Ontological Issues Concerning Money

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1 Introduction

There has in recent times been an increased interest in the ontology of trust and money, and how to model those [1, 2, 11]. Still, we believe that there are a few puzzling existence and identity aspects of money that seem hard to reconcile. Money, it is said, is debt [8]. But how then can it be that one can burn a bank note and lose its worth forever? Do we burn the debt by setting fire to the note? Do we really lose money in the fire? Or can it be recreated somehow?

The purpose of this discussion paper is to highlight some properties of money and ask ourselves what consequences those properties have for conceptual modelling. Amaral et al [2] identify three commonly used criteria that anything called money must fulfil. Money is:

- "a medium of exchange: a means of payment with a value that everyone trusts; 'money is used as an intermediary in trade to avoid the inconveniences of a barter system, i.e. the need for a coincidence of wants between the two parties involved in the transaction', [5]. Borrowing an example from [13], the statement 'I bought this shirt for 20 euros' reports the use of money as a medium of exchange.
- a unit of account: 'money acts as a standard numerical unit for the measurement of value and costs of goods, services, assets and liabilities', [5]. An example, mentioned in [13], that reports the use of money as a measure of value is the statement 'My car is worth 10,000 euros'.
- a store of value: 'money can be saved and retrieved in the future', [5]. The statement 'I have 1,000 euros in my bank account', [13] reports the use of money as a store of value."

2 A Three Level Model — Physical, Social, Informational

In this paper, we discuss money in the context of a three level model having a physical level, a social level, and an informational level, see figure 1. The physical level contains, as the name suggests, all the objects that make up the physical world. This includes, for example, humans, magnetic areas on disks, or pieces of paper. The social level contains objects that are recognised, in a wide sense, as being parts of a society, for example, persons or organisations. The informational level is tucked in between the physical and the social levels, and it contains information about objects in both the other levels. The point of

those levels is the assumption that the notion of money is somehow related to all of them. We should also note that there are no watertight barriers between the levels. For example, an information system exists arguably on all the three levels.
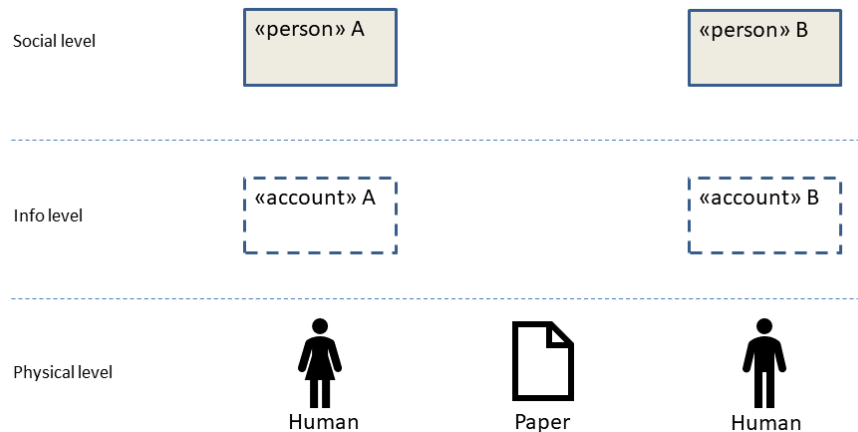

Fig. 1. A three level model

There are correspondences between the levels. What is a human on the physical level corresponds to a person on the social level. And when discussing money, corresponding to a person on the social level is an account on the informational level. However, the correspondence relation between the levels is a somewhat complicated issue. What we first of all want to express is that everything on the social level or the informational level is directly or indirectly grounded in something on the physical level, [6] . When we say that a human on the physical level stands in a correspondence relation with a person in the social level we mean that a human constitutes a person [4, 10]. Constitution postulates the possibility of two objects coinciding physically while still being distinct.

Correspondences between the physical level and the informational level is indirect. The reason for this is that we view accounts as information items signifying persons and not humans. The point of an account is to represent the economic information about a person and make use of this information. So, the correspondence relation between the those levels is signification. The economic information is a sign of something on the social level. In the Resource-Event-Agent (REA) ontology terms, an account can be viewed as an economic agent, [7].

There is however a complication in that items on the physical level may carry economic information that can be used by persons on the social level. For example, a euro bill is a physical item carrying information that expresses an economic

value. From a modelling point of view this could mean that such an item should be positioned on the informational level or, more likely, the informational content is split from the physical item and placed in the informational level. We will not do that but conclude that the correspondence relation between the physical level and the social level can (besides constitutes) also be a signification relation just as it is between the informational level and the social level. A corollary is that items on both the informational level and on the physical level can be used by persons on the social level as economic information.

3   Obligations, Social Debts and Money

An obligation, in this model, is an item on the social level. It may come about as a moral duty to fulfil a promise. When I promise someone to do something for her I become obligated to fulfil that promise; to deliver on my promise. In our view an obligation can be created, kept, and destroyed, but it cannot be transferred. It cannot be separated from the person who has it. As such it may well be modelled, in the UFO sense, as a mode of a person, [9]. Parenthetically, we of course recognize that society has devised many a way by which an obligation seemingly can be transferred. For example, a son may inherit his father's debt. However, we view this phenomenon as a cultural construct built upon the nontransferable personal obligation. Sometimes the words debt and obligation is used interchangingly. This can be done as long as we are clear about that we by obligation mean debt on the social level — a social debt.

Even if a social debt cannot be separated from a person, information about it can. One way of codifying and expressing social debt is as physical money. One may say that physical money (shells or bills, for example) is a very concrete part of a decentralised information system whose purpose is to track debt. A more efficient and more centralized system for this is the banking system. In a bank a person is represented in a book keeping system as an account and a person's social debt is represented in the content of the account. Although banking is by no means the only way to represent info about someone's economic status, we use those banking (or accounting) terms when discussing the informational level.

In figure 2 we sketch some possibilities regarding money. As mentioned, social debt can be created from a promise made from one person to another. The debt is a social item and it is inseparable from the person that holds it. Other plausible ways to view social debt are that it might be seen as a relationship between two persons or perhaps even between two persons and a society. As modelled in figure 2, social debt should be understood as being a part of person B. As such it cannot be considered to be money as it fails Amaral's first criterion (transferability) [2].

Information about social debt, though, can be seen as money. (see [12] for a discussion on this). Info can be given a suitable form (e.g. numbers), be transferred, and be stored for the future. A property of information is that it can be copied without loss to the original. Therefore, it is reasonable to draw two arrows to indicate that info about person B's social debt is represented as numbers both
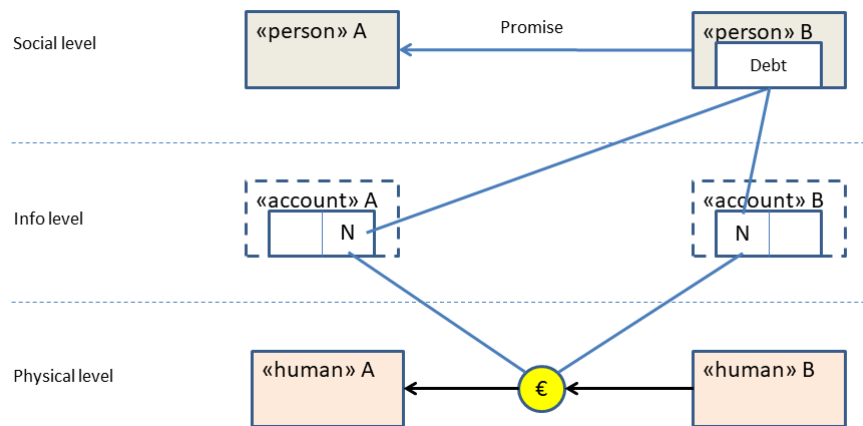
Fig. 2. Money in the three level model

within B's account as well as in A's account. In figure 2, the number N in account B is interpreted as a liability while the number N in A is interpreted as an asset. Both these numbers in the informational level can equally be represented on the physical level by a single € bill whose control will be transferred from human B to human A. Control on the informational level is typically defined in the rules by which information is handled.

One may rightfully wonder about how a single bill on the physical level can keep track of a person's social debt. What is the connection? First of all, the bill exists because there is debt in the world and physical bills can represent that debt, [8, p. 49]. However, the bill in B's pocket didn't necessarily come about as a representation of B's *particular* debt but it came about as a representation of *someone's* debt. B has it in his pocket because by convention it may be accepted as a form of payment in exchange for a good or a service. One of the main ideas behind the bill is just that the control of it can be transferred to someone else as a payment. That is, B relinquishes control of the bill in order to compensate for a debt he has towards A. In this way, it is reasonable to say that the bill selected for a payment is an expression of B's debt towards A.

Note the ontological problems that arise when we can have info about social debt is coupled more or less hard to a carrier. The € and the N's are info about person B's social debt towards A and therefore both are forms of money. A difference between the forms is that the € (which can be thought of as a money bill) is a physical item. As such if it is destroyed then the info about the social debt is also gone. A question is whether one can conclude that social debt disappears when the evidence of it disappears. This can be contrasted with the N's on the informational level. If account B's information should be erased for some reason (e.g. in a disk crash), then this information can be restored from info in account A or from a backup tape.

Another ontological question is that according to the above we have that a social debt can be modelled as a UFO mode. We have hypothesised that information about the mode is money. On the information level we have said that the information can be copied and that there may exist multiple copies of it. On the physical level we say that physical items (e.g. bills) under someone's control can be viewed as assets while the same items used in a payment is representing a liability (i.e., a debt). When modelling money this is challenging and shows that although money is information about a social debt, the way by which the info is handled affects how money can be modelled.

4 Some Issues on Money and Identity

In everyday life, money is typically viewed as being anonymous, i.e., not having identity. As the saying goes, money does not smell. So, the question arises how this lack of identity can be modelled on various levels. On the physical level, there are objects, such as shells, notes and coins. For these, there exists some identity principle, as for any physical objects. Thus, these objects do have identity, which seems to contradict the perception of money as anonymous. However, the identity principle may be more or less easy to apply, depending on the type of physical object. For example, for most notes, there is a serial number printed on each one of them, which can be used in an identity principle, such as "two notes are the same if they have the same serial number". However, for other monetary objects, such as coins, there is typically no serial number. In practice, it then becomes difficult to identify such monetary objects. This situation illustrates that identity and mechanisms for identification have a practical side, meaning that people sometimes introduce tailor-made properties to be used for supporting identification. How can such properties and mechanisms be represented in an ontology for money?

Another issue is whether it is possible to devise a form of money, say some kind of electronic money, where identification is ruled out (without resorting to some anonymizing procedure). Considering the case of bitcoin, each token representing a bitcoin, or subdivision thereof, is actually identifiable through a number. But would it be possible to design a scheme in which electronic money could be transferred without keeping its identity? Possibly, such a scheme could make use of the fact that electronic money is not specifically dependent on some unique physical object. Instead, the information representing money can migrate between physical objects, and even be encoded in multiple physical objects, as is the case in, for example, a distributed ledger. In other words, the information is a generical dependent continuant, in the terms of BFO [3]. (With that said, we note that although the idea behind BFO's generical dependent continuant is clear enough, the definition of it can be improved.) Can this property of electronic money be used for making money anonymous and how could this be modelled? In particular, how do we model electronic money for which identification is possible or facilitated in contrast to impossible or at least made complicated?

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