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Money as things vs. money as pure information

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Introduction

Apologies. Could not realize initial project: Price formation in theories of money. Turned out to be too complicated. Instead, I discuss a more primitive issue that has to do with the way actions are coordinated with the help of money. Do agents need “tangible monetary objects” or to what extent can they rely on “pure information” when using money?

Money as pure information?

As can be observed in any supermarket, contemporary money comes in many forms: cash, “plastic”, checks are used as means of payment and the differences between them do not seem to matter. That more and more payments are accomplished without the use of cash, of tangible money objects like coins or central bank bills, has led to the belief that cash –if not money as such--is about to disappear. There are people who will tell you with a certain pride that they are not touching the stuff anymore. As we all know: *pecunia non olet*, money does not stink. So what are the reasons for such pride? Is it really more convenient to pay a taxi with a credit card than with cash? More secure? More reliable? More up to date?

More seriously, there is a growing conviction that „money is independent of the means whereby it is represented, taking the form of pure information“ (Giddens 1990:25). Searle has recently pointed to a difficulty in his earlier frequent use of money as an example of a physical fact, the green piece of

paper, being the carrier of an institutional fact, the dollar bill, according to his „X counts as Y in C“ formula. Searle explains that he was „operating on the assumption that currency was somehow or other essential to the existence of money“, but he no longer thinks so:

„You can easily imagine a society that has money without having any currency at all. And indeed, we seem to be evolving in something like this direction with the use of debit cards. All you need to have (as) money is a system of recorded numerical values whereby each person (or corporation, organization, etc.) has assigned to him or her or it a numerical figure which shows at any given point the amount of money they have. They can then use this money to buy things by altering their numerical value in favor of the seller, whereby they lower their numerical value, and the seller acquires a higher numerical value“. Of course, this raises the question of who will do the recording and assigning, but let us leave that aside for the moment. In short, Searle says, „currency is not essential to the existence or functioning of money“. (Searle 2005: 19f.)

Even hard-core monetary theorists who start by describing the economy in physical terms alone arrive at propositions like: „Money is memory“ (Kocherlakota 1998). More exactly, Kocherlakota tries to show that money, in the form of tangible money objects, is functionally equivalent to a sort of public record-keeping institution. There, as in Searle’s cashless world, „an imaginary balance sheet is kept for each agent. When an individual gives consumption to someone else, his balance rises, and his capacity for receiving future transfers goes up. When he gets consumption from someone else, his balance falls, and his capacity for receiving future transfers declines.“ The conclusion is that in the world we actually live in, “money is merely a physical way of maintaining this balance sheet.“ (Kocherlakota 1998: 233).

More empirically bent writers have examined the experiences with innovations like „electronic cash“ or EFTPOS (“electronic fund transfers at the point of sale”). But the story is the same:

“Indeed, it is possible to imagine a world in which there is no need for any specific medium of exchange, but the means of payment is provided by

bookkeeping entries that track changes in ownership of financial assets arising from economic trades. If, for example, agent A purchases an item from agent B, this transaction can be settled by a cheque or EFTPOS instruction subtracting the item's price from A's bank balance and crediting it to B's account, without the need for any medium of exchange." (Dalziel 2000: 381)

All three writers ask us to "imagine" a world slightly different from the one we experience in our daily use of money in order to argue that cash is not a necessary ingredient of a monetary economy. To use a bit of imagination is a welcome theoretical device, but is money in the form of tangible cash really just a functional equivalent for "a (typically imperfect) form of memory" (Kocherlakota 1998: 233)? Isn't the role of money somewhat broader? What are the conditions for replacing these old-fashioned, circulating, tangible money objects by social bookkeeping arrangements?

Money and budget constraints

A link between the "money as pure information"-argument and the proposition that money no longer has to take the form of tangible money objects is suggested in Niehans' theory of money:

„Exchange is a way to make sure that nobody can escape his budget constraint(s). If one could be perfectly certain that everybody always stays within his budget constraint, everybody could be allowed to obtain goods without a specific *quid pro quo*." (Niehans 1978: 62f.)

In other words, monetary exchange using cash, along with barter, solves a problem that any economy beyond the household of an isolated Crusoe has to solve: People have to be prevented to spend more than they earn or own as wealth. One way to describe the problem is to imagine the set of all commodities as a common pool of resources. As a general rule, based on norms of justice, nobody should take out more than he or she contributes without the consent of the others. To solve the problem, the first thing needed is an accounting system that defines equivalence relations over the set of all commodities. Otherwise, if we want to be sure about everybody respecting

budget constraints, a player who delivered corn to the pool could only take out corn, since all we know is that 1 lb of corn is equal to 1 lb of corn.¹ In order for the corn producer to take out meat, there has to be a commonly accepted corn/meat transformation ratio. If there are n different commodities, we need to define $1/2n(n-1)$ such transformation ratios.

The question then is: Who is to define these ratios? Can a consensus be reached on all of them? Instead of bothering with the search for a set of uniform universally accepted exchange ratios, for example, by installing a planning authority à la Lange or by applying linear programming to the overall reproduction problem of the economy, a market system provides a decentralized solution: Ownership rights are distributed over the set of all commodities. If they are respected—and, ultimately, we need the state to ensure that—access to any commodity one does *not* own is subject to the consent of the owner. The owner can refuse access by others, demand a *quid pro quo*, or whatever. With each access through barter, a single, more or less arbitrary transformation ratio is defined as a by-product. We can leave open here whether it has any significance beyond the individual transaction in which it was generated. However it is defined, as long as all transactions are spot transactions, all players must stay within their budget constraints, as Niehans stressed. All transactions are subject to a local constant sum condition: if x_a, x_b are the commodity bundles owned by A and B before exchange and x'_a, x'_b are the respective commodity bundles after exchange, $x_a, x_b = x'_a, x'_b$.

Does having to pay cash do the same job? Evidently, to guarantee the respect for budget constraints, the access to money objects has to be governed by the same restrictive ownership rules as the access to commodities. Given that each transaction now generates a price instead of barter ratios. Money becomes not only the tertium comparationis in all transactions, but also the tool that allows a buyer to remove something from

¹ Of course, all sorts of specifications are required in terms of quality, space, time to make such a statement valid.

the ownership of the seller. Observations and comparisons of and communication about transactions are enormously simplified.²

Thus, apart from such simplification, the reason why tangible money objects have been used in most everyday transactions until the recent spreading of credit and debit cards and electronic account keeping could indeed have been: Cash on the spot ensures that buyers stay within their budget constraints. However, there is a question we have to ask Niehans: While an economic system would be easily ruined if nobody had to worry about budget constraints and everybody could shop on credit all the time, this is not a worry for individual agents. All they have to worry about is to get something worthwhile in return for what they trade away. So with money, they have to check whether the money objects they accept are valid, not whether the buyer has not respected his budget constraint, has borrowed, stolen, found money on the street or whatever.

But there is no reason why there should not be other means to accomplish budget discipline. The problem of preventing people to spend more than they have can be solved without the use of money objects as tangible things. In an appropriate institutional setting pure „book money“ is sufficient. If a device can link buyers and sellers to an information system so that the monetary income and expenditure streams between them are recorded by a neutral third party, everybody can pay with a debit card, for example. Access to accounts is controlled and spending is possible only as long as one has a positive balance (or does not overstep the credit line granted by the bank). Payment promises by the buyer can be checked and fulfilled on the spot, so modern information and communication technologies make possible what using tangible money objects accomplishes: Ensuring the imposition of budget constraints.

In contrast to the huge techno-institutional back up required for modern payment systems, using tangible objects as money is a very simple or even primitive functional equivalent. With cash, the worry whether others are respecting budget constraints cannot even arise. Incidentally, such a worry can only plague ordinary private traders if they are asked to accept a promise

² Instead of $1/2n(n-1)$ barter ratios, there will be n prices (or $n-1$, if one of the commodities is used as money).

to pay instead of a spot payment. When receiving cash, there is no reason why the seller of a commodity should worry about the future payment capability of the buyer. Once the commodity and the money have changed hands, the relationship between seller and buyer is finished. The social relation involved in the transaction is an ephemeral (as Max Weber put it) two-player affair. Although the use of money always implies the intrusion of a larger social context into such a two-player setting, this intrusion is rather limited when cash is used. The money object must be recognized as such by the respective currency “community” and it must have come from someone else –it is unlikely to be recognized as money if it is homemade-- and will be moving on to third players in the future. But circulating money objects used in spot transactions connect players only in a loose, short term way. What happened in the *past*, how the buyer got his money, does not matter for the seller: *pecunia non olet*. Once a transaction is completed, rationality dictates to “let bygones be bygones”. What the seller will do in the *future* with the newly acquired money, does not matter to the buyer, either. With respect to a potentially intrusive social environment, the terms of a cash transaction are not controlled or controllable from the outside and they cannot be so controlled retrospectively: “cash leaves no paper trail” (Shubik 1999, I: 236). Such a loose social network -- established by money as cash circulating from a buyer to a seller who turns into a buyer and meets the next seller, and so on-- is insufficient to support the use of credit instruments. By contrast, cashless monetary transactions are possible only if they leave a paper trail. There has to be some background agency keeping the accounts and assuming controlling and mediating functions. In addition, as soon as credit is involved, there has to be a second order institutional background generating and regulating reactions to defaults, bankruptcies, broken promises to pay. To compensate for the loosening of budget constraints through credit, the communication network of the “cashless credit” economy has to be much tighter than the cash network. Or, to put it into the language of search models: If there is a range between no monitoring and perfect monitoring, credit relations are located closer to the perfect monitoring end, whereas cash transactions are close to the no monitoring end.

Limits to money becoming pure information.

To see why the trend toward money as “pure information” rests on the evolution of an adequate institutional back-up, compare the money game to chess: Before the age of the personal computer, one normally learned to play chess by using a board and tangible chess pieces --and a tutor. More accomplished players then learn to read the diagrams depicting a situation in a game and the notation used to keep records of games: d2-d4, d7-d5, and so on. Reiterating such abstraction from tangible objects, some advanced players develop the ability to play whole games by simply announcing their moves and keeping track of the game in their memory. Except for the minimal reliance on physical facts—using brain-cells to memorize previous moves and voices to produce sounds-, two such players can indeed reduce the game to the “form of pure information” (Giddens 1990).

Is this a learning sequence similar to the development of monetary systems? You start playing with board and tangible pieces, you move on to using paper and keeping records and you may end up announcing moves and using memory—without any “embodiment” except some traces in the mysterious brain? Interestingly, in chess that last stage not only demands considerable mental skills, but two people can play in that way only as long as there is no dispute. If White says “check” to the Black King on f7 and Black says: “But my king is on f6”, it is difficult to imagine that these two players can continue the game. They might do so if they can reconstruct every move and agree on where the virtual black king “really” is, but it is more likely that they stop playing and start swearing. It is difficult for them to distinguish between error and fraud by the other player. Written records would help, but only if each move is recorded at the time it is made and the record cannot be manipulated afterwards. Only records written by a third, neutral person to whom the players announce their moves are a sure means to avoid all such difficulties. In other words, blind chess is a sustainable activity only if, or as long as, players trust each other or if a third party records the moves made.

Now, imagine two traders³ frequently buying from and selling to each other. Like the chess players, they could rely on their memories and perhaps meet once a week to check whether they both arrive at the same balance. Then, they could again trade in the next week, starting from that balance. This can go on and on as long as their claims for delivery and payment roughly cancel each other out over time. Not only is there no need for cash to change hands, there is not even a need for written records. As in playing “blind” chess, this can work as long as there is no dispute. A slight difference may be noted: If both traders do not announce the balance simultaneously, some additional trust is required. Let A_1 announce the balance first. A_2 has calculated a different one, but A_1 's balance is more favorable for A_2 . Then A_2 may correct A_1 's error or may exploit the opportunity and make a gain by simply announcing the same balance as A_1 . There are several ways to avoid such a risk and to settle disputes in general. First, you can select your trading partners according to their reputation for honesty.⁴ Second, in case of a discrepancy, the traders can go through their transactions together step by step, identify the one on which they disagree and try to settle their dispute and find the correct balance. Third, if they cannot trust each other, they can use written records of transactions that cannot be altered but can be examined *post factum* by both. Fourth, they can use a third neutral person to record their transactions as they take place and do the accounts.

What does this analogy between chess and trade tell us about the need for cash, for tangible money objects? As long as there is no dispute, memory can do the work of cash flows. But one has to keep in mind that memory is something distributed among players with divergent, opposing interests. Disputes are likely. To avoid or resolve them, a third agent is required, either the “public” or a trusted neutral third agent who can keep records and do accounts. Thus, memory as record keeping can do the work of cash flows. Money is still required for price formation and accounting, but only on the level of mental representations that can be communicated in the language of prices and recorded in writing. No tangible money objects have to be present or

³ With more than two traders, additional problems of trust emerge, but the limits to cashless and unrecorded buying and selling can be made clear in the two trader case already.

⁴ Max Weber (1970a: 305) described the role of membership in protestant sects in the United States as a foundation for economic networks along those lines. Reputation is related to history and monitoring.

change hands. There may be a point where cash may still enter the game: If there is a prolonged, sizeable imbalance in transactions, one of the traders looks more and more like a debtor and the other like a creditor. The latter may demand at some point that the imbalance be corrected: Pay up. Settlement will also be demanded if one of the traders wants to discontinue the relationship.⁵

In sum, cash can be replaced by records of transactions, preferably written by a neutral third party. Cash will still be needed if balances have to be settled. One effect of replacing cash by monitoring and keeping accounts is a considerable, if unacknowledged tightening of the social network of money users. The implication of the “money is memory”-argument is extreme in that respect: If all actions were perfectly monitored by Big Brother and the records were publicly accessible so that everybody could know on demand what everybody else had ever done, there would be no need for circulating money as a means for enforcing budget constraints. But there would be a steeply increased interdependence of transactions. Instead of acting on vague notions of the state of the world and hunches of where it is going, it is assumed that players could and would act on the tremendous amount of information collected. By contrast, tangible money objects are needed only in contexts of “imperfect monitoring”⁶. By showing cash, a buyer can demonstrate on demand that the claim he makes on resources is valid: Excluding force, fraud and forgery, holding money is proof that he has earlier on done something that was worthwhile to be paid for by at least one holder of money. So if he has earned enough cash earlier to pay the price agreed upon

⁵ In a pure credit system à la Wicksell (1898), such settlements between any two traders may be accomplished by using the promise to pay of a third party. To illustrate, this is how the billbroker Chapman described a crisis situation before a 19th century British parliamentary committee: “If ..there should be no currency to settle the transactions at the clearing house, the only next alternative ...is to meet together, and to make our payments in first-class bills” (quoted in Marx 1992: 605)

⁶ Perfect monitoring is the active side of perfect memory. Some agency collects information, stores it and makes it available to those interested: “To emphasize the role played ... by perfect monitoring, consider its polar opposite: no monitoring in the sense that each person’s previous actions are private information to the person. If so, then a person could misrepresent to any extent his or her assigned value of any intangible state variable. In other words, if there is no monitoring, then to have an intangible state variable play the role of money would require that any possible misrepresentation of the intangible state variable is also possible for holdings of money. However, misrepresentation of holdings of a tangible object is limited by the possibility that others can at least say „show me.“ (Wallace 2000: 850) So either money objects have to be tangible or monitoring has to be perfect, but there seem to be a lot of possibilities in between.

in the transaction now, business can go on with very limited knowledge⁷. The seller does not have to know or trust the buyer, all he needs to know or trust is the buyer's money.

Money, common knowledge and conflicts of interest as foundations of price formation

Neil Wallace has argued that in an adequate theory of money, money has to be "essential". To see whether money is essential in a given model, he suggests to construct a functional equivalent for money. If such a functional equivalent exists, then money is not essential. This led Wallace to the proposition that money is essential in a context of "imperfect monitoring". In other words, if all actions were perfectly monitored and everybody knew what everybody else had ever done, then there would be no need for money. The argument is analogous to Kocherlakota's proposition that money is memory. According to both arguments money in the form of tangible objects is needed to show that the claim one makes on resources held by others is legitimate because one has provided a corresponding service or produced a good for somebody else before. One can hold money as part of the initial endowment, but beyond that my holding money is proof that I already have done something worthwhile for (some member of) the community of money users. I have contributed to the basket of goods or the stream of services, therefore I can now legitimately demand a corresponding share of the total available resources. It seems that perfect memory and perfect monitoring lead to the same result: Common knowledge. So the Wallace/Kocherlakota hypothesis is: If it were common knowledge –knowledge shared by all the players involved-- that a player has done something worthwhile in the past, that player would not have to rely on money now.

The argument ignores an essential function of money, however: The general knowledge that I have performed a haircut for agent *i* does not imply that

⁷ That markets require only limited knowledge was Hayek's one big and valid point in the so-called planning debate in the 1930s. Because Lange (1936/7), defending the possibility of socialist planning, pointed out the functional equivalence of an all knowing central planning board to a Walrasian market with an all knowing auctioneer, Hayek had to reject Walrasian general equilibrium analysis (Hayek 1976).

everybody agrees on how relevant my contribution was. I will be able to forward my claim to a share of the available resources corresponding to my service only if agent *i* rewarded me either with a generally accepted means of exchange or if agent *i* registered such willingness to pay a definite amount with a bank that adjusted our accounts accordingly. The alternative could be a board supervising all transactions that acknowledged the size of my contribution in terms of a generally applicable unit of account. But how can the board arrive at generally acceptable evaluations. By contrast, in a decentralized monetary economy, the fact that agent *i* pays me a definite amount of money signals simply that I have found *one* person willing to make a quantitatively determinate sacrifice for my service. While nobody else will have to agree that the price agent *i* paid for my service was appropriate, after receiving the money, I can turn around to buy something else, selecting from a large set of sellers appearing on the market. My *individual*, particular contribution to the well-being of another player has been transformed into *general* purchasing power. The price I pay with it is subject to a separate agreement to be reached *now* between myself and the seller of the commodity I want to buy. So there are two transactions, one past, one present. I can form a link between them as the holder of a definite amount of money, but the former does not determine, it only constrains the latter. Both transactions result in prices, but the determination of those prices is taking place on the spot, one in the past, one now. The “perfect monitoring” or “money is memory” argument does not say explicitly why perfect information on past transactions should be relevant for current or future price formation except as a constraint on the ability to pay of a potential buyer. In that argument, whether implicitly or explicitly, prices are frequently assumed to be fixed, given and stable—they are equilibrium prices holding for the period considered. Thus, underlying the “money-is-memory”-argument is an assumption of equilibrium. This rules out a theory of money in which money is used to *form* prices in decentralized transactions. Why? Because if agents move in a world of equilibrium prices over time, they know exactly what they can buy at t_1 with the money (held and) received at t_0 . The story should be one of merely transmitting budget constraints, but not one of only quantity adjustment in view of given prices. If I receive money in an arbitrary

transaction at t_0 , the amount received limits my buying potential at t_1 , but within these limits, I can buy (abstracting from credit at this point) and I can try to bargain about prices.

To illustrate, take Neil Wallace's story of Ellen and the hairdresser. Ellen wants a haircut and has a lecture in economics to offer in exchange. Ellen runs into the standard difficulty of barter, the absence of a double coincidence of wants. As we know, it can be overcome by using money, by splitting the transaction and expanding the game to include more players: Ellen sells her lecture to the university for money. Ellen uses money to buy a haircut. The hairdresser can use the money in turn to buy whatever is in the attainable price range. Wallace argues that such a use of tangible money would be redundant if there was perfect monitoring:

"If everyone knows whether or not the hairdresser provides a service to Ellen, then the hairdresser can be rewarded or punished in the future depending on whether or not the service was provided. The role of tangible money is to provide this evidence. Hence, with perfect monitoring, tangible money is not needed. The result fits well with the somewhat commonplace notion that strangers use money, but that people who know each other well often accomplish trades without using money." (Wallace 2000: 851)

What Wallace appears to overlook: The hairdresser has provided a service to Ellen, but third persons do not have to agree on the value of that service. So the hairdresser cannot—simply by providing the service to agent A—cannot make a quantitatively determined claim on rewards by agents C, D,.... In a self-regulating market economy, price formation takes place in each transaction. Whatever the deal between Ellen and the hairdresser, it is their private affair. With money, they can agree on the price Ellen will have to pay for the service. The hairdresser as a money holder can then go on to buy other goods and services, seeking agreements with sellers and purchasing within the limits of his budget constraint. But he could make definite claims on resources held by others only if there was a fixed, known, accepted and therefore stable set of exchange ratios of haircuts vs. everything else or set of fixed prices in money terms. In other words, by assuming that the mere common knowledge of a service performed is a functional equivalent of

money, Wallace ignores the role of money in decentralized price formation among pairs of buyers and sellers.

To put it a little differently: Given the likelihood of a divergence between individual evaluations and the standard conflict of interest between buyers and sellers, only the hairdresser himself can accept Ellen's economics lecture as a direct *quid pro quo* for his service. Neither he nor Ellen can create an obligation for third persons to accept the lecture as a *quid pro quo*, for example by Ellen writing an IOU for the hairdresser to use. Whether he can use it to buy depends on the willingness of a third agent. Even if she had been paid for the lecture by the university and would use the money received for the hairdresser that would not create a binding obligation for any third agent to accept money from the hairdresser. The terms of a transaction in which the hairdresser is the buyer will have to be negotiated with the respective seller. As soon as the impossibility of barter is overcome by money, we have two transactions which are only loosely coupled.

The argument against the Wallace/Kocherlakota proposition can be summed up very simply: Common knowledge, perfect memory or perfect monitoring do not imply common evaluation.

To sum up: Wallace, Kocherlakota et al. ignore an essential feature of market economies, namely, that prices are formed in pair-wise, decentralized, only loosely coupled transactions. However, this objection does not damage the general proposition that tangible money objects are replaceable and effectively replaced by money more and more taking the "form of pure information"⁸. Given an appropriate institutional backup, there seems to be no reason why those pair-wise, decentralized, loosely coupled transactions cannot be performed without tangible money objects.

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⁸ I do not want to argue about the „purity“ of the information. If we think of the world and its parts as composed of matter/energy and information, monetary systems seem to follow the general evolutionary social trend of using relatively less matter/energy and more information. (Parsons 1966, Wilden 1972)

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