Money and Production Credit

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Abstract

Wallace's 'Monetary Dictum' insists that monetary models must specify why the monetary object is so used. Another important specification is that the use of this object as money is a stable equilibrium that can be arrived at from distant disequilibrium states. This has not been successfully achieved in models where money is only of importance to exchange. We construct a model where 'team production' under conditions of uncertainty gives rise to a contract where a 'hostage', in the form of future purchasing power, is handed over. The model is extended to show the rational development of hierarchical enforcement mechanisms in banks and in the government backing of the system.

Introduction: The Motivation for Money's Acceptance

Neil Wallace has stated that 'Money should not be a primitive in monetary theory', which he expands to '[t]he physical environment and equilibrium concept of the model [does] not rely on the concept called money or…specify which object will play a special role in trade.'(Wallace 1998) His point is that no definitive answers to the problems of monetary theory can be given by models that specify at the outset the objects that count as money, since they always leave open critical questions about how any modelled outcome has been achieved. The most frequent such question is that of why a medium of exchange exists that has a lower rate of return than other securities in

the model. He points out that many models purporting to explain the role of money in the economy obey his 'dictum', and describes some trading models that do.[1]

In this paper we start by adding another principle. This is that a monetary equilibrium must be stable, in the sense that it can be reached from an initial state far from that equilibrium. Trading models (models where money exists only for the facilitation of trade rather than production) conforming to Wallace's 'dictum' can produce equilibrium states in which money is used, but they do not account for the transition from a non-monetary equilibrium to a monetary equilibrium. The monetary equilibrium is thus never a stable one. Since trading models conforming to Wallace's dictum cannot assume a monetary equilibrium from the outset they can never explain how money comes into existence.

Why is investigating the creation of money of importance? We could just say 'Money exists – so let's start from there!' From personal experience this is a common attitude among economists. In fact the creation of money is an important phenomenon to understand for at least four reasons.

1. Since the quantity of money in most economies is increasing new money is being created, so this is an ongoing, not a historic phenomenon. In the UK recently there has even been a large and rapid deliberate increase in the quantity of high-powered state money in the guise of 'Quantitative Easing'. The causes and consequences of money creation are therefore also a current phenomenon and likely to be of significance.

2. Some theories of money claim that money is any case being continually created (by lending) and destroyed (by the repayment of loans) – so even if the total money stock is constant, money creation is ongoing.[2]

[1] Those that do not include Cash In Advance models and Money in the Utility Function models. Those that do include models that rely on non-cooperative games and asymmetric information. (REFS)

3. The mechanism of money's creation is likely to give important insights into

    a) Why it is used

    b) How it is valued

    c) What happens when money becomes unacceptable or devalued – and therefore what measures are required to restore acceptance and/or value to money.

4. It is likely that understanding the creation of money will give other insights into the role it plays in the economy. It was the insight of Keynes that the generalised purchasing power and liquidity of money could be responsible for business cycles and unemployment. What other problems might be peculiar to a monetary economy rather than a barter economy?

Dissatisfaction with models of money arising from exchange leads us to consider a strong intuition that the existence and value of money are inextricably bound up with production. This intuition springs from the following line of thought, the basis of which has also been suggested by Tobin (1992, p774) and Kiyotaki and Moore (2001, p3). If all production in a monetary economy were for some reason to cease, with no hope of its being restarted, once all remaining efficient exchanges are completed and all stocks used up, no further exchange would take place. Anyone left holding money by the last transaction before this point would be in possession of something completely worthless as a store of value and consequently also as a means of exchange. In fact as it is known that production is to cease, no-one would accept money. Since no-one will accept money in the last transaction, they will not be willing to accept it in the last-but-one transaction, and so it will not be acceptable in the

[2] Primarily the Theory of the Monetary Circuit. See Graziani (2003) or Rochon (1999).

transaction prior to this, and so on by backward induction to the point at which the cessation of production becomes anticipated.

I go on to construct a model in which money's primary purpose is to facilitate production. This model can explain the creation of money de novo, how its use can be a stable equilibrium and show how commercial banking arises. The model is developed to show the welfare benefit to each agent of basing commercial banking on a small quantity of government-issued or 'fiat' money.

Money and Trading

For Kiyotaki and Wright (1989, 1993) agents accept a commodity or token they cannot consume in exchange for goods, because they are at least as likely to meet another agent who will exchange for this as for their production good. But the calculation only holds if all start doing this at the same time. Anonymous matching in exchange is therefore not likely to account for the origin of money, although it does show how once money exists and is valued, it is likely to be used for exchange. What is more, there is no explanation in these models for the valuation of money.

In the pure exchange models of neoclassical monetary theory, while an equilibrium may exist in which money is accepted by all parties and so circulates, and this equilibrium by enhancing exchange can improve collective welfare, there remains an intractable problem as to how such an equilibrium can arise in the first place. Although all may be aware of a social benefit from the widespread use of money this may not always be enough to outweigh a perceived non-negligible risk of holding money that is not going to be accepted in exchange by others. A purely 'conventional' justification for the use of money is not sustainable. The practical and stable use of such money seems improbable, and as Goldberg (2004) points out, it is doubtful if such

money has ever in fact existed despite persistent myths to the contrary. The experimental evidence of Duffy and Ochs (2002, 2003), showing the potential fragility of intrinsically worthless 'fiat' money, backs up this view. There will be a tendency for non-acceptance to spread, rendering such a monetary equilibrium unstable.

A stable monetary equilibrium must therefore be one in which the acceptance of money may be advantageous even when very few or even no other agents are known to accept it. It must be possible for these accepting agents to predict that it is in the self-interest of at least some other agents to accept it even although they have not done so in the past. This situation can never arise in a model in which the sole purpose of money is to facilitate *exchange*, it can only do so when money is created for the primary purpose of facilitating *production*.

The criteria for a true monetary economy must be one in which agents are at least indifferent between monetary transactions and barter transactions even when the latter are available. Shubik (1999, p242) describes what might be the ideal monetary trading economy. Banknotes are issued in exchange for IOUs and these banknotes are used to bid for goods. But these banknotes cannot be additional value in the system, since the quantity of utility-providing goods is unchanged. This makes the monetary system unstable. Accepting money instead of goods has to overcome the risk that money is counterfeit, the risk of bank failure and the risk that the issuer of the IOU might fail to honour it. In particular there may be nothing to prevent the issuer of the IOU finding a barter partner in the meantime. Since the banknotes do not represent additional value, they will fall in value against the available goods. An agent that has accepted such a note may go to the bank and try to exchange it for the IOU backing it, but if the relevant good has been bartered away this will be valueless. As confidence in the use of this money versus barter falls, its use falls further leading to further loss of

confidence in a downward spiral. If barter is available there is no guarantee that money will ever be acceptable – but for a monetary economy to exist individual agents must be, as a minimum, indifferent barter and monetary transactions.

In an economy with trading only we can only ascribe an indirect utility to money that is always less than the goods from which it derives. But if money represents goods that are not otherwise available and that cannot be held in any other way (because they do not yet exist) its value is not only linked to its ability to be exchanged for existing goods. This brings about the possibility that it will be accepted in exchange because it represents a good that cannot be obtained in any other way. Utility is then greater when money exists, because holding money expands the choices available to an agent. In this case the risk of money losing value is offset by the additional utility from future goods. Money then represents additional utility in the form of access to goods that would not otherwise be available. In trading models, convention can always break down if barter is a superior option.

The value of money then arises even when it appears to be dominated by other assets because it represents unique value that is additional to goods that can be acquired by barter. Once this hurdle is overcome, the dominance of money is ensured by its liquidity, low marginal cost of production and because it can be produced precisely where it is needed.

Money and Production

The models of Andolfatto and Nosal (2003) and of Kiyotaki and Moore (2001) seem to hint at the link between money and production; the value of their 'money' arising because they are promises to provide goods in the future. Money in these models is a specific liability of a producer – so ultimately linked to one producer or a

small set of producers and a small number of production goods. These liabilities can be ‘bundled’ by intermediaries to make them more resaleable on the assumption that individual agents are more risk averse than they are. In the previous section of this chapter the models of We develop this idea by proposing a third party (a bank) that can ensure that generalised purchasing power is available for the firms to give to their employees/suppliers. It has the power to enforce the firm to make good on their promises and backing for the purchasing power they issue even if the firm should fail to produce as contracted.

The models of Andolfatto and Nosal and of Kiyotaki and Moore show agents accepting in exchange for goods a promise to supply a good they *do not* wish to consume, because they cannot at any time exchange directly their own production good for goods they *do* wish to consume. The issue of claims to dated output does seem to be able to account for the creation of transferable credit, but there is a problem of its general circulation. A certain level of trust and a certain frequency of meeting is required with those who do ultimately wish the traded-for-exchange commodity (whether as the commodity itself or a promise to supply it), and both of these sets of authors recognise this and address it by modelling some form of ‘bundling’ of promises to reduce the perceived risk to those accepting them.

More generally, a monetary theory of production arises from the idea that some form of token, representing recompense for labour or capital goods supplied for the purposes of production, is required to bridge the gap in time between the start of production when labour and goods must first be applied to the production process, and the end when output can be offered for sale. This time gap is associated with uncertainty of the type categorised by Fontana (2009) as Uncertainty_1; where it is

rational to hold some form of belief, although the level of probability is not quantifiable due to a low 'weight of argument' attached to the premises that give rise to this belief.

Team Production

We start with the benefit to co-operative production, desire for which motivates contracts between owners of capital and suppliers of labour. The concept of 'team production' is described by Alchian and Demsetz (1983) as being production where the output is not a *sum* of separable outputs of each member of the team. Formally: if there are two agents *K* and *L* whose inputs are *k* and *l* respectively, then their team production *y* is characterised by a production function where

$$\partial^2 y / \partial k \partial l \neq 0 . \qquad (1)$$

Intuitively we can say that a higher quantity level of input *k* may result in a greater impact from any increase in the quantity of input *l*. There is thus a production technique where *K* and *L* can pool their resources to produce a greater output than they could each using their own resources alone.

We assume utility to be monotonic in both the initial resources that K and L own (*k* and *l* respectively) and in *y*, the output from team production. Thus if $U_A(y) > U_A(k)$ then $y > k$, and if $U_B(y) > U_B(l)$ then $y > l$. Whether or not team production now takes place will depend on the allocation of output between the parties. Assuming there is zero cost to setting up the contract, and assuming that fairness is not an issue the criteria for benefit for K, then if s_K , s_L; $s_K + s_L = 1$, are the shares of output allocated to the labour suppliers and the firm respectively, the joint criteria for contracting are

$$s_K y > k\,. \tag{2}$$

which can be re-arranged to

$$s_K > k / y\,, \tag{3}$$

and

$$(1 - s_K) y > l \tag{4}$$

which can be re-arranged to

$$s_K < 1 - l / y\,. \tag{5}$$

Equations 2 and 4 give us the condition for a contracting equilibrium

$$k / y < s_K < 1 - l / y\,. \tag{6}$$

The existence criteria for a contracting equilibrium is that

$$k / y < 1 - l / y\,. \tag{7}$$

which can be re-arranged to

$$k + l < y\,. \tag{8}$$

which, given the utility assumptions we have made, is just a re-statement of the team-production principle.

We can represent the contracting equilibrium as follows:

The hatched space on the s_K line is contained by the upper and lower bounds of the feasible values of s_K for which a contracting equilibrium is possible. Since *l* and *k* are independent values, and *y* also depends on the specific production technology employed, the contracting equilibrium space is of indeterminate size relative to the s_K line. The exact value of s_K (and thus s_L) for any particular project where the equilibrium space is greater than zero will depend on the relative bargaining powers of K and L.

Intuitively, the diagram indicates that given a particular production technology, as the quantity of labour supplied to the production process increases for any given quantity of capital, the proportion of output going to labour needed to motivate the contract increases (s_K decreases). As the quantity of capital supplied increases for a given quantity of labour, capital's share required to motivate contracting increases (s_K increases).

Use of a 'Hostage' to Offset the Risk of Contract Failure

For any given values of *k* and *l*, any additional factor that lowers the upper bound or increases the lower bound for s_K may prevent the existence of a previously feasible contracting equilibrium. We assume that the form of production and the ratio of inputs is such that the contracting equilibrium exists, and consider the possibility that K has the opportunity to renege on the contract once production is completed. This opportunity arises because the produced goods remain on K's premises until sold. If K

decides to consume them himself L, having performed his labour, cannot retrieve it. Here we make use of a simple 'hostage-taking' model of Williamson (1983) to demonstrate how credit-money might resolve the problem.

Williamson considers a contracting situation and points out that there is a difficulty where the inputs are specific and there is a delay between their application and the receipt of output, such that one party accords a subjective probability *v* to the risk of expropriation.[3] This fits exactly our time-dependent team production process. Williamson suggests two possible contracting mechanisms

1. Labour is supplied and suppliers are offered a share of output $s_L y$.
2. The firm offers $s_L y$ on the basis of a completed contract but offers a 'hostage' of value αh, $0 \le \alpha \le 1$, to the employee/supplier *before* production commences. The firm loses wealth valued at *h* (the hostage) if it reneges on the contract.

In the first mechanism, for the supplier of labour or capital goods to benefit requires

$$s_L y(1-v) > l \tag{9}$$

$$\Rightarrow (1-s_K) y(1-v) > l . \tag{10}$$

We can rearrange this to show the new upper bound for contracting:

$$s_K < 1 - \frac{l}{y(1-v)} . \tag{11}$$

[3] In the light of our discussion of uncertainty we should consider *v* as the propensity to act where this is translated subjectively into a level of anticipated utility. We can show that in the presence of an uncertainty calculation a certain course of action would be 'rational'; in the sense of following the results of a calculation translated into an ordinal value. What we cannot show is that this *will* happen, only that given a particular mode of calculating it is a plausible course of action. It seems not unreasonable that in the negotiation of a production contract, this mode of calculating might be predominant.

Any value of v greater than 0 has the effect of reducing the upper bound to the contracting space on the s_K line. If the upper bound falls below the lower bound no contracting will take place and the advantage of team production will be lost.

For the employee/supplier to enter the contract under the second mechanism requires

$$s_L y(1-v) - v\alpha h > l \tag{12}$$

For the hostage to be an effective deterrent against K reneging, he must stand to lose at least what he would gain by doing so, which is L's share of output $s_L y$. We can rewrite equation 12 as

$$s_L y(1-v) + v\alpha s_L y > l \tag{13}$$

which becomes

$$(1-s_K) y(1-v) + v\alpha(1-s_K) y > l\,. \tag{14}$$

This can be rearranged to

$$s_K < 1 - \frac{l}{y[1-v(1-\alpha)]}\,. \tag{15}$$

If the hostage has the same value to both K and L, then $\alpha = 1$ and the upper boundary condition reverts to

$$s_K < 1 - \frac{l}{y} \tag{16}$$

and the contract becomes viable on the same terms as before. Even where $\alpha < 1$ the upper boundary condition may be increased enough to render the contract viable again, although the possibility of contract reneging will render the benefit for L less than without this risk.

Williamson makes reference to the fact that the efficient condition $\alpha = 1$ would particularly be realised with the hostage taking the form of generalised purchasing power, and indeed this is the approach we shall take in further analysis of this model. By issuing purchasing power as its own liability while creating a liability on behalf of the firm in the form of a loan, a banker, designated B, can fulfil the role of providing the 'hostage' in the form of money. This then allows the efficient outcome of team production. Moreover, money's liquidity and generalised acceptance means that it may be valued by employees/suppliers *more* than a 'hostage' in the form of equivalently valued real goods would be. This has the effect of increasing α in equation (2.13) with the effect that the firm can lower $s_L y$, thus increasing its profit by the margin of the 'liquidity premium' offered by money. The role of *h* here also points up the fact that the production and lending process involves valuation by the firm and its employees about how the values in real goods of $s_L y$ are converted to the monetary value αh. We might also regard the 'hostage' as playing the role of increasing the Keynesian 'weight of evidence' in favour of the probability of completion of the contract.

The Role of Banking

What is different about what the banker offer? He can assess production contracts for viability and enforce promises because he has access to multiple contracts. The role of the banker is different from that of the 'monitors' of Alchian and Demsetz team production model because the problem is not that of determining effort, which is easy in this situation, but that of preventing abuse of a contract in a situation where full effort has already been provided. Williamson explains why recourse to contract law may not be a satisfactory solution in this sort of situation.

Without the banker K is restricted in the hostage he can offer. If he offers part of his capital stock K, it is unlikely that this represents full value to L ($\alpha < 1$) and clearly

K cannot use this portion of his capital in production. This reduction in *k* applied to the production process both increases the threshold for the contract (by increasing the lower bound on the s_K line) and by reducing *y* lowers the total welfare benefit from production if the contract does go ahead. This also applies to any commodity or fiat money that K holds.

A mechanism that can provide a hostage which does not reduce K's productive capital and which gives full value to L ($\alpha = 1$) will increase the chances of a production equilibrium or increase the total welfare benefit from production. The only candidate for a hostage that fulfils these criteria and that is a claim on the future output of the production contract.

The banker can have the power to enforce contracts as a result of specialisation in the selection, and enforcement of the capital owner's role in production contracts by providing a full value hostage. In return he demands interest payment *i* from K's own share of output. The incentive compatible payment to B is given by

$$i = b + rh \tag{17}$$

where *b* is the opportunity cost of B's enforcement effort and *h* is the expected probability of default given that effort.

This changes K's incentive inequality to

$$s_K y - b + \frac{rl}{y} > k \tag{18}$$

which changes the lower bound for the contracting equilibrium space on the s_K line to

$$s_K > \frac{k}{y} + \frac{b + rl}{y}. \tag{19}$$

B achieves social benefit by permitting the existence of a production contract. This depends on this increase in the lower bound of the contracting space on the s_K line

being less than the increase in the lower bound that would have resulted from K giving up some of his capital as a hostage, or less than the decrease in the upper bound of the contracting space that would have resulted from the absence of a hostage.

Bundling of the expropriation risk by bankers is helpful if L is risk-averse, bundling of claims is advantageous even without risk aversion, because the value of these claims is not limited by what K can provide but can include all goods and services available now and in the future.

Incentives for B

As things stand, B has an incentive to issue claims that he knows are likely to result in default, and/or fail to enforce these claims effectively when default occurs, since no cost falls upon him but only on L in the form of a dilution of goods available for the claims B has issued. In this case α falls, the upper s_K bound is reduced and production contracts may again not be feasible. This gives a role to a small quantity of 'fiat' money issued by the state and its value enforced by the state's power to levy taxes. Essentially B must now provide a hostage in the form of a quantity of this fiat money. If a claim that B has issued results in a default by K, B is fined a quantity of this fiat money. Since it is costly for B to replace this, this fine acts as an incentive for him to issue only viable claims and enforce them effectively. In this case the number of claims that actually default will be a relatively small part of the total, so that the quantity of fiat money B requires to hold to avoid the risk of his bankruptcy will be a small fraction of the number of claims issued by B.

Moreover, we can see how the state, if it can vary the cost to B of acquiring fiat money, has some control over the behaviour of B, and indirectly over the number and quality of the claims he issues.

Conclusion

The very existence of money is evidence of some form of disequilibrium in the real economy, since once such an equilibrium were to be established there could be no further transactions that were not already perfectly predicted (or at least their probability not perfectly covered by insurance), and therefore there would be no reason to value and hold money.

We have argued that money arising from trading only must always be unstable, since the possibility of barter can at any time undermine the value of money. This instability can only be removed when barter for at least some goods is impossible because these goods do not yet exist. Claims issued prior to the production of these goods and exchangeable for these goods will be accepted as long as utility for these goods is anticipated, and the claims are expected to be honoured. Once these claims are given value in this way they also become exchangeable for pre-existing goods.

We have generalised the arguments for the role of circulating debt where there is the dated supply of goods in our team production/hostage model. We have shown that for self-interested agents able to order the uncertainty surrounding a contract under different costs for the other contracting partner, it is plausible for them to use a form of token that represents a promise to supply a portion of output. We have also argued from this model that where the token is managed in a way analogous with the 'bundling' of the debt circulation models cited above, this can enhance its use.

Our model shows the individual motivations and a potential mechanism by which intrinsically worthless tokens may become acceptable means of exchange when they are guaranteed claims to future output. Once the initial agreement to pay the banker for his enforcement services is made, the motivation for accepting these tokens thereafter is a purely individual one. If it is known that there is a mechanism in place that will force firms to give up part of their output in exchange for tokens, these tokens will have value to each individual quite apart from their 'public good' benefits of enhanced exchange. No collective agreement or convention is required to establish the acceptance of money in this case. Moreover, by ensuring a due share in the increased output of team production an improved use of available resources is enabled that allows the production of goods that would not otherwise have been achieved. The existence of money can increase output as a whole.

We have gone on to show how there is a role for a relatively small quantity of money, backed by the coercive power of the state, that can enable the issue of production claims by private bankers, allowing production to take place that could not otherwise have done so, and how this provides a basis for state 'monetary policy'.

The strength of the model is not in the logical certainty of the described outcome, but in its plausibility given an average combination of human suspicion and willingness to co-operate for mutual advantage. Of course the model delineated is very different from a modern economy. There is initially only one productive 'firm', only one 'bank' and no bank deposits, and no government sector or central bank. Outstanding issues are how this might translate to the real monetary economy, with its existing institutions, and why generally there is one money with a value against all goods in any economically developed area.

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