Bank credit

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Abstract

The monetary multiplier allows to increment the money in circolation by using more and more banks: we want to show that it is possibile even by a single bank and that the entire banking system has a limit that is virtually infinite.

1 Bank credit

Introduction

We want to show as the banks (EVEN A SINGLE ONE) can borrow more of what they received, therefore creating money from nothing.

With the term *banking system* we point to **all** the banks, they are imagined as all part of a big **aggregate** "**BANK**"; the whole constituted by all the entities bank moves as a macro-bank.

A monetary institution to lend has to deposit in its own account at the central bank a tiny amount (today is 2%) of what is lent (see ECB/1745/2003 on the EU website), this quantity is called "*minimum reserve*" (r_m).

Actually the reserve r is composed by the sum of two terms: the *free reserve* (r_f), what is statically withdrawn in cash, and the *minimum reserve* (r_m) which is mandatory to lend; so $r = r_m + r_f$. Summarizing the rules say that the bank can lend t after it has deposited $t \cdot r_m$ in the central bank. The value r_f is set independently by every single bank, usually a figure between 9% and 11%. Therefore, before lending an institution has to set aside with free reserve and minimum reserve a figure of about 12% of what it is going to lend.

A financial institution never lends using cash but only giving the availability of the sums. This amount can be cashed by somebody who has not borrewed anything, such an example a loan can be used for a wire transfer, remaining in electronic money and never becoming anything but computer bits.

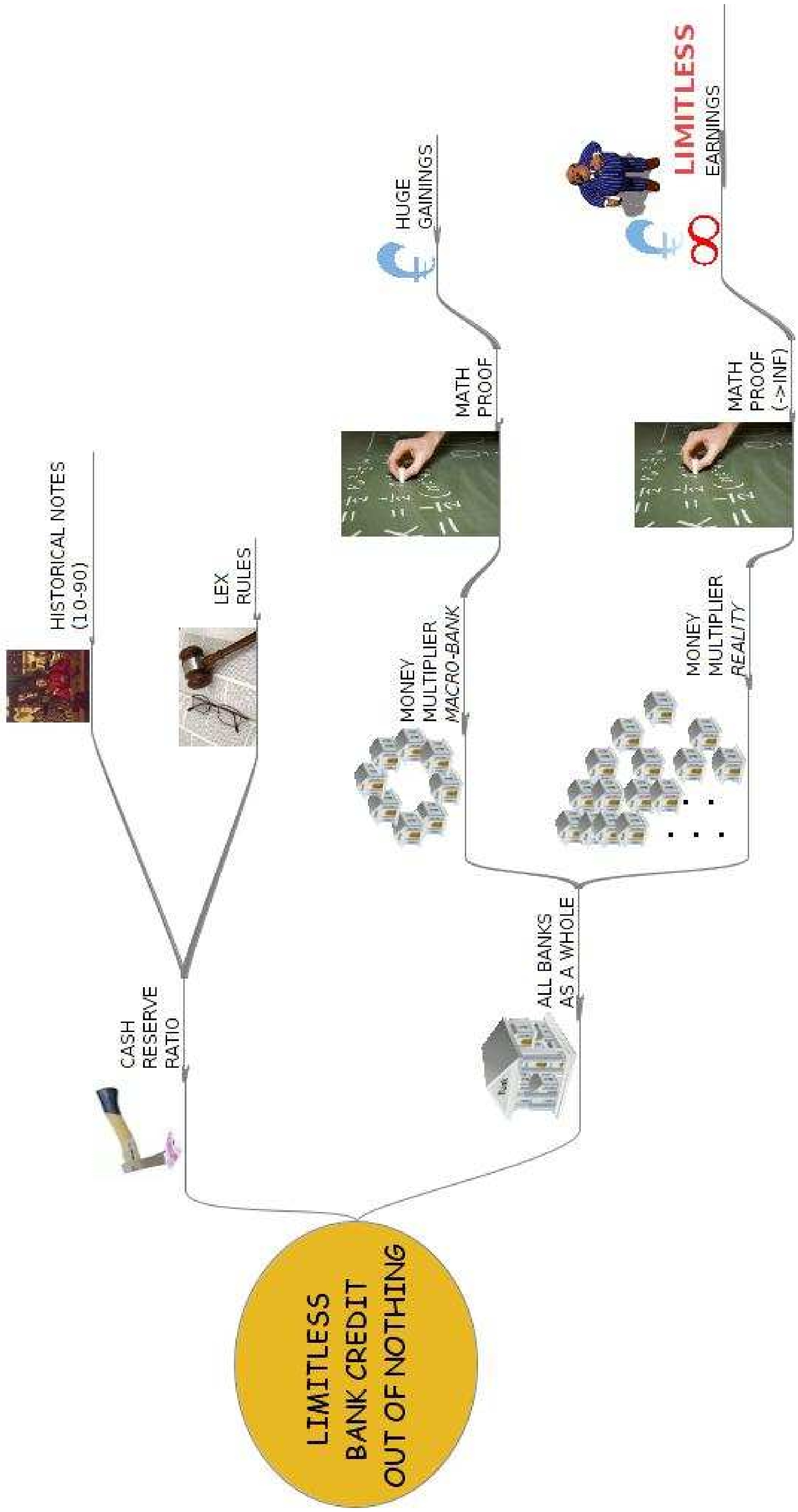

Figure 1: Mental map of this document

1.1 Single bank

We assume that a person can borrow only from one bank in other words that exists just one institution then can lend (recalling the well-know case of the monetary multiplier but just a single bank).

A capital sum of c, in cash, has been deposited in the bank.

The bank keeps as reserve $c \cdot r$ and "lends" (writes on an account) the remaining $c(1-r)$.

activity	reserve	loan	asset
deposit	0	-	c
loan 1	$c \cdot r$	$c(1-r)$	$c(1-r)$
loan 2	$c(1-r) \cdot r_m$	$c(1-r)(1-r_m)$	$c(1-r)(1-r_m)$
loan 3	$c(1-r) \cdot r_m^2$	$c(1-r)(1-r_m)^2$	$c(1-r)(1-r_m)^2$
loan $c(1-r) \cdot r_m^3$	$c(1-r)(1-r_m)^3$	$c(1-r)(1-r_m)^3$	
$\cdots$	$\cdots$	$\cdots$	$\cdots$
loan i	$c(1-r) \cdot r_m^{i-1}$	$c(1-r)(1-r_m)^{i-1}$	$c(1-r)(1-r_m)^{i-1}$
$\cdots$	$\cdots$	$\cdots$	$\cdots$
loan $i \to \infty$	c	0	0

The bank put aside in reserve another $c(1-r)r_m$ and "lend" again $[c(1-r)](1-r_m) = c(1-r)(1-r_m)$; at this point $(c - cr - c(1-r)r_m)$ are still available in cash, then the bank put aside also $c(1-r)r_m^2$ and another loan for $c(1-r)(1-r_m)^2$ can be emitted ... and so on until the initial cash amount deposited c is over.

Before that the sum c deposited is over, with n of these "loans" a quantity S_n that we are going to calculate is lent.

$$S_n = c(1-r) + c(1-r)(1-r_m) + c(1-r)(1-r_m)^2 + c(1-r)(1-r_m)^3 + \cdots$$

With an infinity number of steps (not a real case but a necessary assuption for a mathematics analysis), to what approches S_n, the sum of the lended money? Mathematically

$$\begin{aligned}
S &= \lim_{n\to\infty} S_n && (1)\\
&= \lim_{n\to\infty} \sum_{i=0}^{n} c(1-r)(1-r_m)^i && (2)\\
&= c(1-r)(\sum_{i=0}^{\infty} q^i) - && (3)\\
&= c(1-r)\frac{1}{1-q} && (4)\\
&= c(1-r)\frac{1}{1-(1-r_m)} && (5)\\
&= \frac{c(1-r)}{r_m} && (6)
\end{aligned}$$

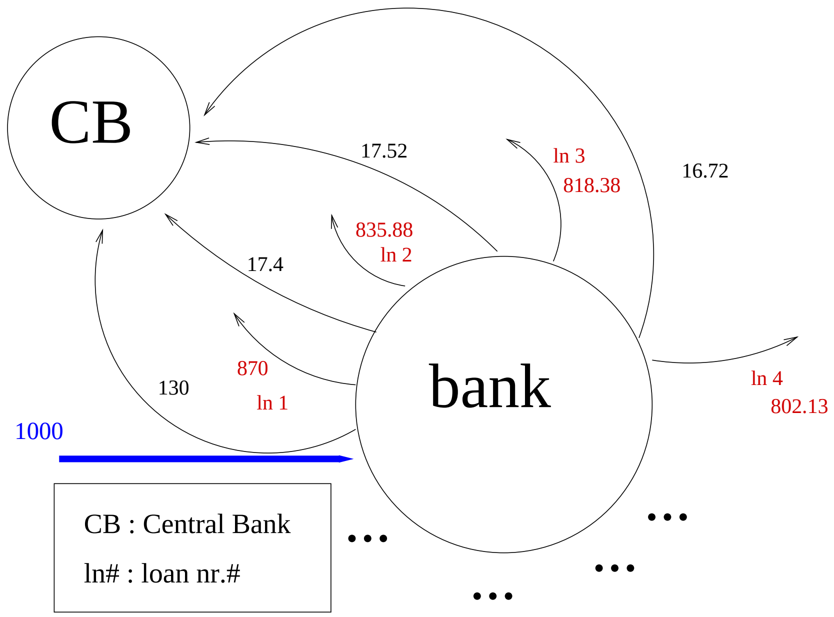

Figure 2: Flow of the loans for a single bank

Let

$$q = 1 - r_m \tag{7}$$

When

$$q < 1 \Rightarrow (1 - r_m) < 1 \Rightarrow 1 - r_m < 1 \Rightarrow -r_m < 0 \Rightarrow r_m > 0 \tag{8}$$

and

$$q > 0 \Rightarrow (1 - r_m) > 0 \Rightarrow 1 - r_m > 0 \Rightarrow -r_m > -1 \Rightarrow r_m < 1 \tag{9}$$

that is

$$0 < r_m < 1 \tag{10}$$

Threfore the sum lended S approaches $\frac{c(1-r)}{r_m}$, as the given series is reductable to an infinite geometric series of general term q whose result is $\frac{1}{1-q}$.

Such an example let $c = 1000$, $r = 13\%$, and $r_m = 2\%$, yields $S = \frac{870}{0{,}02} = 43500$

1.2 Banking system

Now we consider that Mr Smith, who borrowed a sum, spends it giving a check to Mr Young that runs to deposit it to his bank, that can be a bank different from the one of Mr Smith but still belonging to the "banking system".

Now, with the same rules of the previous case, both the banks, Mr Smith one ad Mr Young one, can lend. The only difference between the two banks is that only the former one had receveid a cash deposit; therefore only the first bank can use the cash that has been deposited to lend while all the others banks have to use the money they put aside in the past to give to the central bank the r_m's required to lend.[1]

A simple method to create founds for the loans is that the bank of Mr Young might had used was setting that on the first 500 cash deposits the free reserve r_f should be of 21% instead of 11%; in such a way in the immediate time it would had lended less but it would had put aside for the future, when it would had not receveing cash but just electronic money.

The first bank "lends" $c \cdot r$, as in the case of the single bank. Now in the second step, both the first bank and second one can "lend" $c\dot{(}1-r)^2$. In the third step, with same process four banks can "lend" $c\dot{(}1-r)^3$. In the following eight banks can "lend" $c\dot{(}1-r)^4$.. And so on.

loan #	resrve	loan
1	$c \cdot r$	$c(1-r)$
2	$2[c(1-r)] \cdot r$	$2[c(1-r)](1-r)$
3	$4c(1-r)^2 \cdot r$	$4[c(1-r)]^3$
4	$8c(1-r)^3 \cdot r$	$8[c(1-r)]^4$
...	...	...
i	$2^{i-1}[c(1-r)]^{i-1} \cdot r$	$2^i[c(1-r)]^i$
...	...	...

Mathematically the money "lended" is

$$\begin{aligned} S &= c(1-r) + 2 \cdot c(1-r)^2 + 4 \cdot c(1-r)^3 + 8 \cdot c(1-r)^4 + \cdots \\ &= c(1-r) + 2^1 \cdot c(1-r)^2 + 2^2 \cdot c(1-r)^3 + 2^3 \cdot c(1-r)^4 + \cdots \end{aligned}$$

that is, after n steps

$$S_n = c(1-r) + \sum_{i=1}^{n} 2^i \cdot c(1-r)^{i+1} \tag{11}$$

and with $n \to \infty$, S_n is

$$S = c(1-r) + \lim_{n\to\infty} \sum_{i=1}^{n} 2^i \cdot c(1-r)^{i+1}$$

that is

$$S = c(1-r) + \lim_{n\to\infty} \sum_{i=1}^{n} 2^i \cdot c(1-r)(1-r)^i \tag{12}$$

[1]The bank of Mr Smith can lend because it still has 870 in cash instead the bank of Mr Young has only electronic (virtual) money.

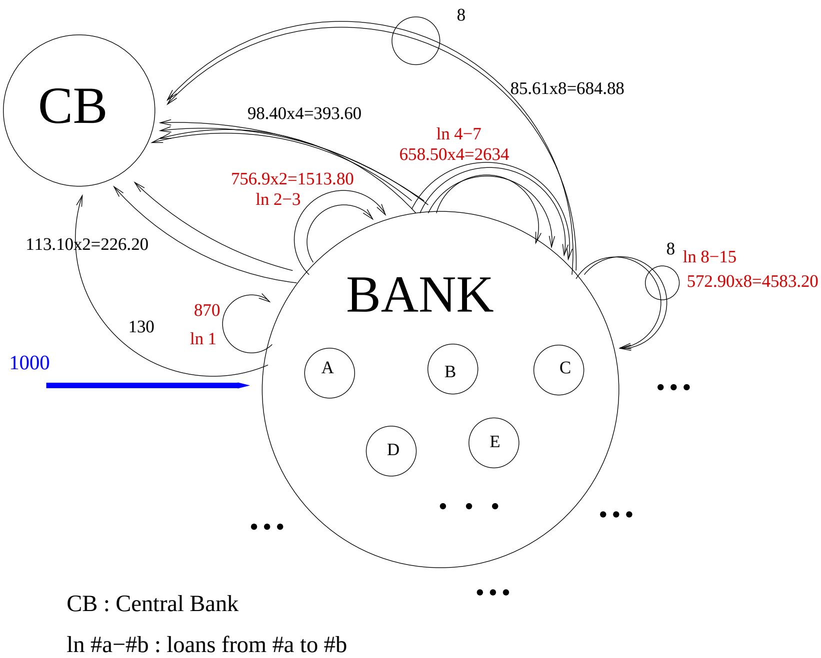

Figure 3: Flow of the loans for a banking system

This time the series **diverges**; that is the money that can be lended are limited just by the capacity of the banks to give the mandatory reserve in cash using the money thay put aside in the past.

So the banks can create money out of nothing for lendind as long as they have money to put as mandatory reserve in the central bank for those loans.

An example clarify the process. To adhere to law and to the eventual asks for cash withdrawing of the ones who borrow, the bank XYZ which wants to lend 10 000 000 to Mr Smith (that is just *writing* + 10 000 000 on the account Mr Smith) the bank has to have $x = 10\ 000\ 000 * r \rightarrow x = 10\ 000\ 000 * 0.13$, so have $x = 1\ 300\ 000$ in cash.

We can not solve the series mathematically, as it diverges, so we wrote a very simple simulation on the computer using in the Java language (results, stopping aftert 15 iterations, so we do not have to worry about machine limits).

From the simulation, limited to 15 iteration we have

i= 15 b= 65534 lend= 107.72 loans= 8 298 774.88

In 15 steps 8 298 774.88 have been lent, that is $8\ 298\ 774.88 - 1\ 000 = 8\ 297\ 774.88$ **are created**.

1.3 Ratio cash vs virtual-money

We have to introduce the concepts of **monetary aggregates**:

M0 In some countries, such as the United Kingdom, M0 includes bank reserves, so M0 is referred to as the monetary base, or narrow money.

M1 Bank reserves are not included in M1.

M2 represents money and "close substitutes" for money. M2 is a broader classification of money than M1. Economists use M2 when looking to quantify the amount of money in circulation and trying to explain different economic monetary conditions. M2 is a key economic indicator used to forecast inflation.

M3 Since 2006, M3 is no longer tracked by the US central bank.[this isn't an issue as we'll use ECB data] However, there are still estimates produced by various private institutions. (M2 +large deposits and other large, long-term deposits)

(Source wikipedia)

Hence $M3 - M0$ is the amount of non printed nor non conied money.

The European Central Bank gives these figures for the monetary aggregates (Billions of Euro):

M0 $629, 33$

M1 $3849, 18$

M2 $7439, 07$

M3 $8789, 49$

Values of January 2008, prior of the crisis.

$M3 - M0 = 8789, 49 - 629, 33 = 8160, 16$ billions of Euro

This yields a ratio of 7,71% of real money versus 92.29% air money.

The answer to the question "why the money created out of nothing in not infinite?", is simple: "because the real money is a limited quantity".

1.4 Conclusion

We proved a single bank can lend more of what has been deposited: *one bank is enough and there is not any need for the banking system.*

If 1000 euro/... are deposited then the money that can be lent varies from

43500 euro/... to a figure that is virtually infinite (bounded only by the capability of the banks to have cash to give to the Central Bank).

$$\boxed{1000 \quad \rightarrow \quad 43500 \ < \ \text{loans} \ < \ \infty}$$

It comes that the more a bank lend the more its revenues are. The bank has to be more similar to the model of the *macro-bank* (banking system) as it can. In that model, let's recall it, all the banks are joined together in a big-big bank so **all the accounts belong to customers of this *macro-bank***.

In order to maximize its revenus the bank has to have the more final destination of loans that go back and deposit the sum received on their account on that bank it can, therefore it has to have many customers. This the true reason we see soo many merges!

As it should be clear, the amount of money in circulation is not decided just by the issuing bank but also from banks who lends to privates. This capability to create arbitrary credit yields the financial system subject to decision of the private bankers and actually not manageable from the autorities that should control it.