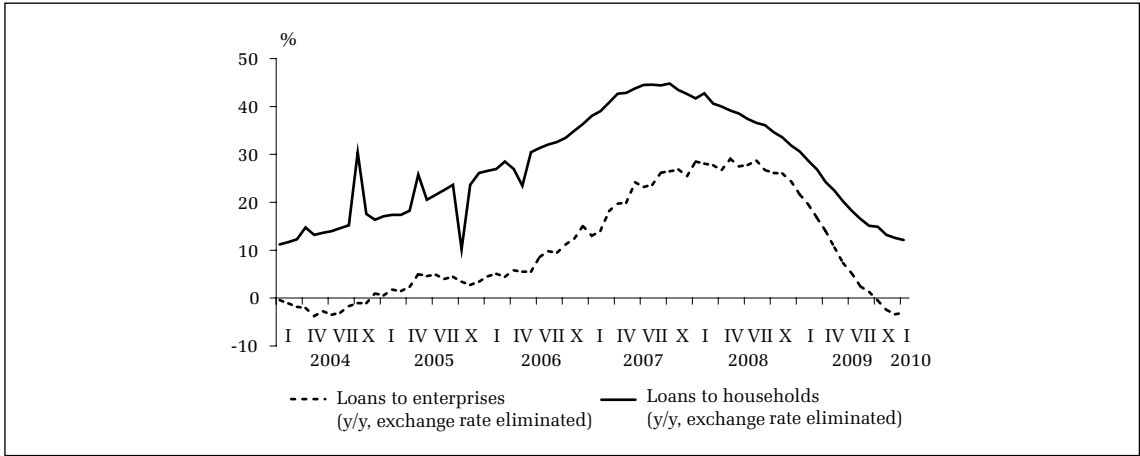
These developments seem to have affected the Polish banking sector – otherwise healthy and only negligibly exposed to opaque financial products – via the two main channels of increased risk aversion and – related to that – a general tightening of money market conditions. Simply put, Polish banks began facing problems with refinancing, particularly in EUR and CHF in the global wholesale markets. Second, they have to some extent imported from the U.S. and the euro area the concern over counterparty risk and as a result medium- to longer-term lending has practically evaporated. Figure 10 shows a rough measure of the tensions in the Polish interbank market, as proxied by the spread between the rate on 3-month interbank deposits and the OIS rate.

The reason why monetary authorities tend to be concerned about frictions in the financial markets is that these frictions are quickly transmitted to the real sector and can potentially be a source of macroeconomic instability. As Friedman (1968, p. 173) famously pointed out, money is so pervasive an economic machine, that “when it gets out of order, it throws a monkey wrench into the operation of all the other machines.”<sup>35</sup> When banks stop lending to each other, the monetary transmission mechanism gets clotted, as the decline in the flow of credit quickly affects the nonbank sector. Without the means of financing its working capital, the corporate sector is likely to cut back on the production capacity, which in turn is likely to lead to a fall in the aggregate demand, with the obvious result of widening the output and unemployment gaps, and potentially also eroding banks’ assets by increasing the ratio of non-performing loans, thus perpetuating the slowdown.

Aware of the risks associated with such a self-reinforcing mechanism, the NBP acted early in October by introducing its “confidence package,” i.e. a set of measures – including longer-term liquidity providing repos, FX swaps and a broadened range of collateral accepted in the open market operations – to stabilize and improve the functioning of the financial market. Though the

<sup>35</sup> Incidentally, these remarks were part of Friedman’s argument in favor of strict money supply control by the central bank – a viewpoint that has been discussed in Section 1.

Figure 11  
Growth of credit to the nonfinancial private sector

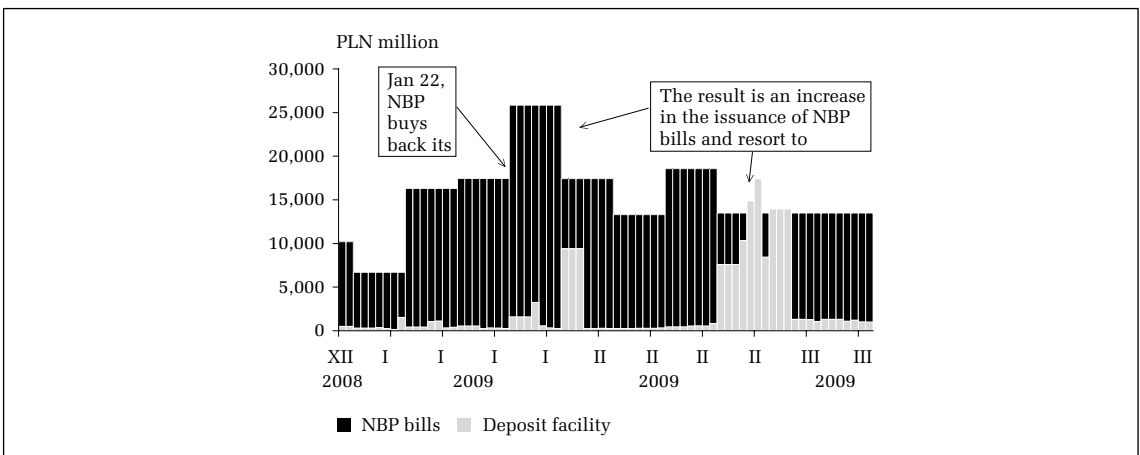


Source: based on NBP data.

tension in the interbank market can indeed be said to have declined somewhat as a result of the NBP's actions (as evidenced, e.g., by the decrease in the spread between the 3-month interbank rate and the policy rate from over 80 basis points in September 2008 to just above 40 basis points in February 2009), the slowdown of credit does seem to persist and even increase in magnitude.

Figure 11 illustrates the declining trend in the growth of bank lending. Though the year-on-year change in the zloty value of credit outstanding had actually been increasing until February'09 (reaching 35% that month, which was 10 percentage points higher than in mid-2008), this increase was almost solely due to the depreciation of the zloty – as evidenced by the fact that the

Figure 12  
The amount of NBP bills outstanding and the funds deposited with the NBP as end-of-day deposits



Source: based on NBP data.

rate of growth is actually declining when changes in the exchange rate are accounted for (since a considerable share of loans are denominated in foreign currencies, when the zloty declines in value, the zloty-value of credit outstanding increases).

The dismal state of affairs has been of some concern to bankers themselves. Indeed, Pruski and Bielecki (2009) in their widely discussed article in the Polish edition of the *Wall Street Journal* estimate that the growth of credit outstanding will decline from PLN 145 billion in 2008 to just PLN 40 billion in 2009. The authors argue that the principal reason why banks have decided to cut back on lending is the lack of liquidity. Thus, they propose that the NBP tackle the situation by i.a. lowering the required reserve ratio from the current 3.5% to just 2% (with any 1 percentage point decrease freeing up, according to the authors’ calculations, PLN 6 billion that could be used for credit creation), and buying back the bonds it had issued in 2002, which are maturing in 2012.

We have already addressed the issue of decreasing the required reserve ratio in the preceding section and we have seen there that essentially the only channel via which such a step could prompt banks to extend more credit is by increasing their profits and thus allowing them to reduce their loan markups. The reason for being skeptical about this effect, is that – as we have estimated – banks profits would only increase by about PLN 15 million a year, the potential impact of which on the markups could only be negligible. Such logic is probably one of the reasons behind the NBP’s reluctance to change its operational framework and decrease the required reserve ratio thus far.<sup>36</sup>

Nevertheless, on January 22 the NBP bought back the bonds it had issued in 2002 (in a step to limit the banking system’s operational liquidity surplus), increasing the liquidity of the banking sector by roughly PLN 8 billion, in accordance with the postulates of Pruski and Bielecki (2009). Figure 12 clearly shows that the liquidity freed up by the repurchase of bonds immediately came back to the central bank in the form of increased demand for its seven-day bills, as the total amount of bills outstanding increased from PLN 17.5 billion on January 22 to PLN 25.8 billion on January 23. Figure 12 shows further that when the NBP decided to limit the amount of bills it supplies to commercial banks, the latter could initially find no better way of disposing of the surplus liquidity than by depositing it overnight with the central bank. Accordingly, in mid-February, the normally marginal resort to the deposit facility amounted to over PLN 10 billion, and the subsequent moderation in its use in March reflected banks’ growing appetite for government bills. As a money market dealer from one of the commercial banks told Reuters recently:

In my view, it cannot be hoped that a drastic curtailment of the issuance of NBP bills will lead to an increase in bank lending. As a result of the crisis of confidence, banks are only willing to hold their excess funds in the most liquid and safest instruments, i.a. government securities. Until mid-October’08 the NBP had also been curtailing the supply of its bills but it did not have any impact on the amount of new loans granted, since the demand for [NBP] bills is part of a short-term liquidity management policy, whereas granting loans is a long-term investment (Reuters 2009).

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<sup>36</sup> Admittedly, the surplus liquidity is spread asymmetrically over the banking system, i.e. some banks might actually have an operational deficit of liquid funds. While their situation might indeed improve as a result of the lowering of the required reserve ratio, it is unclear to what extent that would actually affect their lending policy, since they currently have the option of financing credit expansion to creditworthy borrowers at the going rate of interest *via* the NBP’s liquidity-providing OMOs under the so-called Confidence Package.

In the face of what has been argued above, the lack of a significant effect of the increased interbank liquidity on credit expansion should not come as a surprise. As Disyatat (2008) astutely observes in a recent paper, to the extent that central banks accommodate any extra demand for reserves to preserve interest rate stability – and as said, the NBP certainly adheres to this approach – the money supply is endogenous and there is no mechanical link between reserves and the supply of loanable funds. However, this does not mean that there is no relationship between the monetary policy stance and loan supply:

Given that central banks supply reserves endogenously, the existence of a bank lending channel [avenue *via* which central banks can directly affect the amount of loans and deposits in the economy – J.J.] in practice depends on whether changes in money market interest rates can have an independent effect on banks' loan supply. For example, an increase in interest rates may affect the economic outlook of banks and increase the perceived riskiness of loans leading to an inward shift in banks' loan supply function... To the extent that monetary policy has an independent impact on loan supply, it is likely to take place through the balance sheets effects and revisions of risk perceptions rather than through any mechanical link between stance of policy and quantity of deposits (Disyatat 2008, pp. 16–17).

Hence, a risk-taking channel of monetary transmission mechanism, as recently proposed by Borio and Zhu (2008), might perhaps offer a more enlightening perspective on the lending policy of Polish banks. Briefly, the focus should shift from simplistic aggregate liquidity considerations to banks' risk perception and risk tolerance, the current and expected levels of income and profits in the economy, as well as asset and collateral values, since those variables might potentially turn out to have a significant effect on lending. Interestingly, Benmelech and Bergman (2009) argue that in a world of asymmetric information, where firms cannot easily commit to repay their loans, it is collateral values that determine debt capacity levels. The authors show that a credit trap – i.e. a situation where any easing of monetary policy is ineffective since banks simply hoard the additional reserves created by the central bank – is actually an equilibrium outcome resulting from a drop in collateral values in the corporate sector. Liquidation values might initially fall as a result of an exogenous change (Holmström, Tirole 1997), e.g. in economic outlook, but are then endogenously depressed further due to the lack of credit.

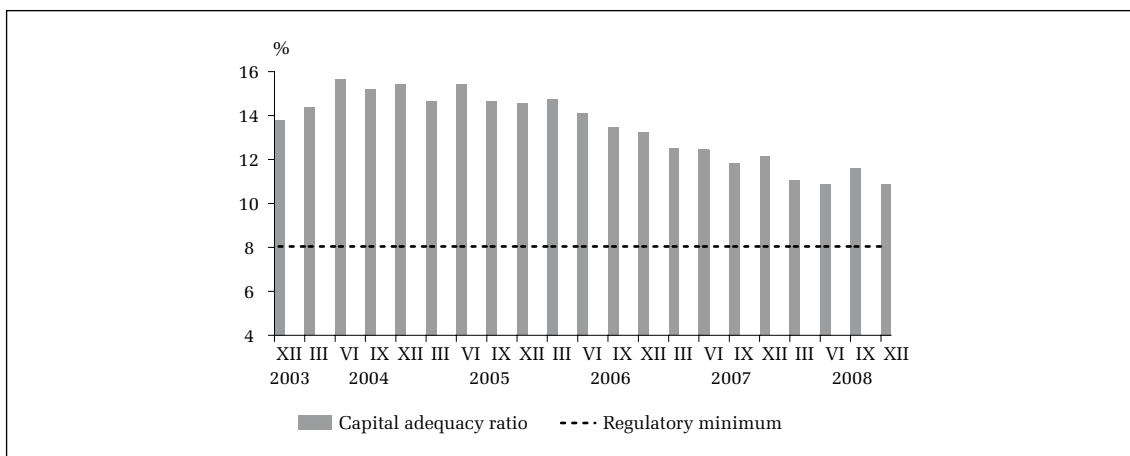
Another direct constraint on bank lending – which seems much more relevant in Poland than reserve requirements – is the amount of capital that it holds. As is well known, capital – common stock, reserves etc. – is the part of a bank's financing that does not have to be repaid, or has to be repaid only at some relatively distant point of time, and thus can serve as a buffer against losses in the sense that even if a part of a bank's assets need to be written off, this need not necessarily render it insolvent, since the value of its total assets might still exceed the value of total liabilities. Due to its critical importance in guaranteeing banks' safety, capital adequacy is tightly regulated and monitored by financial supervisors.<sup>37</sup> It is beyond the scope of this paper to describe in detail

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<sup>37</sup> Bhattacharya et al. (1998) argue that capital adequacy rules are a necessary constraint on banks' risk-taking and moral hazard created by deposit insurance schemes.



Figure 13  
Average capital adequacy ratio in the Polish banking sector

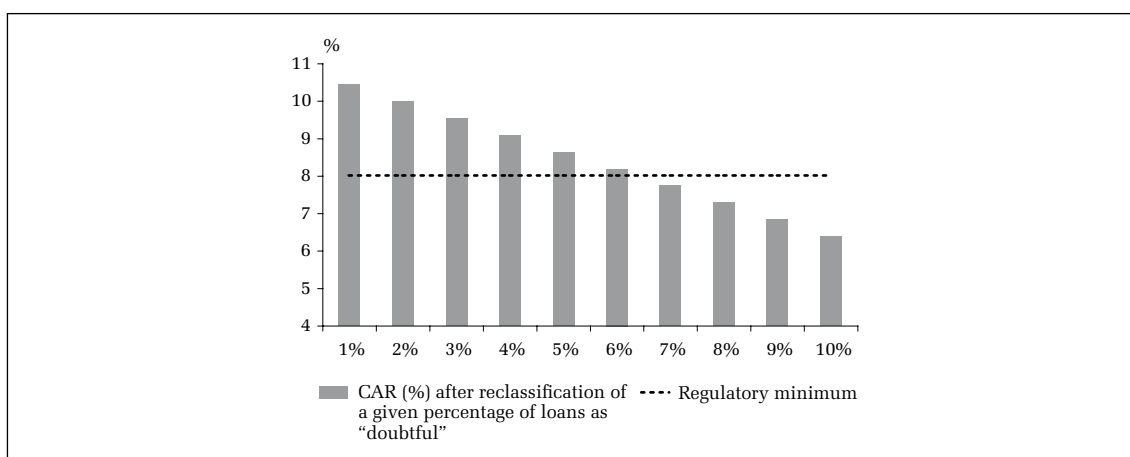


Source: based on NBP data.

the specifics of bank capital adequacy regulations, suffice it to say that within a broader set of international regulations, banks in Poland need to maintain the ratio of regulatory capital to the sum of capital requirements<sup>38</sup> multiplied by 12.5 at no less than 8%.

Figure 13 illustrates the evolution of the ratio over the past years. Even though the current level of 10.9% (December 2008) is still well above the regulatory minimum,<sup>39</sup> the declining trend may

Figure 14  
Changes to capital adequacy ratio resulting from a reclassification of a given percent of a bank’s loans from “standard” to “doubtful”



<sup>38</sup> Capital requirements are calculated separately for each class of risk: operational risk, credit risk etc.

<sup>39</sup> It should be noted that, the capital ratio mentioned above is just an average for the whole banking sector, which means that some banks might be in a better condition and some in worse. In particular, it may be of some concern that several large banks (Kredyt Bank, Nordea and Invest Bank) have ratios below 9%.

be of some concern, particularly as the deteriorating macroeconomic environment may increase the amount of nonperforming loans on banks' balance sheets and force some asset write-downs. Declines in the value of a bank's assets, absent any correction of liabilities, wipe out a fraction of its capital. Since obtaining new capital tends to be costly, especially so with generally falling stocks and a deteriorating economic outlook, banks might choose to improve their capital ratios by limiting the expansion of balance sheets, i.e. by cutting back on lending. This conclusion finds some support in the recent survey of loan officers conducted by the NBP (2009), according to which 75% of banks considered their current or expected capital position as a factor contributing to the observed tightening of lending policy (cf. Figure 11). To gain some perspective on banks' loan loss absorption capacity, and thus the relative strength of the constraint on their lending, consider a very simple "stress test".

Polish regulators insist that banks classify their loans into one of the five risk categories: satisfactory, special mention, substandard, doubtful or loss. The latter three are considered irregular loans and are subject to special provisioning requirements designed to disclose expected losses which equal 20%, 50% and 100% of the initial value of the loans respectively. Thus, a reclassification of a loan from, say, standard to doubtful, entails marking down its value by 50% and absorbs the corresponding amount of a bank's profits. Figure 14 plots the results of a simple arithmetic exercise illustrating the changes to the capital adequacy ratio (CAR) resulting from a given impairment of its loans.<sup>40</sup> During the slowdown of 2001–2002, when GDP growth fell to just 1.2%, roughly 4% of the total amount of loans were reclassified as irregular. Such a change in banks' loan portfolio in 2009 would *ceteris paribus* bring the average capital adequacy ratio in the banking sector to 9%, possibly pushing some banks below the regulatory threshold. This provides a simple illustration that the capital constraint is of critical importance in analyzing bank lending policy.

We have argued above that money in Poland is endogenous and we have run a simple econometric exercise to show that aggregate liquidity of the banking sector is not a causal determinant of credit expansion. This conclusion should be contrasted with the recent practice of some of the leading central banks – most notably the Fed and the Bank of England – which have begun to pursue a policy of quantitative easing. Though the specifics vary, the policies adopted have certainly one thing in common: they focus on the expansion of the central bank's balance sheet by increasing the supply of central bank money in the economy through outright purchases of government bonds and other high quality securities. The monetary authorities hope that these operations will help improve the flow of credit, raise private sector spending and thus boost the nominal income. To the extent that assets are purchased from the non-bank private sector, the supply of broad money (deposits) and monetary base (bank reserves) is certainly likely to increase, but it need not mechanically lead to an increase in credit expansion. Indeed, as a former Morgan Stanley economist and newly appointed member of the MPC at the Bank of England stresses,

(...) we cannot have a lot of faith that quantitative easing will directly boost lending. The money generated from quantitative easing may plausibly remain within the non-bank financial sector (who are large holders of gilts that the Bank of England will want to

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<sup>40</sup> The following assumptions are made for the purpose of the simulation: (1) regulatory capital consists only of core capital (PLN 73 billion as of December'08); (2) charges to impairment provisions fully decrease a bank's regulatory capital; (3) impaired loans carry a 100% risk weight.

purchase) and the banks... Banks could just hoard the money in Bank of England reserves, earning the current policy rate (or, potentially in the Bank of England's operational standing deposit facility earning the policy rate minus 25 bp). There is already evidence that the operational standing deposit facility has been used substantially in recent months (Miles, Baker 2009).

San Francisco Fed president also makes a point that in a time of widespread uncertainty and low interest rates, “government securities and cash are almost perfect substitutes – both are essentially riskless assets that yield a zero or near-zero rate of return; thus, exchanging one for the other should have little effect on banks’ desire to lend” (Yellen, 2009). Similarly, Bernanke (2009) notes that the easing is most likely to work via asset price and credit spreads effects by reducing funding costs of households and the corporate sector. Hence, while it can be argued that once the central bank pushes its policy rate to near-zero territory and refocuses on directly increasing money in the economy and improving the liquidity of commercial banks’ balance sheets, lending could be to some extent exogenously stimulated, nevertheless even in such dire circumstances credit expansion remains to a large extent driven endogenously by the demand for loans, creditworthiness of borrowers and bank’s own profitability. As such, therefore, the most recent change in policy of some central banks does not seem to invalidate the conclusions regarding the endogeneity of money and credit in Poland that we have reached above.

#### **4. Conclusions**

The purpose of this thesis was to add to the investigation of the money-supply process in modern economies. The central problem addressed was whether the multiplier model of the money-supply process, understood as a setup where broad money is exogenous, determined causally and mechanistically by the monetary base, can be a good approximation of reality. In the first step, the historical evolution of the Western financial system was analyzed from the perspective of the money supply process, which concluded that though the exogenous money hypothesis, incorporated in the money multiplier model, constitutes a largely accurate description of the financial system up to the first half of the twentieth century, modern institutional conditions, as well as the monetary policy framework currently in operation, are much better understood from the perspective of a bank-centric, endogenous money view. In the second step, the focus shifted to the monetary policy implementation framework of the National Bank of Poland and the nature of the money supply process in Poland. An econometric model was devised to test the main prediction of the multiplier model that an increase in monetary base automatically leads to the creation of broad money and credit. Causality test results show that the degree of the banking system’s liquidity did not Granger-cause credit expansion in the decade 1998–2008. That said, it should be stressed that the empirical results obtained are drawn from highly aggregated data and thus should be treated with due caution. Specifically, it is unclear to what extent the results are distorted by the asymmetric distribution of liquidity (NBP bills) in the banking system. A noteworthy development of the ideas presented thus far would consist in investigating – for example with the use of a panel regression – the determinants of bank lending revealed from disaggregated data.

It seems that the result obtained, though still preliminary, do strengthen the argumentation that money supply is endogenous in Poland and provide new ground for analyzing the challenges for monetary policy under the current credit crunch. With several leading central banks moving on to unconventional methods of directly impacting the supply of money and credit in the economy it seems particularly interesting to what extent monetary expansion can be spurred by supplying banks with additional reserves. A conclusion that follows from money endogeneity is that the reasons for the decline in credit expansion should be sought primarily in the real economy and the extent to which credit risk and asset write-downs weigh on banks' capital position, not in the amount of cash reserves immediately available to banks.

## References

- Bagehot W. (1999 [1873]), *Lombard Street – A Description of the Money Market*, Wiley, New York.
- Bernanke B. (2009), *The Crisis and the Policy Response*, <https://www.federalreserve.gov/newsevents/speech/bernanke20090113a.htm>.
- Bhattacharya S., Boot A.W.A., Thakor A.V. (1998), The Economics of Bank Regulation, *Journal of Money, Credit and Banking*, Vol. 30, No. 4, 745-770.
- Bindseil U. (2004), *Monetary Policy Implementation. Theory, Past, and Present*, Oxford University Press, New York.
- Bisschop W.R. (2001 [1896]), *The Rise of the London Money Market*, Batoche Books, Kitchener, Ontario.
- Bofinger P. (2001), *Monetary Policy. Goals, Institutions, Strategies, and Instruments*, Oxford University Press, Oxford.
- Borio C., Zhu H. (2008), *Capital regulation, risk taking and monetary policy: a missing link in the transmission mechanism?*, Working Paper, 268, BIS, Basel.
- Borowski J., Kot A., Rozkrut M., Szpunar P. (2005), *Kreacja kredytu we współczesnym systemie bankowym*, unpublished manuscript.
- Brunner K. (1961), A Schema for the Supply Theory of Money, *International Economic Review*, January, 79–109.
- Brunner K., Meltzer A.H. (1964), Some Further Investigations of Demand and Supply Functions of Money, *Journal of Finance*, May, 240–283.
- Burgess W.R. (1946), *The Reserve banks and the money market*, Harper and Brothers Publishers, New York and London.
- Caprio G., Dooley M., Leipziger D., Walsh C. (1996), The Lender of Last Resort Under a Currency Board. The Case of Argentina, *Open Economies Review*, 7, Supplement 1, 625–650.
- Cassel G. (1928), The Rate of Interest, the Bank Rate, and the Stabilization of Prices, *The Quarterly Journal of Economics*, 42 (4), 511–529.
- Chick V. (1986), The evolution of the banking system and the theory of saving, investment and interest, *Economies et societes*, 111–126 [Reprinted in: M. Musella, C. Panico, eds. (1995), *The Money Supply in the Economic Process: A Post Keynesian Perspective*, The International Library of Critical Writings in Economics, Edward Elgar, Aldershot].
- Chick V. (1993), The Evolution of the Banking System and the Theory of Monetary Policy, in: S.F. Frowen (ed.), *Monetary Theory and Monetary Policy: New Tracks for the 1990s*, Macmillan, London.

- De Roover R. (1942), Money, Banking, and Credit in Medieval Bruges, *The Journal of Economic History* (2), Supplement: The Tasks of Economic History, 52–65.
- De Roover R. (1944), What is Dry Exchange, *Journal of Political Economy* 52 (3), 250–266.
- De Roover R. (1954), New Interpretations of the History of Banking, *Journal of World History* (2), 38–76.
- De Soto J.H. (2006), *Money, Bank Credit, and Economic Cycles*, Ludwig von Mises Institute, Auburn, AL.
- Diebold F.X. (2001), *Elements of Forecasting*, South Western Publishing, Cincinnati.
- Disyatat P. (2008), *Monetary policy implementation: Misconceptions and their consequences*, Working Paper, 269, BIS, Basel.
- Foot M.D.K.W., Goodhart C., Hotson A.C. (1979), Monetary base control, *Bank of England Quarterly Bulletin*, 19 (2), 149–159.
- Friedman M. (1968), The Role of Monetary Policy, in: B. Snowdon, H.R. Vane, eds. (1997), *A Macroeconomic Reader*, Routledge, London.
- Gambacorta L., Mistruli P.E. (2004), Does bank capital affect lending behavior?, *Journal of Financial Intermediation*, 13 (4), 436–457.
- Goodfriend M., Hargraves M. (1987), A Historical Assessment of the Rationales and Functions of Reserve Requirements, in: M. Goodfriend (ed.), *Monetary Policy in Practice*, Federal Reserve Bank of Richmond.
- Goodhart C. (1987), What do Central Banks Do?, in: C. Goodhart, (1995), *The Central Bank and the Financial System*, Macmillan, London, 205–215.
- Goodhart C. (1989), The Conduct of Monetary Policy, *The Economic Journal*, 99, 293–346.
- Goodhart C. (1994), What Should Central Banks Do? What Should Be Their Macroeconomic Objectives and Operations?, *The Economic Journal*, 104, 1424–1436.
- Goodhart C. (1995), Money Supply Control: Base or Interest Rates?, in: C. Goodhart (ed.), *The Central Bank and the Financial System*, Macmillan, London, 249–262.
- Goodhart C. (2001), The Endogeneity of Money, in: P. Arestis, M. Desai, S. Dow (eds.), *Money, Macroeconomics and Keynes, Essays in Honour of Victoria Chick*, 1.
- Gorton G. (1985), Clearinghouses and the Origin of Central Banking in the United States, *The Journal of Economic History*, 45 (2), 277–283.
- Hall M.W. (1935), Early Bankers in the Genoese Notarial Records, *Economic History Review*, 6 (1), 73–79.
- Hamilton J.D. (1996), The Daily Market for Federal Funds, *Journal of Political Economy*, 104, 26–56.
- Hanke S.H., Schuler K. (1991), *Currency Boards For Eastern Europe*, The Heritage Lecture, 355, [http://www.heritage.org/Research/Europe/upload/92206\\_1.pdf](http://www.heritage.org/Research/Europe/upload/92206_1.pdf).
- Heffernan S. (2005), *Modern Banking*, John Wiley and Sons, Chichester.
- Hicks J.R. (1967), Monetary Theory and History – An Attempt at Perspective, in: J.R. Hicks, *Critical Essays in Monetary Theory*, Oxford, The Clarendon Press.
- Holmes A.R. (1969), Operational Constraints on the Stabilization of Money Supply Growth, in: Federal Reserve Bank of Boston, *Controlling Monetary Aggregates*, Boston.
- Holmström B., Tirole J. (1997), Financial Intermediation, Loanable Funds, and the Real Sector, *Quarterly Journal of Economics*, 112 (3), 663–691.
- Howells P. (2001), The endogeneity of money, in: P. Arestis, M. Sawyer (eds.) *Money, Finance and Capitalist Development*, Edward Elgar, Cheltenham.

- Kohn M. (1999a), *Early Deposit Banking*, Working Paper, 99-03, Dartmouth College, Department of Economics.
- Kohn M. (1999b), *Bills of Exchange and the Money Market to 1600*, Working Paper, 99-04, Dartmouth College, Department of Economics.
- Kot A., Rozkrut M. (2004), Od stereotypów do praktycznych aspektów prowadzenia współczesnej polityki pieniężnej, *Bank i Kredyt*, 3, 37–48.
- Mankiw N.G. (2007), *Macroeconomics*, New York, Worth Publishers.
- Meulendyke A.-M. (1988), Can the Federal Reserve influence whether the money supply is endogenous?, *Journal of Post Keynesian Economics*, X (3), 390–397.
- Meulendyke, A.-M. (1993), Federal Reserve Tools in the Monetary Policy Process, in: M. Goodfriend, D.H. Small (eds.), *Operating Procedures and the Conduct of Monetary Policy: Conference Proceedings*, Federal Reserve Board, Washington D.C.
- Miles D.K., Baker M. (2009), *Quantitative Easing: What It is and How it Might Work*, Morgan Stanley (March 5).
- Mishkin F.S. (2004), *The economics of money, banking, and financial markets*, Addison-Wesley, Reading M.A.
- Moore B. (1988), *Horizontalists and Verticalists*, Oxford University Press.
- Moore B.J. (1989), The endogeneity of credit money, *Review of Political Economy*, 1 (1), 65–93.
- Moore B.J. (2006), *Shaking the Invisible Hand*, Palgrave Macmillan, New York.
- Munn C.W. (1981), *The Scottish Provincial Banking Companies 1747–1864*, John Donald, Edinburgh.
- Munro J.H. (1994), Patterns of Trade, Money, and Credit, in: T.A. Brady, H.A. Oberman, J.D. Tracy (eds.), *Handbook of European History, 1400–1600: Late Middle Ages, Renaissance, and Reformation*, BRILL, New York, 147–196.
- NBP (2001), *Monetary Policy Guidelines For the Year 2001*, www.nbp.pl.
- NBP (2007), *Monetary Policy Guidelines For the Year 2008*, www.nbp.pl.
- NBP (2009), *Senior loan officer opinion survey on bank lending practices and credit conditions, 1st quarter 2009*, [http://www.nbp.pl/en/SystemFinansowy/kredytowy1\\_2009\\_en.pdf](http://www.nbp.pl/en/SystemFinansowy/kredytowy1_2009_en.pdf).
- Niggle C.J. (1990), The Evolution of Money, Financial Institutions, and Monetary Economics, *Journal of Economic Issues*, XXIV (2), 443–450.
- Phillips C.A. (1931 [1920]), *Bank Credit*, Macmillan, New York.
- Polański Z. (1998), *Polityka pieniężna w Polsce w drugiej połowie lat 90.: bieżące problemy i strategiczne wyzwania*, Materiały i Studia, 72, Narodowy Bank Polski, Warszawa.
- Pruski J., Bielecki J.K. (2009), Skąd wziąć pieniądze na kredyty, *The Wall Street Journal Polska*, 6 January (Tuesday).
- Reuters (2009), *NBP zmniejszył podaż bonów pieniężnych do 12 mld zł*, 3 April, 16:10.
- Rothbard M.N. (1983), *The Mystery of Banking*, Richardson and Snyder, New York.
- Rothbard M.N. (1995), *Economic Thought Before Adam Smith*, Vol. I, Edward Elgar, Cheltenham.
- Rothbard, M.N. (2005), *What Has Government Done to Our Money*, Ludwig von Mises Institute, Auburn, AL.
- Sachs J. (1998), Alternative Approaches to Financial Crises in Emerging Economies, in: M. Kahler (ed.), *Capital Flows and Financial Crises*, Cornell University Press, Ithaca NY, 247–262.
- Schuler K. (1992), Free Banking in Canada, in: K. Dowd (ed.) *The Experience of Free Banking*, Routledge, London, 79–92.

- Selgin G., White L.H. (1985), The Evolution of a Free Banking System, Economic Research Reports, 85-38 (November), Department of Economics, New York University, New York.
- Selgin G., White L.H. (1994), How Would the Invisible Hand Handle the Money, *Journal of Economic Literature*, XXXII, 1718–1749.
- Smith V.C. (1990 [1936]), *The Rationale of Central Banking and the Free Banking Alternative*, Liberty Fund, Indianapolis, In.
- Snowdon B., Vane H.R. (2005), *Modern Macroeconomics*, Edward Elgar, Cheltenham.
- Spufford P. (1986), *Handbook of Medieval Exchange*, Royal History Society, London.
- Tobin J. (1963), Commercial Banks as Creators of “Money”, in: D. Carson (ed.), *Banking and Monetary Studies*, Richard Irwin Inc., Chicago, Ill.
- Usher A.P. (1934), The Origins of Banking: The primitive banks of deposit 1200–1600, *Economic History Review*, 399–428.
- Usher A.P. (1943), *The Early History of Deposit Banking in Mediterranean Europe*, Harvard University Press, Cambridge, M.A.
- Van der We H. (1977), Monetary Credit and Banking System, in: E.E. Rich, C.H. Wilson (eds.) *The Cambridge Economic History of Europe*, Vol. 5, Cambridge University Press, New York, 290-392.
- Von Hagen J. (1999), Money growth targeting by the Bundesbank, *Journal of Monetary Economics*, 43, 681–701.
- Wigmore B. (1987), Was the Banking Holiday of 1933 a run on the dollar rather than the banks?, *Journal of Economic History*, 47, 739–756.
- Woodford M. (2001), Monetary Policy in the Information Economy, in: *Economic Policy for the Information Economy*, Federal Reserve Bank of Kansas City.
- Woodford M. (2003), *Interest and Prices: Foundations of a Theory of Monetary Policy*, Princeton University Press.
- Yeager L.B. (1997), *The Fluttering Veil. Essays on Monetary Disequilibrium*, Liberty Fund, Indianapolis, In.
- Yellen J. (2009), U.S. Monetary Policy Objectives in the Short and Long Run, *FRBSF Economic Letter* (January), 1–5.
- Zatorski P. (2005), Kształtowanie i realizacja polityki pieniężnej w warunkach zmiany w polskim systemie bankowym, *Bank i Kredyt*, 10.

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