

What is Money?

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It is early Autumn 2014. A philosopher, an economist, an (ex-)banker and a computer scientist are having a meeting at CWI, the Dutch national centre for research in mathematics and computer science, in Amsterdam. Their plan is to arrive at a better understanding of the present international financial crisis by clarifying basic concepts and by learning from one another. They have decided to try to crack a difficult nut first: what is money?

Philosopher: Thanks for agreeing to take part in this discussion. In my invitation to you I mentioned Rohit Parikh’s plea for an enterprise of *social software* [10], in which logicians, philosophers, and computer scientists collaborate with social scientists to gain a better understanding in the social mechanisms that make our societies tick, or sometimes cause them to break down. I challenged you to explain to me what money is. I have tried to prepare myself for this meeting by means of a bit of preliminary reading in economics textbooks, but if anything this left me more confused. It seems clear to me that money is an agreement in a community, just like a marriage agreement or an agreement about shared ownership. Money is part of the construction of social reality [13]. Yet, most textbooks I consulted treat money as some kind of ‘thing.’

Computer Scientist: I suppose in the days when people still paid their debts in coins made of precious metal, it was quite easy to understand what money was. Just pieces of convenient stuff valued by everyone, and therefore suitable as a medium of exchange.

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Economist: Money whose value comes from a commodity that it is made of, such as gold, silver or copper, is called commodity money. Gold coins have value in themselves as well as value in their use as medium of exchange.

Philosopher: But what makes gold precious or valuable in itself? Why do people want to have it? Let us see. It is easily divisible, it is scarce, it is reasonably easy to carry around, it does not deteriorate, it is hard to counterfeit, it can be used to make beautiful jewelry. Maybe these are all connected?

Economist: Well, does it matter? Let us say that the intrinsic value of a gold coin is what people are willing to trade it for. At some point the intrinsic value of coins will start to deviate from its nominal value. Usually there is a government that sets the nominal value of the coins.

Computer Scientist: Thus creating all kinds of difficulties. I remember a time in the Netherlands when the silver in a one guilder coin was worth more than the nominal value of the coin. These silver guilders quickly disappeared from circulation.

(Ex-)banker: That is a well-known phenomenon called Gresham's law. When a government undervalues one kind of money, that kind of money tends to disappear from circulation because it is hoarded.

Computer Scientist: Yes, these silver guilders were quickly replaced by nickel guilders. In normal circumstances, the metal value of coins is never more than its nominal value.

Philosopher: But if the government issues paper money, and rules that a paper guinea is worth the same as a guinea coin made of gold, then people are not hoarding the gold guineas. Why not?

Economist: Indeed, they will not, as long as they trust the statement of the government that the paper bills can be exchanged at any moment for the gold coins.

Philosopher: You seem to believe that what makes money valuable is this connection with precious metal. That's also the message I get from the textbooks I consulted. In primitive times, there was barter, but since it was inconvenient when you had to go to the baker with something the baker wanted in exchange for bread, cash was invented. Suddenly exchanges at

armories, bakeries, breweries, became a lot easier.

Computer Scientist: That story is hard to believe, isn't it? Well, you have proposed to us to investigate the concept of *money* from the perspective of social software. I find it remarkable that a social software treatment of money has not already been done. The closest we got with methods from computer science was to simulate scrip systems to study how they can be optimized.

Philosopher: What is scrip?

Computer Scientist: Artificial money. Token money. Kash, Friedman and Halpern [6] give a lucid description, taking their lead from the story of the Capitol Hill Baby Sitting Co-op, which issued coupons that were good for baby sitting services. These coupons had to be earned by taking care of babies of other parents. It turns out that there is an optimum for the number of coupons that have to be in circulation for a given number of participants. The authors engage in a game-theoretical analysis, distinguishing various kinds of agents besides the standard ones: altruists, hoarders. Having altruists is the same as adding money. Having hoarders has the effect of removing money. Too many altruists or too much money make the system break down. So game theory can be used to analyze how money functions, to some extent.

Philosopher: But surely this is just one aspect of the role of money. It seems to me that real money, as opposed to token money, acts as a capability multiplier. The more money an agent has, the greater his or her powers in the game. Players without money have almost no power in the game. Players in debt to other players become virtually enslaved.

Computer Scientist: Ample scope for game theoretic modelling and logical analysis, but it seems to me that we still have to start.

Philosopher: And part of the problem with starting the analysis is confusion about the nature of money. In a paper [8] written in 1913 Alfred Mitchell Innes exposes the story of a barter economy that got replaced by a money economy as a myth invented by Adam Smith [14]. It got repeated by economy textbook writers ever since, but Mitchell Innes believes that it is false. Instead of bartering, people just kept track of mutual obligations, and if they used money then only as a unit of accounting. "Money [...] is credit and nothing but credit. A's money is B's debt to him, and when B pays his debt, A's money disappears. This is the whole theory of money."

Computer Scientist: So there was hardly ever a need to exchange coins for goods?

Philosopher: This leads to a different or complementary theory of money. The way Georg Friedrich Knapp explains it, in a book written in the 1920s, money originated from the attempts of states to regulate economic activities [7]. The state creates indebtedness of its subjects by levying tax on imports and on the produce of farming. Once these obligations exist, the state can rule that they can be paid off in the paper money of the state. This is what gives the paper money its value. As Knapp states in the first sentence of his book, “Money is a creature of law.”

(Ex-)banker: Still, gold coins existed before paper money, and the coins were worth what the gold was worth, there is no way around it. And historically it was banks who first issued paper notes. As long as people trust the bankers, they will not hoard gold but use the much more convenient promissory notes issued by the bank.

Philosopher: It is not so clear what existed earlier, tally sticks for keeping track of debet and credit, or coins. But let’s accept your story for now. Then this is how it goes on: the bankers soon discover that it is not necessary to have one million pounds of silver in their vaults to cover the worth of one million promissory notes “Good for one pound of silver.”

(Ex-)banker: This was in fact discovered by goldsmiths who gave out notes for gold deposited with them for safekeeping. They observed that people do not all reclaim their deposit at the same time, and they saw no objection to invest part of the gold that they had received for safekeeping.

Economist: Indeed, as Adam Smith observed, two hundred thousand pounds of silver would be enough to cover the worth of promissory notes for one million pounds sterling. In fact, two hundred thousand government backed pound notes would also have been enough.

(Ex-)banker: The reserve requirement (or cash reserve ratio) is a regulation by the central bank setting the minimum fraction of deposits and notes that each commercial bank should hold as reserve. The 20 percent that Adam Smith suggests is very high, by modern standards. Nowadays, Chinese banks have this. In the USA it is more like 10 percent. In the Euro zone it is much less still.

Computer Scientist: And the converse of the cash reserve ratio, is that what is called the money multiplier?

Economist: That's right. But there is fierce debate among economists about whether the money multiplier exists [2].

Computer Scientist: One way to think about the cash reserve ratio R is by saying that a bank is allowed to lend out $(1 - R)X$ of every deposit X that it receives. Next, this money can be put in deposit again. either with the same bank, or with another bank, it does not matter. Suppose for simplicity it gets deposited with the same bank. Then $1 - R$ of the new deposit can be loaned out again. This is $(1 - R)^2X$. And so on. This is a geometric series. Let's see. The original amount X gets multiplied to

$$X + (1 - R)X + (1 - R)^2X + \dots$$

Applying the formula for a converging geometric series this gives

$$\frac{X}{1 - (1 - R)} = \frac{1}{R}X.$$

So the money multiplier is indeed the converse of the reserve ratio.

Economist: An easier way to see this is as follows. The bank receives X in deposit. If the deposit consists of cash, it simply reasons, hey, we have to keep fraction R of our loans in reserve, so on the basis of this new cash deposit X in our vaults we can loan out $\frac{1-R}{R}X$. Together with the deposit X this gives $X + \frac{1-R}{R}X = \frac{1}{R}X$. So $\frac{1}{R}$ is the money multiplier. This is explained in many places, in books you can download from internet [9; 11].

Philosopher: The money multiplier explains why it is a severe threat to the financial system when a really large bank fails, I suppose. If the bank is worth one billion dollars, we may assume it has a cash reserve of about one billion dollars. Assuming a reserve ratio of 10 percent, when it goes bankrupt ten billion dollars get destroyed. In fact much more gets destroyed, for the banks lend out much more than allowed by the cash reserve ratio.

(Ex-)banker: You are forgetting that the money was lent out in exchange for securities, an entitlement to your house, for instance. The net worth of a bank is not equal to its cash reserve ratio, but to the difference between

its assets and its liabilities. When the bank goes bust the securities are still there. How much gets lost depends on the quality of the collateral. Often, the collateral cannot easily be turned into money. So if there is a run on a bank, there is not enough money to pay the worried customers.

Computer Scientist: Here is a famous quote:

Banking was conceived in iniquity and was born in sin. The Bankers own the earth. Take it away from them, but leave them the power to create deposits, and with the flick of the pen they will create enough deposits to buy it back again. However, take it away from them, and all the great fortunes like mine will disappear and they ought to disappear, for this would be a happier and better world to live in. But, if you wish to remain the slaves of Bankers and pay the cost of your own slavery, let them continue to create deposits.

Philosopher: Who said that?

Computer Scientist: Sir Josiah Stamp. He was president of the Bank of England in the 1920's, and the second richest man in Britain at that time.

Philosopher: And was he serious?

(Ex-)banker: There is no doubt he was. And right too. The only surprising thing about the quote is that it is unusually frank and lucid, for a banker. You should know that I decided to quit my profession some time ago.

Computer Scientist: I can see that with a scheme like this, backing up by some government assurance is important. But this government-backing has ceased, right? In 1971 Richard Nixon unilaterally cancelled the direct convertibility of dollar bills into the gold in Ford Knox.

Philosopher: And still, people continue to trust dollar bills.

Economist: Right now, the USA has an astronomical national debt of more than 17.6 trillion dollars, in the American sense of 'trillion'. That is 17.6 times 10^{12} dollars. Mind you, this is the debt of the government that is backing up the dollar bills.

Philosopher: So why do people still trust dollar bills? Can anyone explain

this to me, please?

(Ex-)banker: If the figure of 17.6 trillion dollars scares you, let me remind you that the Gross Domestic Product of the US in 2014 is also roughly 17.6 trillion dollars.

Economist: Maybe we should talk a bit more about what money is, and then hope that gradually things will become clearer. For it is definitely not true that all money consists of either government-backed notes or bullion. In fact, most money is of a different kind.

(Ex-)banker: Money not backed by a guarantee of convertibility to anything else is called fiat money. What gives fiat money its value is the ruling that it is legal tender: it cannot be refused as payment for debts. Also, you can pay your taxes with it.

Philosopher: If it is the government that creates and circulates the money, why does it give it to the people first, and then takes some of it back later? Why not simply keep some of it in the first place? Why doesn't the central bank simply transfer the tax amount to the treasury each month?

(Ex-)banker: Something like a automated national tax payment from freshly created money? That would be cool. But when the central bank creates money, it does not simply *give* it to the taxpayers. Instead, it brings money into circulation by *buying* something with it, for example government bonds.

Philosopher: Still, if the state has the power to create cash, why not credit the new money as state revenue? Isn't this precisely what monetary reform activists propose [5]?

Economist: But cash is not the only kind of money. There is another kind that gets created by banks. Call this IOU money, or more precisely, spendable IOUs. These are created over and over. My colleague professor Charles Goodhart gives a nice explanation. See www.fractionalreserves.com.

(Ex-)banker: Goodhart is professor emeritus of banking and finance, London School of Economics. Not precisely your colleague.

Philosopher: Never mind. Can you summarize his explanation for us?

Economist: Goodhart explains it with a story. Mick wants to borrow 10 pounds from Jim. So he writes an IOU ("I owe you") for 10 pounds, signs

it, hands it over to Jim, and receives his 10 pounds. When Mick repays the loan, Jim will hand back the IOU agreement and dispose of it. It has done its job. An IOU gets created, next there is a period of time when it has value, and finally, when the loan gets repaid, the IOU has no further use and expires.

Philosopher: You say that the IOU has value. But the IOU note is not money. If Jim takes it to his local pub to pay for his beer, the note will be refused.

Economist: That depends a bit on whether the publican knows Mick. If not, then it will be refused, yes.

(Ex-)banker: But that situation changes when a bank puts its stamp of approval. Then the bank says that the IOU note is as good as a 10 pound note.

Economist: These are spendable IOUs. When a spendable IOU gets created, it gets created out of nothing. It did not exist before, and it was not created from anything else, nor obtained from anybody else.

(Ex-)banker: See, this is what happens all the time. You go to the bank, sign an agreement that you owe them 200,000 euros, with the house you are going to buy as security against the loan, and you receive 200,000 euros on your account. The snag is that this is not money they have and lend to you.

Computer Scientist: By government regulation they only need to have 20,000 euros themselves against the 200,000 euros they give you. Still, they receive interest from you on 200,000 euros.

(Ex-)banker: What you are giving now is the textbook account. This is not exactly how it happens. If you go to the bank and ask for your mortgage, do you really think the desk clerk first looks at her computer to see if the bank still has ten percent of the money they are going to lend to you? Of course not. She just presses a button, and lo and behold, next time you log in to your bank account you see that you have 200,000 euros extra to your credit. And when you close your deal with the former owner of the house you buy, the 200,000 euros disappear from your bank account and make their appearance on his. Banks operate within an electronic clearing system that nets out multilateral payments at the end of each day. So they need to hold only a tiny proportion of central bank money to meet their payment

requirements. Much less, in fact, than the cash reserve ratio.

Computer Scientist: The story brings to mind a quote from John Kenneth Galbraith:

The study of money, above all other fields is one in which complexity is used to disguise truth or to evade truth, not to reveal it. The process by which banks create money is so simple that the mind is repelled. [3]

Economist: Next, Goodhart explains the bathtub model of money circulation. If the bank's seal of approval can change a non-spendable IOU into a spendable IOU, then with every bank loan the bank is effectively creating money. If the bank grants you a loan, the bank gets you to sign an IOU. In return they give you a checkbook, or access to an electronic account by means of a debit card. So the bank loan is effectively an IOU swapping exercise.

(Ex-)banker: Money is created when loans are made. Money disappears when loans get repaid. So money is continually being created and destroyed. It flows into the bathtub at the tap, as new loans being made. It flows out at the sink, as repayments of loans. So the supply of money in the system depends critically on the rate of flow in and out of the system. Banks make their money on the difference between what they earn making loans and what they spend in paying interest to depositors and to lenders like the central bank.

Philosopher: Well, banks are there to make money, I suppose. But it surprises me they do it in such a very literal sense. Your story makes lots of things clear. It explains why banks charge no money for taking care of our money, for instance. They lend out our money and earn interest on it as soon as we deposit it.

Economist: In the golden age of Dutch banking, in the Seventeenth Century, the Bank of Amsterdam charged a fee for deposits in silver or gold.

(Ex-)banker: Indeed, for a while the Bank of Amsterdam, maybe the first example of a central bank, functioned on a full reserve basis. But that was abandoned in 1657, when the bank started to allow depositors to overdraw their accounts. Also, it was providing large loans to the City of Amsterdam and to the Dutch East India Company. This was initially done in secret,

and when it became public knowledge the bank got in trouble and had to be taken over by the City of Amsterdam, in 1791.

Philosopher: Well, it seems to me that this system where banks can lend out money they don't have is dangerous.

Computer Scientist: I don't mean the defend capitalist economy, but cash reserve ratio is one of the fundamental concepts that fueled the global economical development. I don't think that people invented this system to be evil. It simply makes sense. After all, even after all the economical melt-downs, still, global and national economies are in gain. They take some backwards steps from time to time, but it is always improving in a larger scale in capitalist societies.

Philosopher: You seem to agree with Mitchell Innes. Here is a quote from the paper I mentioned [8] that I found so remarkable that I made a note of it: "To attempt the regulation of banking by limiting the note issue is to entirely misunderstand the whole banking problem, and to start at the wrong end. The danger lies not in the bank-note but in imprudent or dishonest banking. Once insure that banking shall be carried on by honest people under a proper understanding of the principles of credit and debt, and the note issue may be left to take care of itself."

Computer Scientist: Well, that sounds a bit naive, doesn't it? I think honest or dishonest is beside the point. The money trade is a game, so we should talk about the rules.

(Ex-)banker: Yes, there is a definite need to rethink the rules of the money game. One could argue that institutions like the IMF and the WTO are causing untold misery to people in third world countries, and are now helping to turn countries like Greece into places of misery too.

Philosopher: Let me ask you an important question. (*Takes a 10 Euro bill from his wallet.*) Does this 10 Euro bill represent wealth, or would it be more accurate to say that it represents debt? I am asking this because I recently read David Graeber's *Debt* [4]. Graeber is an anthropologist who argues that money turns personal obligation into impersonal debt: "...money [has the capacity] to turn morality into a matter of impersonal arithmetic — and by doing so, to justify things that would otherwise seem outrageous or obscene."

(Ex-)banker: Wow! Well, your bill is cash. You can keep it indefinitely, but

it will lose its value by inflation. Or you can deposit it in a bank. And the instant you deposit your money, the bank starts playing musical chairs with all but a tiny fraction of it.

Philosopher: In itself, that is not a problem. For if the bank creates money, the created money always gets exchanged for an IOU of the lender, isn't that right?

(Ex-)banker: That is exactly right. And the big problem right now is that nobody knows what all these IOUs are really worth. For that you need to know who owes what to whom, and what else they possess. Right now, this is a great mess, and it needs to be disentangled. This is all clearly indicated in a blog by Rick Bookstaber [1].

Computer Scientist: Wait, wait. Let us go back to the 10 Euro question, for I think we can answer it now. The 10 Euro bill represents credit or debt, for that is the same thing, depending how you look at it. You can use it to fulfil an obligation of a very specific weight, to any stranger, for money quantifies obligation and makes it anonymous. And how can this magic occur? By the power of a state — or a community of states — ruled by law, that is behind all this.

Philosopher: Yes, and we can say more. The value of 10 Euros now is different from that of 10 Euros a year in the future. Economists call this time discounting, I believe. Also, the value of 100 Euros to a poor person is very different from what 1000 Euros offer an affluent one. Economists call this diminishing marginal utility of money. And the function of money in bankers' trading is very different from that in buying bread, or in saving for one's pension.

Economist: The function of money in buying bread is as a means of exchange. The function of money in saving for one's pension is as a store of value. The function of money in banker's trading, I am not so sure.

Philosopher: I propose to leave that for another occasion. A social software study should at least analyze three different functions of money: medium of exchange, store of value, unit of account. And it may well end with a plea for reform. Advocates of monetary reform usually start with an analysis of how money functions in society, and then move on to how it *should* function [5; 12].

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