2. A glimpse of the financial sector: money, monetary aggregates, financial assets

1. Money and wealth

The relationship between money and wealth involves the fallacy of composition. If the European Central Bank gives a particular Spaniard €1 million, his or her wealth has increased in the sense that he or she is able to claim more wealth (buy more goods). But what if everyone in Spain (some 45 million people) receives €1 million? Can all of them (and "Spain") be considered wealthier? (45×10^{12} euros is more than forty times the value of Spain's GDP.)

This thought experiment tries to motivate the idea that, from a macroeconomic point of view, money is not wealth. An economy does not automatically become "rich" by just producing or issuing more money.

2. Purchasing power

Even if money sometimes may embody or represent wealth, the wealth embodied or represented by money could be an indeterminate amount. That is, it is not always clear what amount of wealth corresponds to a given amount of money.

Example 2.1. The 100 trillion dollar banknote in Fig. 1 circulated in Zimbabwe for some months in 2009. It is the banknote with the largest number of zeros printed on it ever issued. Can it be concluded that the owner of the banknote is a rich person? Quite on the contrary: since millions of such banknotes circulated, the astronomical face value (large denomination) of the banknote is a sign of poverty rather than prosperity. At some point in 2009, the banknote could just buy a bus ticket; see http://online.wsj.com/news/articles/ SB10001424052748703730804576314953091790360. In April 2009 the Zimbabwan dollar stopped being legal tender. Banknotes like the one shown in Fig. 1 have nowadays become a commodity (wealth) for currency collectors and tourists.

Fig. 1. 100 trillion Zimbabwean dollar banknote | http://en.wikipedia.org/wiki/Zimbabwean_dollar

Definition 2.2. The purchasing power of an amount of money is the amount of goods that can be obtained from it.

Purchasing power is a measure of the wealth that money may be said to represent or embody. A banknote with a very little purchasing power (like the one in Fig. 1) represents or embodies a very little amount of wealth. But purchasing power is not itself wealth: it is rather a claim on wealth. In this respect, money is viewed as an instrument to acquire wealth (goods) but not wealth itself.

3. Is more money better?

For wealth, it appears that the more, the better. Does the same apply to money? Is there no limit for the amount of money that is desirable for an economy to have?

Since money is instrumental (not an end it itself), what counts is not the amount of money in the economy but its purchasing power. So the question is whether the purchasing power of money grows with the amount of money.

Purchasing power is inversely related to the general price level (as measured, for intance, by the CPI): inflation reduces the purchasing power of money, whereas deflation increases it.

If aggregate production grows at a rate smaller than the quantity of money, then, in proportion, more money corresponds to each good. One may conjecture from this fact that the money price of goods would rise. By how much? There can be no limit, as hyperinflations testify: in a hyperinflation, the inflation rate is out of control. In Hungary, 1946, prices doubled every 15.6 hours (monthly inflation reached 12,950,000,000,000,000 per cent). The largest denomination banknote ever issued (Hungary, 1946) was worth 100 quintillion (= 10^{20}) pengő.

The conclusion from the above considerations is that "too much" money may be harmful, in the sense that purchasing power tends to evaporate as the stock of money grows. More money, less value of money (less purchasing power).

4. What is money?

"Money" is a problematic concept because of its self-referential character. Money is everything considered money: money is as money does. Money is recognized by the following functions.

• Medium of exchange. Goods can be generally obtained in exchange for money, that is, money must can be used to make purchases of goods. It is said that the use of money as a medium of exchange facilitates the circulation of goods.

• Store of value. Money has the ability to preserve (at least part) of its purchasing power in time: it is a way of accumulating (to be a repository of) purchasing power.

• Unit of account. As a unit of account, money provides a common measure of value, since the value of goods is expressed in terms of money. For instance, the euro from 1999 to 2002 was not yet physical money (could not be used as medium of exchange or store of value) but existed as unit of account.

• Means of unilateral payment or instrument for settling debts (a standard for deferred payments). When performing this function, money must be capable of cancelling debts (taxes, in particular).

5. The commodity theory of money

Definition 5.1. The commodity theory of money holds that money is just a commodity whose quintessential role is to make trade easier.

This is the conceptualization of money adopted by orthodox economic theory and most textbooks. The following are characteristics or implications of this view.

- The problem is to find the most convenient commodity to facilitate the exchange of goods: one that is durable, easily recognized, divisible, easy to transport… The choice eventually narrowed down to the metals (http://mises.org/daily/6122/).
- Preeminence is given to money as a medium of exchange.
- Money is considered a universal commodity that can be exchanged for any other commodity.
- Money is a "veil" under which the "true" economy (real sector) operates, as money is supposed to simply facilitate the exchange of goods.
- As with any other commodity, an "excessive" amount of money tends to lower its value. When there is "too much" money, more money should be given for goods, so the prices of goods are pushed up. The policy recommendation is to limit the amount of money in circulation.

Remark 5.2. If you want a commodity, you can produce it. Yet, if you want more money, you cannot produce it yourself: since it is illegal to manufacture money, you must get it from some one else. [Question: why is the production of legal money forbidden to ordinary people?]

6. The credit (debt) theory of money

Definition 6.1. The credit theory of money holds that money is not a commodity (a "thing") but an accounting tool: money is a yardstick that measures debt (debt is the same thing as credit).

According to this view, coins and banknotes constitute promises to pay something (the popular traditional perception is that money derived its value from the precious metals of which coins were made). The credit theory asserts that a sale and a purchase is the exchange of a commodity for credit, so the value of credit or money does not depend on the value of any metal or metals, but on the right to get the credit satisfied. The origin of money lies in credit.

Money then expresses claims and credits. This conceptualization emphasizes the function of money as unit of account, because the ability to use money as a measure of value makes prices and debt contracts possible. The essence of money is that it measures debt. In fact, money is seen as debt that becomes saleable: money is transferable credit (anonymous debt).

> "Money is not a commodity medium of exchange, but a social technology composed of three fundamental elements. The first is an abstract unit of value in which money is denominated. The second is a system of accounts, which keeps track of the individuals' or the institutions' credit or debt balances as they engage in trade with one another. The third is the possibility that the original creditor in a relationship can transfer their debtor's obligation to a third party in settlement of some unrelated debt. This third element is vital. Whilst all money is credit, not all credit is money: and it is the possibility of transfer that makes the difference."
> Félix Martín (2014): *Money: Unauthorized Biography*, pp. 40-41.

7. The state theory of money

Definition 7.1. The state theory of money (chartalism, from the Latin *charta*, 'token' or 'ticket') holds that money is not a commodity but "a creature of law": money is created (as fiat money) by the state, which recognizes it as legal tender, to account for and settle debts, the most important of which being tax debts.
http://en.wikipedia.org/wiki/Chartalism

In this view, money:

- is fiat money, that is, intrinsically worthless pieces of paper or metal (government-issued tokens serving as the unit of money);
- is created by the state by declaring what is accepted as payment for tax debts at the public pay offices and by establishing the nominal unit of account in which tax debts are measured;
- enters circulation through government spending.

8. Orthodox and heretodox views of money

The popular view identifies money with currency (= physical money = coins and banknotes), which is what is typically used to buy goods. In the past, currency had intrinsic value (were pieces of metal). Nowadays, fiat money systems have replaced metallic money systems.

In orthodox analysis, money just eases exchange. Heterodox traditions have in common:

> "that money is essentially an abstract measure of value; that money consists in a claim or a credit; that the state, or an authority, is an essential basis for money; that money is not neutral in the economic process."
> Geoffrey Ingham (2004): *The nature of money*.

In the orthodox account, the value of money corresponds to its purchasing power, as determined by the inflation rate (which is presumed to be under the control of the central bank).

But if money is a "creature of the state", by monopolizing the issue of money, the state influences the value of money by regulating the conditions under which people could obtain it (for instance, by raising or lowering taxes).

> "The government does not 'need' the public's money in order to spend; rather, the public needs the government's money in order to pay taxes. This means that the government can 'buy' whatever is for sale in terms of its money merely by providing that money […] because the public will normally wish to hold some extra money, the government will normally have to spend more than it taxes; in other words, the normal requirement is for a government deficit."
> L. Randall Wray (2006): *Understanding modern money*.

> "Under our current system, the foundational form of "money" is legal tender fiat currency originated by the central bank of the country, the printed version of which is a paper note we usually refer to as "cash".
>
> Strictly speaking, a note is a promise of payment in something else, like gold or silver, or wheat. However, legal tender notes are notes in name only as they cannot be redeemed for anything other than themselves. The paper wears out with use and therefore, legal tender notes are redeemable for new notes, nothing more.
>
> As a medium of exchange, it doesn't really matter that they can't be redeemed for "stuff". As long as people accept them as symbols for value they function perfectly well as "money".
>
> To ensure acceptance, the federal government decrees (fiat) that these notes issued by the often privately owned central bank of the country, are "legal tender". That means they must be accepted by law for the payment of all debts public and private. So, if you are offered (tendered) fiat notes in payment of a debt, you have to accept them or the courts won't enforce the debt."
> http://paulgrignon.netfirms.com/MoneyasDebt/Money_or_Credit.pdf

Heterodox economists alert us to the danger of confusing money with the form it takes (coins, for instance). One of the heterodox currents, the postkeynesians, puts the emphasis on money as store of value. The ability of money to store wealth lies behind the existence and persistence of the unequal distribution of wealth.

The orthodox view postulates the neutrality of money (money is a "veil" over the workings of the real sector, a lubricant of economic activity): only prices, not production, are affected by changes in the amount of money. But by controlling the amount of money so that the interest rate is kept at a high level, creditors benefit (they get more from lending money). In that respect, money does not seem to be neutral: it may increase income inequality.

9. Paradoxes of money

In the orthodox account, money could be defined as anything generally accepted as a payment in exchange for goods. But money is accepted for goods because of the belief that it will be subsequently accepted for goods. The conclusion is then that for something to be money it must be believed that that something is already money. This suggests the following question: when something is considered money in an economy, how did people manage to create, share, and sustain the belief that that something was money?

Historically, two conflicting views on money have coexisted; see David Graeber (2011), *Debt: The first 5,000 years*, p. 9.

- Lending money is evil (no sympathies for the moneylender)
- Once you borrow, you must pay back (to pay one's debts becomes a moral issue)

Example 9.1. The current Spanish Minister of Economy and Competitiveness recently reminded the Greek government that a debtor 'must' repay debts and, specifically, the €26 billion the Spanish government lent the Greek government (a reminder made despite the fact that, as the Minister himself confessed, "Those €26 billion were in pure solidarity with Greece").
http://www.thelocal.es/20150214/spain-seeks-greek-debt-payback

Example 9.2. Historically, recurrent cancellations of debt were the norm. Sumerian and Babylonian kings periodically declared all outstanding consumer debt null and void. The bankruptcy laws that nowadays exist implicitly recognize that not all debts must be paid back. And, by willing to lend, is not the lender accepting that lending is a risky undertaking?

10. How did money arise?

Most textbooks tell a myth on the origin of money. They explain the story of the progression from barter to currency (gold and silver coinage) to credit.

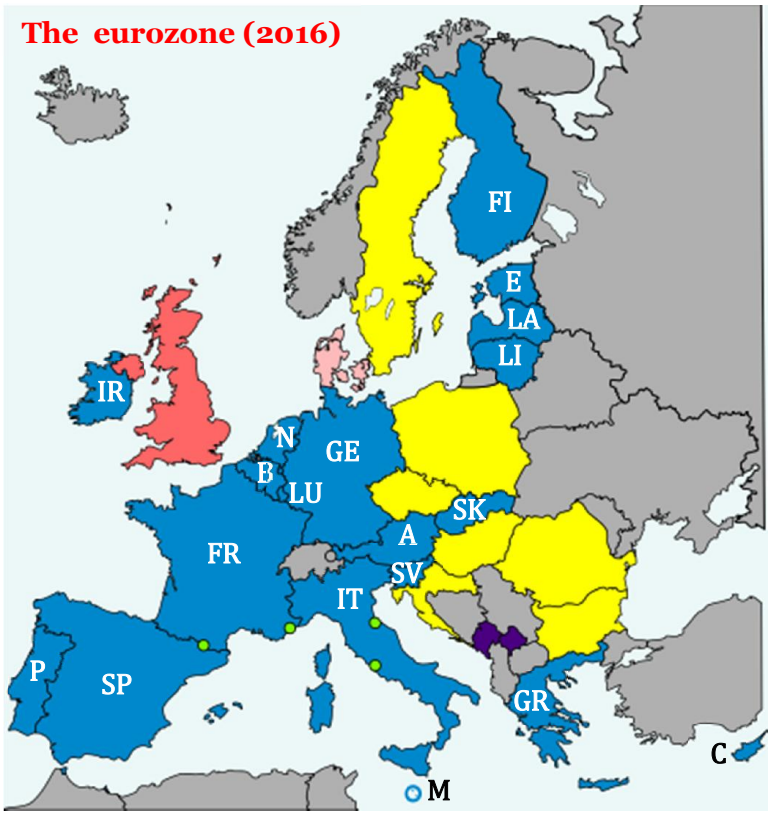
The historical evidence suggests that things have occurred the other way round: money originated as a means of calculating debts and obligations in primitive (pre-market) societies. Historical evidence points to money as quantified reminders of debts (money served as mere unit of account). As regards more complex societies, records from Ancient Egypt and Mesopotamia (ca. 3,500 BC) show that a credit system preceded the invention of coinage. In Ancient Mesopotamia, prices and debts (rents, fees, loans) were calculated in silver but had not be paid in silver. Peasants settled their debts mostly in barley and most transactions were based on credit.

> "In fact, our standard account of monetary history is precisely backwards. We did not begin with barter, discover money, and then eventually develop credit systems. It happened precisely the other way around. What we now call virtual money came first. Coins came

much later, and their use spread only unevenly, never completely replacing credit systems. Barter, in turn , appears to be largely a kind of accidental byproduct of the use of coin age or paper money: historically, it has mainly been what people who are used to cash transactions do when for one reason or an other they have no access to currency."
David Graeber (2011): *Debt: The first 5,000 years*, p. 40

"Instead of trying to locate the origins of money in a supposed primitive market originally based on barter, we find the origins in the rise of the early palace community, which was able to enforce a tax obligation on its subjects. […] Historical evidence suggests that virtually all 'commerce' from the very earliest times was conducted on the basis of credits and debits."
L. Randall Wray (2006): *Understanding modern money*, p. 40.

11. Meet our currency: the euro



The euro (sign: €; code: EUR) is the official currency of the 19 members of the eurozone (officially called euro area): A, B, C, E, FI, FR, GE, GR, IR, IT, LA, LI, LU, M, N, P, SK, SV, and SP.

The euro was born in January 1999 as a unit of account and became currency on 1 January 2002. It is managed by the Euro-system: the European Central Bank plus the central banks of the eurozone members.

It is the second most traded currency in the world, after the US dollar. By mid-2010, it surpassed the US dollar as the currency with highest value in circulation.

http://en.wikipedia.org/wiki/Eurozone

12. Monetary aggregates

Monetary aggregates are technical ways of defining (measuring the amount of) money.

Definition 12.1. M0. The monetary aggregate **M0** (also called monetary base, narrow money, or high-powered money) is defined as $\mathbf{M0} = \boldsymbol{E} + \boldsymbol{R}$, where:

- $\boldsymbol{E}$ is the currency held by the public (cash); and
- $\boldsymbol{R}$, the bank reserves, is the currency held by banks (in the banks' vaults and in ATMs) plus the banks' deposits in the central bank.

Definition 12.2. M1. The monetary aggregate **M1** (also called monetary mass, money stock, or money supply) is defined as $\mathbf{M1} = \boldsymbol{E} + \boldsymbol{D}$, where:

- $\boldsymbol{D}$ is the total amount of sight bank deposits (non-interest-bearing accounts) held by the public in banks.

Definition 12.3. M2. The monetary aggregate **M2** is **M1** + savings deposits.

Definition 12.4. M3. The monetary aggregate **M3** is **M2**+ time deposits + other categories.

13. Monetary aggregates as defined by the European Central Bank

http://www.ecb.europa.eu/pub/mb/html/index.en.html | http://www.ecb.europa.eu/pub/pdf/mobu/mb201401en.pdf

"M1: a narrow monetary aggregate that comprises currency in circulation [banknotes and coins] plus overnight deposits [balances that can immediately be converted into currency or used for cashless payment] held with MFIs [monetary financial institutions] and central government (e.g. at the post office or treasury)."

"M2: an intermediate monetary aggregate that comprises M1 plus deposits redeemable at a period of notice of up to and including 3 months (i.e. short-term savings deposits) and deposits with an agreed maturity of up to and including 2 years (i.e. short-term time deposits) held with MFIs and central government."

Liabilities (1)	M1	M2	M3
Currency in circulation	X	X	X
Overnight deposits	X	X	X
Deposits with an agreed maturity up to 2 years		X	X
Deposits redeemable at a period of notice up to 3 months		X	X
Repurchase agreements			X
Money market fund (MMF) shares/units			X
Debt securities up to 2 years			X

"M3 is a broad monetary aggregate that comprises M2 plus marketable instruments, in particular repurchase agreements, money market fund shares and units, and debt securities with a maturity of up to and including two years issued by MFIs".

(1) = Liabilities of the money-issuing sector and central government liabilities with a monetary character held by the money-holding sector
http://www.ecb.europa.eu/stats/money/aggregates/aggr/html/hist.en.html

"These aggregates differ with regard to the degree of moneyness of the assets included".

14. How banks create M1

Example 14.1. Suppose the central bank buys some asset, worth 100, from Bank 1 and pays the purchase with new banknotes. Fig. 2 represents (as T-accounts) the changes that take place in the balance sheets of the central bank and Bank 1 (assets are represented on the left-hand side of a balance sheets and liabilities on the right-hand side).

central bank	
assets	banknotes
100	100

Fig. 2. The central bank buys assets from Bank 1

Bank 1	
~~assets~~	
~~100~~	
banknotes	
100	

Bank 1	
~~banknotes~~	
~~100~~	
loans	
100	

Fig. 3. Bank 1 lends the banknotes to a firm

Firm	
banknotes	loans
100	100

Bank 1 cannot stand having banknotes sitting idle in its vault, so Bank 1 satisfies a loan request of 100 by a firm. The firm receives the banknotes from Bank 1. Fig. 3 depicts the impact of this operation on the respective balance sheets. The firm uses the banknotes to pay the wage of one of its workers. The worker gets the banknotes and deposits them in Bank 2. Fig. 4 displays the changes in Bank 2's balance sheet after the worker deposits the banknotes.

Bank 2	
banknotes	deposits
100	100

Fig. 4. Bank 2 receives deposits

Bank 2	
~~banknotes~~	deposits
~~100~~	100
loans	
100	

Fig. 5. Bank 2 lends the banknotes

Bank 3	
banknotes	deposits
100	100

Fig. 6. Bank 3 receives deposits

Bank 2 is like Bank 1 and cannot resist having banknotes gathering dust in its vault. Hence, Bank 2 grants a loan to a consumer. Fig. 5 shows the resulting change in Bank 2's balance sheet.

The consumer spends the banknotes purchasing goods. The seller of the goods is given the banknotes in exchange for the goods and deposits them in Bank 3. Fig. 6 indicates the effect on Bank 3's balance sheet of the seller's deposit. Now it is Bank 3 that is willing to lend the banknotes and the process goes on…

To recap, the central bank has "injected" 100 units of currency (in the form of banknotes) in the economy through Bank 1. Yet, the increase in **M1** is larger than the value 100 of the new banknotes. The reason is that, up to the point at which Bank 3 receives the deposit (Fig. 6), new deposits worth $100 + 100 = 200$ have been created. Hence,

$$\Delta \mathbf{M1} \geq \Delta \text{ banknotes} + \Delta \text{ deposits} = 100 + 200 = 300\,.$$

Moreover, economagically, three agents can make use of the same money: Bank 3 can lend the banknotes; the seller of the goods can use his or her deposits in Bank 3 to make payments; and the worker can also make use of his or her deposits in Bank 2 to make payments.

It is worth noticing that the new deposits in Bank 2 and Bank 3 (which add up to 200) are backed by the same banknotes (whose value is only 100). To see why this observation is relevant, suppose that the seller and the worker would simultaneously like to withdraw their deposits. If Bank 3 has

not yet lent the banknotes, the seller's request can be satisfied. But Bank 2 would have a problem to pay back the banknotes to the worker because the banknotes the worker deposited have been lent. That means that, if Bank 2 has no funds to attend the client's request, Bank 2 would need to borrow money. In normal circumstances this could be easily done in the interbank money market. During a financial crisis, interbanks markets freeze: no one is willing to lend money precisely because all the banks face the same lack of funds problem (liquidity constraint).

15. The textbook model of M1 creation

The model (which aims to ascertain the final outcome of the process described in Example 14.1) presumes two behavioural rules. First, banks hold as reserves a fixed fraction r of the deposits by clients. Second, the public keep in cash a fixed proportion l of their deposits.

Definition 15.1. The cash reserve ratio $r = \boldsymbol{R}/\boldsymbol{D}$ is the amount of reserves banks hold per unit of deposits. It is the percent of deposits that banks choose (or are required) not to lend.

Definition 15.2. The liquidity ratio $l = \boldsymbol{E}/\boldsymbol{D}$ is the amount of currency that people hold per unit of deposits.

With the above definitions, it is possible to express **M1** as a fixed multiple of **M0**.

Proposition 15.3. If the ratios $r = \boldsymbol{R}/\boldsymbol{D}$ and $l = \boldsymbol{E}/\boldsymbol{D}$ are held constant, then

$$\mathbf{M1} = \frac{1+l}{r+l} \cdot \mathbf{M0}\,. \tag{1}$$

Proof. It follows from $l = \boldsymbol{E}/\boldsymbol{D}$ that $\boldsymbol{E} = l \cdot \boldsymbol{D}$. It follows from $r = \boldsymbol{R}/\boldsymbol{D}$ that $\boldsymbol{R} = r \cdot \boldsymbol{D}$. Therefore, $\mathbf{M0} = \boldsymbol{E} + \boldsymbol{R} = l \cdot \boldsymbol{D} + r \cdot \boldsymbol{D} = (l + r) \cdot \boldsymbol{D}$. Solving for $\boldsymbol{D}$, it turns out that

$$\boldsymbol{D} = \mathbf{M0}/(l + r). \tag{2}$$

On the other hand, $\mathbf{M1} = \boldsymbol{E} + \boldsymbol{D} = l \cdot \boldsymbol{D} + \boldsymbol{D} = (1 + l) \cdot \boldsymbol{D}$. Solving for $\boldsymbol{D}$, now $\boldsymbol{D} = \mathbf{M1}/(1+ l)$. The combination of this equation with (2) yields (1).■

Definition 15.4. The money multiplier mm is the ratio $\dfrac{1+l}{r+l}$.

Suppose banks choose $\boldsymbol{R}$ so that, for a fixed proportion $0 < r < 1$ and given $\boldsymbol{D}$, $\boldsymbol{R} = r \cdot \boldsymbol{D}$. Suppose as well that people choose $\boldsymbol{E}$ so that, for a fixed proportion $0 < l < 1$ and given $\boldsymbol{D}$, $\boldsymbol{E} = l \cdot \boldsymbol{D}$. Then Proposition 15.3 asserts that $\mathbf{M1} = mm \cdot \mathbf{M0}$; that is, the money stock **M1** is a fixed multiple (mm) of the monetary base **M0**. Equivalently,

$$mm = \frac{\mathbf{M1}}{\mathbf{M0}}.$$

This says that the money multiplier mm indicates how many units of money stock **M1** is generated by one unit of monetary base **M0**.

Remark 15.5. If mm remains constant, then $\Delta\mathbf{M1} = mm \cdot \Delta\mathbf{M0}$.

In sum, with a fixed money multiplier, a change in **M0** causes a fixed proportional change in **M1**.

16. Illustrating the model of M1 creation by means of an example

Example 16.1. M0 is increased by €600 million. For instance, the central bank buys financial assets from the banks and pays by increasing €600 million the reserves of banks in the central bank. Assume that

- $l = \frac{1}{5} = 0.2$, which means that people hold 0.2 euros in cash for each euro deposited in banks; and
- $r = \frac{1}{10} = 0.1$, so banks only need to keep 10% of new deposits as reserves and can lend the rest.

Since the deposits $\boldsymbol{D}$ in banks have not changed, banks have an excess of reserves equal to €600 million. They can then lend the €600 million to consumers and firms. Denote loans by $\boldsymbol{L}$. The change $\Delta\boldsymbol{L}$ in the volume of loans is equal to the change $\Delta\boldsymbol{D}$ in deposits minus the change $\Delta\boldsymbol{R}$ in reserves. Let consumers and firms be always willing to borrow any amount offered by banks.

The people that borrow the €600 million will spend them buying goods or financial assets. The sellers of the goods or the financial assets get €600 million. This amount must be allocated between cash and deposits to make the increase in cash ΔE divided by the increase in deposits $\Delta\boldsymbol{D}$ equal to 0.2. The following two equations provide the solution.

- Distribution of 600 between two uses $\quad \Delta\boldsymbol{E} + \Delta\boldsymbol{D} = 600$
- Fulfillment of the liquidity ratio $\quad \Delta\boldsymbol{E}/\Delta\boldsymbol{D} = 1/5$ (or, equivalently, $\Delta\boldsymbol{D} = 5 \cdot \Delta\boldsymbol{E}$)

Consequently, $\Delta\boldsymbol{D} = 500$ and $\Delta\boldsymbol{D} = 100$. This means that people deposit €500 million in banks and hold €100 million in cash. With reserve ratio $r = 0.1$, banks retain 10% of the new deposits as reserves ($\Delta\boldsymbol{R} = \Delta\boldsymbol{D}/10 = 500/10 = 50$) and lend the rest ($\Delta\boldsymbol{L} = \Delta\boldsymbol{D} - \Delta\boldsymbol{R} = 500 - 50 = 450$). The following table summarizes the process so far.

round	$\Delta\mathbf{M0}$	$\Delta\boldsymbol{D}$	$\Delta\boldsymbol{E}$	$\Delta\boldsymbol{R}$	$\Delta\boldsymbol{L} = \Delta\boldsymbol{D} - \Delta\boldsymbol{R}$	$\Delta\mathbf{M1} = \Delta\boldsymbol{E} + \Delta\boldsymbol{D}$
1	600				600	
2		500	100	50	450	600

At this point the process recommences: people borrow and spend 450, and those receiving the 450 keep a part in cash (75) and deposit the rest (375) on banks. The same process is repeated round after round, as shown in Table 7.

round	$\Delta\mathbf{M0}$	$\Delta \boldsymbol{D}$	$\Delta \boldsymbol{E}$	$\Delta \boldsymbol{R}$	$\Delta \boldsymbol{L} = \Delta \boldsymbol{D} - \Delta \boldsymbol{R}$	$\Delta\mathbf{M1} = \Delta \boldsymbol{E} + \Delta \boldsymbol{D}$
1	600				600	
2		500	100	50	450	600
3		375	75	37.5	337.5	450
4		281.25	56.25	28.125	253.125	337.5
5		210.9..	42.1...	210.9...	189.84...	253.125
...		...	...	...	...	...
TOTAL	600	2,000	400	200	1,800	2,400

Table 7. The deposits (money) multiplier process and the limit of the process

The result is that deposits grow continuously: 500 + 375 + 281.25 + 210.9 + … In the limit, the sum converges to 2,000.

M0 initially increased by 600. The fraction held in cash is the sum 100 + 75 + 56.25 + 42.18 + …, which converges to 400.

Since $\mathbf{M0} = \boldsymbol{E} + \boldsymbol{R}$, $\Delta\mathbf{M0} = \Delta \boldsymbol{E} + \Delta \boldsymbol{R}$. That is, 600 = 400 + $\Delta \boldsymbol{R}$. Thus, $\Delta \boldsymbol{R}$ = 200. This is also the value to which the sum 50 + 37.5 + 28.125 + 21.09 + … converges.

On the other hand, $\mathbf{M1} = \boldsymbol{E} + \boldsymbol{D}$ yields $\Delta\mathbf{M1} = \Delta \boldsymbol{E} + \Delta \boldsymbol{D}$. As $\Delta \boldsymbol{E}$ = 400 and $\Delta \boldsymbol{D}$ = 2,000, it follows that $\Delta\mathbf{M1} = \mathbf{2{,}400}$: an increase of 600 in **M0** is transformed into an increase of 2,400 in **M1**.

Remark 16.2. Given $\Delta\mathbf{M1} = \Delta \boldsymbol{E} + \Delta \boldsymbol{D}$ and $\Delta\mathbf{M0} = \Delta \boldsymbol{E} + \Delta \boldsymbol{R}$, it turns out that $\Delta\mathbf{M1} - \Delta\mathbf{M0} = (\Delta \boldsymbol{E} + \Delta \boldsymbol{D}) - (\Delta \boldsymbol{E} + \Delta \boldsymbol{R}) = \Delta \boldsymbol{D} - \Delta \boldsymbol{R} = \Delta \boldsymbol{L}$. In words, the multiplier effect (the increase **M1** of over **M0**) is generated by loans (in Example 16.1, $\Delta \boldsymbol{L} = \Delta\mathbf{M1} - \Delta\mathbf{M0}$ = 2,400 – 600 = 1,800).

The preceding analysis suggests that the money multiplier *mm* has to be 4: $\Delta\mathbf{M0}$ = 600 generates $\Delta\mathbf{M1}$ = 2,400. In fact,

$$mm = \frac{1+l}{r+l} = \frac{1+0.2}{0.1+0.2} = \frac{1.2}{0.3} = \frac{12}{3} = 4\,.$$

Value *mm* is the total effect on the cash held by the people and the deposits created by the process

… ⇒ ↑deposits ⇒ ↑loans ⇒ ↑expenditures ⇒ ↑revenues ⇒ ↑deposits ⇒ ↑loans ⇒ …

The above sequence illustrates the interaction between the financial sector (deposits and loans) and the real sector (purchases of goods) of the economy. Fig. 8 next sketches the process underlying the results in Table 7.

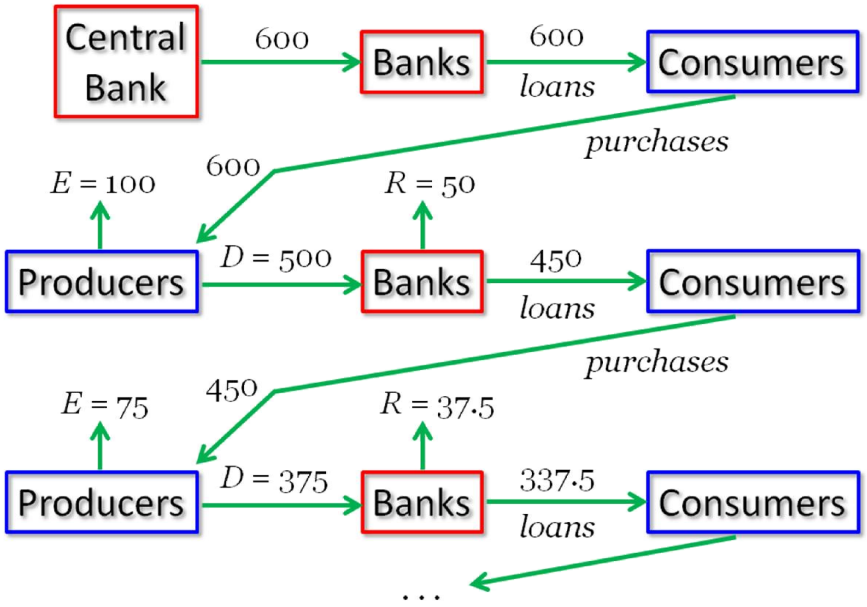


Fig. 8. The sequence of events behind the deposits (money) creation process

17. The reality of bank lending

In the model described in §16, banks need to receive a deposit to lend. In reality, when a bank makes a loan, the money lent is not taken from anyone's account nor from the bank's funds: it is created out of thin air.

As deposits are accounting entries in a computer, a bank creates the money by crediting its customer's account with the amount of the loan and balancing this liability by registering the amount of the loan as an asset. The bank is not actually providing cash but the promise to provide cash. But that promise, the account at the bank, counts as cash.

18. The banking system's shaky foundations

The problem is that the banks promise to deliver something that they cannot deliver, because there is not enough cash in an economy to cash all bank deposits.

Definition 18.1. A bank run is a sudden and simultaneous demand by customers to withdraw a sufficiently high volume of deposits.

In Table 7, deposits worth €2,000 million are created, but they are backed by only the additional €600 million in cash. In consequence, if all depositors tried at the same time to withdraw their deposits, banks would be forced to get the remaining €1,400. But what if no one is willing to supply those funds because, for instance, the bank run is on the whole banking system? What is more: if depositors believe that banks face liquidity problems, then the subsequent bank run may actually create the liquidity problems for banks.

In Spain, the Deposit Guarantee Fund of Credit Institutions guarantees up to €100,000 per deposit in case of bankruptcy. The fund ended 2012 with a shortfall of €1.263 billion. To put it in a nutshell, the stability of the banking system relies on the belief that the banking system is stable.
http://www.fgd.es/en/index.html

19. The banking business: between fraud and catastrophe

http://www.opendemocracy.net/ourkingdom/oliver-huitson/uneconomics-guide-to-money-creation

The preceding discussion points to the following conclusions.

• Banking works as long as everyone believes it does. If confidence is lost, the system collapses insofar as it relies on the fiction of unexisting money.

• The creation of bank money (loans) rests only on the banks' belief that the borrowers can repay.

• Nothing controls the scale/timing of bank lending. Banks lend freely until they fear a default on repayments. Led by that fear, new loans are refused and economic activity declines. The resulting credit crunch and economic contraction feed each other following the circular sequence

$$\ldots \Rightarrow \downarrow \text{lending} \Rightarrow \downarrow \text{expenditure} \Rightarrow \downarrow \text{production} \Rightarrow \downarrow \text{employment} \Rightarrow \downarrow \text{lending} \Rightarrow \ldots$$

The economy enters a recession which, depending on the severity and intensity of the above snow-ball effect, may turn into a depression.

20. A simple model of endogenous money

The texbook model of **M1** creation explained in §15 and §16 presents money as exogenous, in the sense that the money stock of the economy can be controled by the public (monetary) authority that regulates **M0** (in advanced economies, this authority is the central bank).

More specifically, presuming the money multiplier *mm* stable, by controlling **M0** the monetary authority can set the value of **M1** with precision. Therefore, since **M0** is exogenously determined by the monetary authority, when *mm* is constant, $\mathbf{M1} = mm \cdot \mathbf{M0}$ is also exogenously determined by the monetary authority.

Heterodox economists question the exogeneity of **M1**. In their view, the money stock is endogenous in the sense that "the economy" itself determines **M1**.

Recall that, in the textbook model, the amount of money created by banks (bank money) coincides with the volume of loans granted by banks. In the model, that volume of loans is endogenous: given the parameters of the model, loans are completely determined, so that banks do not choose how much to lend: they just lend all that they can and what they can is the difference $\Delta \boldsymbol{D} - \Delta \boldsymbol{R}$.

A simple way of making the money stock endogenous is to revert the above traits, namely, to allow banks to choose the volume of loans. This means that the volume of loans is now exogenous (not determined by the model). The new model is based on the same equations of the textbook model with the addition of (3); see Ronald Shone (1989): *Open Economy Macroeconomics*, p. 154.

$$\boldsymbol{D} = \boldsymbol{L} + \boldsymbol{R} \qquad (3)$$

Actually, (3) was implicit in the textbook model, but with $\boldsymbol{L}$ considered endogenous; that is, $\boldsymbol{L} = \boldsymbol{D} - \boldsymbol{R}$ defined the value of $\boldsymbol{L}$.

In the new version, $\boldsymbol{L}$ is taken to be exogenous. This means that $\boldsymbol{L}$ is chosen by banks (in particular, $\boldsymbol{L}$ is determined by their beliefs on the borrowers' ability to repay). Under this alternative approach, the aim is to express **M1** as a function of $\boldsymbol{L}$.

Proposition 20.1. In the model described by equations $\mathbf{M1} = \boldsymbol{E} + \boldsymbol{D}$, $\boldsymbol{E} = l \cdot \boldsymbol{D}$, $\boldsymbol{R} = r \cdot \boldsymbol{D}$, and (3),

$$\mathbf{M1} = \frac{1 + l}{1 - r} \cdot \boldsymbol{L}\,. \tag{4}$$

Proof. From $\boldsymbol{R} = r \cdot \boldsymbol{D}$ and (3),

$$\boldsymbol{D} = \boldsymbol{L} + \boldsymbol{R} = \boldsymbol{L} + r \cdot \boldsymbol{D}.$$

Solving for $\boldsymbol{D}$,

$$\boldsymbol{D} = \frac{\boldsymbol{L}}{1 - r}\,. \tag{5}$$

Using the first three,

$$\mathbf{M1} = \boldsymbol{E} + \boldsymbol{D} = l \cdot \boldsymbol{D} + \boldsymbol{D} = (1 + l) \cdot \boldsymbol{D}.$$

The combination of the last result with (5) yields (4).■

According to (4), if banks can obtain the necessary reserves, then the money stock **M1** depends on the volume of loans $\boldsymbol{L}$ that banks find profitable to make. In case that banks consider profitable any loan, **M1** will be determined by the demand for loans; in other words, the demand for money creates is own money. That would correspond to the heterodox view according to which money is endogenous. [Thanks to Judit Garcia for pointing out a mistake.]

21. Trying to make money

In a modern monetary economy, goods are typically not exchanged for goods but for fiat money. Therefore, even though people are ultimately interested in getting goods, the first activity in which people must engage is raising money.

One way of raising money is to sell goods others want. Thus, one may sell his/her time for a wage or a good he/she can produce for a price.

But what if one has no good others may want? Then one can raise money by issuing a financial asset, which is essentially a promise to pay money in the future.

22. Financial assets

Definition 22.1. A financial asset is the expression of a promise to pay money in the future.

A financial asset is

- basically an IOU: a paper where someone acknowledges a debt ("I owe you");
- a substitute for money: since it represents a promise today to pay money in the future, it is a way of capitalizing future revenues.

23. Rate of return of a financial asset

Imagine you do not have money today, but you expect that you will have some in the future. A financial asset is like a time machine allowing you to take your money back from the future: you issue an IOU and sell it today for money. Problem: part of your future money is lost while going back to the present.

Suppose you know you will get €1,000 in a month and need (or want) them today. You then issue a financial asset stating that you will pay €1,000 in a month to the bearer (owner) of the asset.

But it will illusory to expect to sell that asset for €1,000, for the buyer gives €1,000 and receives €1,000 in a month: the buyer loses the possession of €1,000 for a month in exchange for nothing. For this reason the asset must be sold for less than €1,000. The interest rate of the asset is its implicit rate of return.

Definition 23.1. Let V the nominal (face) value of the asset: how much it promises to pay in the future. Let P be the price at which the asset is bought at present. Then the (implicit) rate of return i_R (or rate of profit) of the asset is the profit $V - P$ obtained from buying the asset per monetary unit invested in the purchase. The formula is (to get a percentage, multiply the right-hand side by 100)

$$i_R = \frac{V - P}{P}.$$

Example 23.2. If $V = 1{,}000$ and $P = 800$, then $i_R = \frac{1{,}000-800}{800} = \frac{1}{4} = 0.25 = 25\%$. You need to invest 800 to obtain a profit of 1,000 – 800 = 200. This makes your rate of return a 25%.

24. Role of financial assets

From the perspective of the purchaser, the financial asset is a way of saving purchasing power (a way of sending it from the present to the future).

From the perspective of the issuer (or the seller, if the original buyer becomes a seller), the financial asset is a way of acquiring purchasing power (a way of bringing purchasing power from the future to the present).

Financial assets channel purchasing power (in the form of money) from those who wish to lend to those who wish to borrow.

Those wishing to borrow have a deficit: planned expenditure larger than current income. For those wishing to lend, planned expenditure is smaller than current income: they have a surplus.

Being a financial asset an instrument to get money if you need it from someone not needing it now, a financial asset is like a loan of money. View in this way, a financial asset is a financial claim by means of which a lender has a claim on a borrower to pay a certain amount of money at a given time.

25. Properties of financial assets

To repeat, the owner of a financial asset has a claim on someone else to pay a certain amount of money. The basic associated properties of this claim are four.

• Maturity (or maturity time). Date at which the claim must be satisfied.

• (Default) Risk. The likelihood that the claim will not be satisfied at maturity.

• Liquidity. Ease and rapidity with which the asset can be turned into money (be sold) before maturity (ease and rapidity with which the claim can be –partially– satisfied in advance).

• Rate of return. Ratio of the profit the asset generates to the cost of obtaining that profit (value of the claim in relation to the cost of being the beneficiary of the claim).

26. Basic types of financial assets

Currency can be considered a financial asset with instant maturity (€1 pays €1 now), no return, no risk, and maximum liquidity.

Definition 26.1. Financial securities ("securities") are tradable (can be bought and sold) financial assets. A security is any fungible, negotiable financial instrument.

Securities are divided into debt securities and equity. The market where securities are initially sold (by the issuer) is the primary market. Subsequent sales take place in the secondary market.

27. Tradable financial assets: bonds

Definition 27.1. Bond. Debt security that, in exchange for the face value V, pays a given amount (interest payment) at fixed periods before maturity and repays V at maturity.

Example 27.2. A four-year €100 bond offering an annual 5% interest rate pays €5 at the end of years 1, 2, 3, and 4, and repays the €100 at the end of year 4.

Definition 27.3. Bond issued at discount. Bond sold for less than the face value.

Example 27.4. Treasure bills (or, for short, T-bills) are short-term government bonds issued at discount. In Spain, the nominal value of a T-bill is €1,000. Currently, they are issued with a maturity of 3, 6, 9, or 12 months. Weighted average rates of return in the last auction: 3 month T-bills, –0,268% (a year ago, 0.018%); 6, –0,061% (0.088); 9, –0,085% (0.137); and 12, 0% (0.19). http://www.tesoro.es/

Example 27.5. The so-called commercial paper is another example of bonds issued at discount. "Commercial paper" refers to unsecured promissory notes issued by firms to fund operational expenses (short-term debt, like payroll) and maturity not greater than 270 days.

28. Are shares financial assets?

In a strict sense, shares of a firm are not financial assets, since they represent parts of the property of a firm: the owner of shares is a shareholder (owns the firm).

Unlike debt securities, shares do not entitle to a regular payment: the payment of dividends is discretional. But shares typically represent such a small part of the value of a firm that they are bought and sold not because of their intrinsic value, but because of the expected evolution of their price. Money invested in shares is mostly a matter of gambling, mostly unconcerned with the firm's business.

Example 28.1. The dot-com bubble of 1997-2000; see http://en.wikipedia.org/wiki/Dot.com_bubble.

Buying shares is a form of saving, and selling them is a form of raising money. Thus, shares become indistinguishable from financial assets.

Any commodity sold and bought according to the expected evolution of its price behaves like a financial asset: it is not sold or bought due to intrinsic qualities, but as a tool for making money by exploiting price changes.

This may generate "speculative bubbles". Known cases: oil, real estate, raw materials, stamps…

29. Non-tradable financial assets

Example 29.1. Bank deposit. By depositing money in a bank, the depositor is purchasing an asset issued by the bank: the deposit. This asset is riskier than currency: if the bank goes bankrupt, the money is lost. Since there is no market where people can buy or sell their bank deposits, they are iliquid assets (a liquid asset may turn iliquid: preferred shares).

Example 29.2. Loan. The loan can be seen as the reverse of the deposit: it is as if the bank deposited money on you in exchange for a premium and the repayment of the deposit. In principle, to transform the loan into money the bank must wait until it is repaid.

30. Securitization

Definition 30.1. "Securitization is the financial practice of pooling various types of contractual debt such as residential mortgages, commercial mortgages, auto loans or credit card debt obligations and selling said consolidated debt as bonds, pass-through securities, or collateralized mortgage obligation to various investors. The principal and interest on the debt, underlying the security, is paid back to the various investors regularly."
http://en.wikipedia.org/wiki/Securitization

Securitization means transforming non-tradable financial assets (like bank loans) into securities by creating secondary markets for them.

• Method 1 of securitizing a loan: bundle together bank loans and sell partipations in the profits from the pool of loans to investors, who receive the payments from the borrowers that repay the loans.

Hence, a new financial asset is created by combining existing financial assets and marketing different tiers of the repackaged assets to investors. The problem of method 1 is that, by packaging assets, relevant information about them (like risk) may be lost. Risky loans (subprime mortgages, for instance) are easier to sell when pooling them with safer loans, but then investors may not know what they are actually buying.

• Method 2: issue debt (a bond, for instance) secured by the pool of loans (asset-backed security).

Securitized assets typically constitute a large pool of illiquid assets (like loans). By selling the loans, the bank receives funds that otherwise would have come in the future as the loans were being repaid. The funds can be used to make additional loans.

31. Trade-off between properties

Financial assets can be viewed as money imitators. But as they cannot have maximum liquidity, they must offer something in return to be attractive.

• Liquidity versus profitability. If two assets differ only in liquidity and profitability, the more liquid must be the less profitable and vice versa (money versus bonds).

• Risk versus profitability. If two assets differ only in risk and profitability, the riskier should be the more profitable and vice versa (shares versus deposits).

Having more of the favourable properties is balanced by having more of the unfavourable ones.

More profitability will in general be accompanied by less attractive qualities: more risk and/or less liquidity.

More liquidity will be accompanied by less attractive qualities: more risk and/or less profitability.

More risk will be accompanied by more attractive qualities: more profitability and/or more liquidity.

32. Shadow banking

Definition 32.1. The expression "shadow banking" refers to non-bank financial intermediaries that act like banks, but are not subject to bank regulations (like legal reserves) and lack access to central bank funding and deposit insurance.

Example 32.2. Shadow banking instruments, entities or structures: securitization vehicles, mortgage companies, investment banks, asset-backed commercial paper, money market mutual funds, markets for repos (repurchase agreements), hedge funds…

Remark 32.3. Total value of the world's financial assets (2012): $225 trillion. Estimated size of the shadow banking system (2012): over $100 trillion. Nominal world GDP: $72 trillion (85 at purchasing power parity). http://www.mckinsey.com/insights/mgi/research/financial_markets http://en.wikipedia.org/wiki/Shadow_banking_system | http://en.wikipedia.org/wiki/Gross_world_product

33. Shadow banking and financial crisis

The 2007−12 financial crisis has been regarded as a run on the shadow banking system; see Paul Krugman (2008): *The return of depression economics and the crisis of* 2008). The moral drawn from this episode is that if it behaves like a bank, regulate it like a bank.

Example 33.1. Auction-rate security (ARS). Individuals lend money on a long-term basis to an institution. At some intervals, the institution holds an auction in which new investors bid for the right to replace old investors wanting to leave (does it sound familiar to the preferred shares scheme in Spain?). The interest rate of the auction determines what investors get until the next auction. For investors, interest rates on ARS were higher than on bank deposits. For the issuers, the rates paid were lower than those on long-term bank loans. This was possible because issuers did not have to hold liquid reserves nor contribute to the deposit insurance system. The ARS system ($400 billion at its peak) collapsed in 2008. Not enough new investors were arriving to allow existing investors to get their money back. Fewer arrived after it was realized that the money was tied-up for decades. Without new investors, ARS turned iliquid: no one wanted to buy ARS.

Example 33.2. Ponzi scheme. "A use of capital is properly considered a Ponzi scheme if the only way the purchased item can increase in value is by locating someone who will pay a higher price. While Ponzi schemes are often called investments, they in fact never are. Housing is one such category when viewed not as a place to live in or rent out to someone else but rather as an item you acquire for capital appreciation."
K. Denninger and C. Hugh Smith (2011): *How cheap money will destroy the world*

34. Fragility of the financial sector: an example

The aim of Example 34.1 is to illustrate the fragility of the financial sector and its power to magnify (in either direction) the outcomes the real sector generates. Subsequent sections deal with the question "Does the financial sector live under the illusion of safety, stability, and control?".

Example 34.1. A firm worth €120 million plans to make an investment to increase production.

- To raise the necessary funds, shares for the 100% value of the firm are issued. To attract investors, the price 100 of the shares is set below the value 120 of the firm.
- An investment company buys all the shares. The investors obtain a 20% rate of return: they pay 100 for something whose actual value is 120.
- Investors run short of cash and ask a big bank for a loan. The bank grants a loan of 100 at a 15%.
- The bank is also short of liquidity and obtains from a small bank a loan of 100 at a 10%.
- The small bank's vault is empty. The bank offers prefential clients a 5% reward for new deposits.

The bank succeeds and collects 100, which are lent to the big bank, which are lent to investors, which are paid to the firm in return for the shares. The sketch in Fig. 9 summarizes the cascade of transactions made and the net worth effect on investors and banks

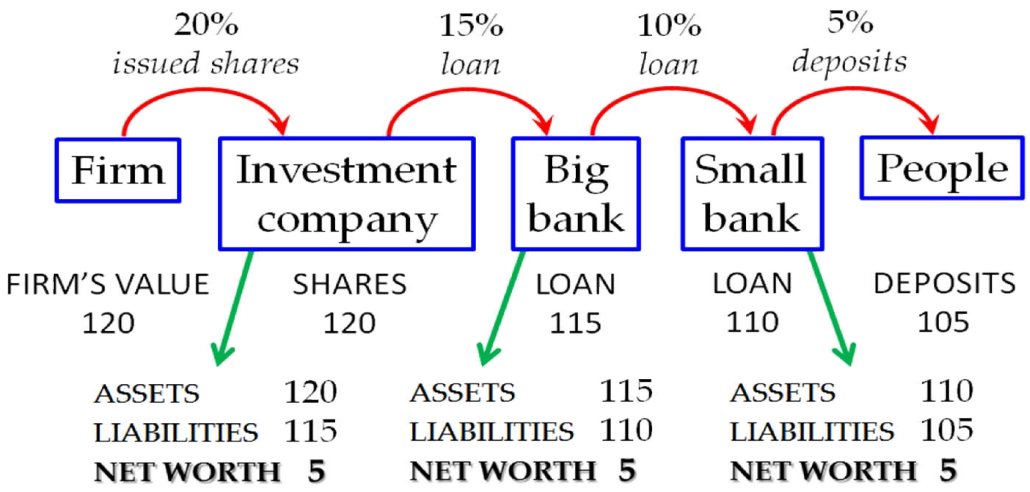


Fig. 9. Example on the vulnerability of the financial sector

Everybody gets a profit in the process: the firm funds the investment project, and investors, banks, and depositors earn 5 each. Thanks to the financial sector, the firm's expansion generates a profit for investors, banks, and depositors.

The example also shows the leverage effect of the financial sector. There are assets in the economy worth 450: shares, 120; loans from the big bank, 115; loans from the small bank, 110; and deposits by clients, 105. But those assets are all backed by the firm's value, which is merely 120.

Financial wealth (paper wealth) worth 450 is lifted by real wealth (wealth created by the real sector, that is, goods) worth 120. This is the positive magnifying effect of the financial sector: real assets worth 120 sustain financial assets worth 450.

The magnifying effect also works in the reverse. For instance, imagine that the investment project fails because the customers that would have bought the goods produced thanks to the project are those depositing money on the small bank.

Given that depositors put their money in the small bank, they cannot buy the new goods the firm produces using the expanded productive capacity. Let us assume that, as a result, the firm goes bankrupt and closes down.

Shares become worthless. Investors cannot settle their debt with the big bank, which cannot repay the loan to the small bank, which cannot give back the money to depositors. In sum: everybody loses. Where have the depositors' funds gone? The firm made use of them to finance an unsuccessful project; yet, depositors were not aware of how their money was being used.

35. Fragility of the financial sector: leverage and the need for regulations

Definition 35.1. Leverage. Leverage represents the extent to which borrowed money is used to finance an investment.

Example 35.2. Investing your own money. An investor plans to buy shares in period t for €100 in order to sell them in the next period $t+1$. The investor believes that, with probability $\frac{1}{4}$ (a 25% chance) the price of the shares in $t+1$ will raise to €120 and believes that, with probability $\frac{1}{4}$ (a 75% chance) the price of the shares in $t+1$ will fall to €60. The expected rate of return r^e of buying the shares in t (with the investor's own money) and selling them in $t+1$ is 5%. This result is calculated as follows, using the next definitions.

R revenue that the investor obtains when the shares are sold in $t+1$
S the amount of money, owned by the investor, spent on purchasing the shares in t
r_- rate of return when the price of the shares falls
r_+ rate of return when the price of the shares raises

• If the price went down, the rate of return would be $r_- = \frac{R-S}{S} = \frac{60-100}{100} = -\frac{40}{100} = -\frac{2}{5} = -40\%$.

• If the price went up, the rate of return would be $r_+ = \frac{R-S}{S} = \frac{120-100}{100} = \frac{20}{100} = \frac{1}{5} = 20\%$.

• The expected rate of return r^e is the weighted average of the two previous rates of return: $r^e = \frac{1}{4}\cdot r_- + \frac{3}{4}\cdot r_+$.

That is, with probability $\frac{1}{4}$ the rate of return −40% is obtained and with probability $\frac{3}{4}$ the rate of return 20% obtains. Consequently, the expected rate of return is $r^e = \frac{1}{4}\cdot\left(-\frac{2}{5}\right) + \frac{3}{4}\cdot\left(\frac{1}{5}\right) = \frac{-2+3}{20} = \frac{1}{20} = 0.05 = 5\%$.

Example 35.3. Investing your own and borrowed money. Consider Example 35.2 again, but now assuming that money can be borrowed at 1% in period t to be repaid in the next period $t + 1$. Suppose that the investor borrows €20 and pays the remaining €80 with his or her own money. Now the expected rate of return is higher: 6%. To see this, take the following definition.

L amount of money borrowed + payment of 1% interest on the amount borrowed = amount of money borrowed multiplied by $(1 + \frac{1}{100})$.

• If the price went down, the rate of return would be $r_- = \frac{R - S - L}{S} = \frac{60 - 80 - 20\cdot(1 + \frac{1}{100})}{80} = -\frac{40 + \frac{1}{5}}{80} = -\frac{40.2}{80} = -\frac{201}{400} = -0.5025 = -50.25\%$.

• If the price went up, the rate of return would be $r_+ = \frac{R - S - L}{S} = \frac{120 - 80 - 20\cdot(1 + \frac{1}{100})}{80} = \frac{20 - \frac{1}{5}}{80} = \frac{19.8}{80} = \frac{99}{400} = 0.2475 = 24.75\%$.

• The expected rate of return is $r^e = \frac{1}{4}\cdot r_- + \frac{3}{4}\cdot r_+ = \frac{1}{4}\cdot\left(-\frac{201}{400}\right) + \frac{3}{4}\cdot\left(\frac{99}{400}\right) = \frac{96}{1600} = \frac{6}{100} = 0.06 = 6\%$.

A measure of leverage would be the amount of borrowed money used to purchase the shares with respect to the amount of own money invested in the purchase. In this case, $20/80 = 25\%$.

The comparison between Examples 35.2 and 35.3 suggests that more leverage leads to both a higher (expected) rate of return and a higher risk. Leverage magnifies results by increasing the volatility of the rates of return. In fact, assuming the investor's belief correct:

• if the price falls, the rate of return without leverage is –40%, yet with leverage it is –50.25%;

• if the price raises, the rate of return without leverage is 20%, but with leverage it is 24.75%.

Putting limits on leverage (among other financial regulations) seems to be needed to prevent investors from assuming excessive risks when looking for higher rates of return.

36. Fragility of the financial sector: systemic risk

Example 36.1. Diversification, systemic risk, and asystemic risk. The government of Spain issues T-bills. With probability $\frac{2}{3}$ the government pays the full nominal value of the T-bill at maturity, in which case the profit an investor obtains from buying a T-bill is €60. But with probability $\frac{1}{3}$ the government only pays a fraction of the nominal value at maturity and, in this case, the investor losses €30 from each T-bill bought. Consequently, the expected return of investing in a T-bill is $\frac{2}{3}\cdot 60 + \frac{1}{3}\cdot(-30) = \frac{90}{3} = 30$ EUR. Assume the investor is willing to buy two T-bills. As a result, the expected return is 60 EUR.

Now imagine that the government of Greece issues T-bills with exactly the same characteristics: with probability $\frac{2}{3}$ investing in a Greek T-bill generates a profit of €60 and with probability $\frac{1}{3}$ it yields a loss of €30. Suppose that the investor considers two investment options.

• Option 1: to buy two Spanish T-bills.

• Option 2: to buy one Spanish T-bill and one Greek T-bill.

As shown above, option 1 yields an expected return of €60. There are two states of the world associated with option 1. In one state, the Spanish government pays the T-bill at maturity, whereas in the other state the government defaults, which causes a loss to the investor.

From the investor's perspective, option 2 gives rise to four states of the world: in one state, both governments honour the debt; in another state, the Spanish government honours the debt and the Greek government defaults; in a third state, the Greek government honours the debt and the Spanish government defaults; and in the fourth state both governments default.

Assume that the four states are uncorrelated; that is, the probability that one government defaults (pays) is independent of the probability that the other government defaults (pays). In this case, Table 10 below calculates the expected return of option 2.

state		state probability	return of option 2	expected return
1	ESP pays GRE pays	$\frac{2}{3}\cdot\frac{2}{3}=\frac{4}{9}$	$60+60=120$	$120\cdot\frac{4}{9}$
2	ESP pays GRE defaults	$\frac{2}{3}\cdot\frac{1}{3}=\frac{2}{9}$	$60+(-30)=30$	$30\cdot\frac{2}{9}$
3	ESP defaults GRE pays	$\frac{1}{3}\cdot\frac{2}{3}=\frac{2}{9}$	$(-30)+60=30$	$30\cdot\frac{2}{9}$
4	ESP defaults GRE defaults	$\frac{1}{3}\cdot\frac{1}{3}=\frac{1}{9}$	$(-30)+(-30)=-60$	$(-60)\cdot\frac{1}{9}$
			AVERAGE EXPECTED RETURN	$\frac{480}{9}+\frac{60}{9}+\frac{60}{9}-\frac{60}{9}=60$

Table 10. Computing the expected return of buying a Spanish and a Greek T-bill under uncorrelation

The result should not come as a surprise because the aggregate expected return comes from the convex combination of two investments (buying a Spanish T-bill and buying a Greek T-bill) that have the same expected return. A first lesson of the example is that risk falls without having to reduce the expected return. Specifically, if risk is associated with the possibility of a loss, then:

• under option 1, there is a possible loss of €60 and this loss occurs with probability $\frac{1}{3}$, whereas

• under option 2, there is a possible loss of €60 and this loss occurs with probability $\frac{1}{9}<\frac{1}{3}$.

This abracadabra outcome is the consequence of presuming asystemic risk, namely, that the risks corresponding to each option are uncorrelated: failure of one investment (for instance, the Greek government defaults) does not make failure of the other investment (the Spanish government defaults) more likely. In sum, in the example, asystemic risk means that default is uncorrelated across governments.