Mutual Credit Systems and the Commons Problem: Why Community Currency Systems such as LETS Need Not Collapse Under Opportunistic Behaviour*

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> The use of money necessarily involves strategic elements and certain aspects of social custom.
>
> Kyotaki and Wright (1989:928)

The Mutual Credit System (MCS) is a 'self-help' solution to the problem of private management of a community currency. The most widely implemented MCS is the Local Exchange and Trading System (LETS). As Michael Linton puts it: "A LETSystem is a self-regulating economic network which allows its members to issue and manage their own money supply within a bounded system" (in Ekins, 1986:200). This 'endogenous money supply' feature of the MCS is, for the purpose of community currency stability, both its most important and most problematic. By effectively putting the management of the money supply in the hands of the individual transactors, that is 'the market', Central Bank malprediction and mismanagement are avoided. Instead, transactors can flexibly adjust their individual money needs to their transaction needs, such that at a macro-level the money supply adjusts in real time to the needs of the economy. This, in turn, may prevent inflationary booms and recessionary busts caused by central administration inertia or failure as described in the Capitol-Hill baby-sitting-co-op currency by Sweeney and Sweeney (1977). However, the other side of the coin is that giving the individual so much power over the management of the community currency might cause dissipation of the benefits of flexibility in the detriment of system collapse. That is, optimising behaviour by individuals at a micro-level might aggregate to disastrous over-supply and collective default at a macro-level.

This problem and its solutions are analysed here, whilst keeping in mind the consequences of the proposed solutions for the endogenous money supply feature of the MCS. The approach is theoretical. The purpose is to provide a framework for analysing the economic potential of the MCS in terms of providing a robust alternative to Centralised Currency Supply Systems given an economically motivated membership. As I have argued before (Schraven, 2000), empirical evidence on existing MCS, such as LETS, can neither serve as a foundation of such a theory nor as its test because the membership of these systems tend to be primarily ideologically as opposed to economically motivated (see

also Caldwell, 1999). Nevertheless, for the purpose of clarification examples of existing MCS, such as LETS, are used to illustrate the theory. These examples are based on my own research on the Talente LETS in Innsbruck Austria, which involved informal unstructured interviews with the system administrator and several members, and on secondary literature.

LETS as an example of what the MCS is and how it operates:

There is a wide variety of LETS in operation, ranging from libertarian designs with little centralisation to those with strict central administration and control. Nevertheless, they do share the basic properties of the MCS. That is, each member, including new members, has an account on which they can draw to finance transactions. The system operates as a pure accounting system of exchange (Black 1970, Fama 1980, White 1984) without an initial stock of cash. All members open an account with a central administration unit, which records transfers in 'units' between these accounts. Members facilitate transactions by running down balances or going into debt, thus 'creating' money according to transaction need. In a well-administered system, all accounts sum to zero.

Many LETS also share the following properties meant to increase system stability. To facilitate mutual monitoring and allow members to check the viability of the system generally there is no banking secrecy. Therefore, the administration publishes the balance and turnover details of the members regularly. Moreover, before a transaction takes place the supplier has the possibility of checking the balance and turnover of the purchaser as a proxy for creditworthiness. Generally, no interest is charged on negative or positive balances.

LETS are not only (mutual credit) bankers, but also market-matchers of demand and supply. This function generally operates through a regular publication advertising what people have to offer or would like to buy. This publication might be supplemented by 'community building events', such as a bazaar where members promote their products and services. In economic terms a LETS thus performs three main functions, namely the provision of *transaction management*, *credit*, and *'market-matching'* of supply and demand. Jointly, these allow LETS currency units to function as a medium of exchange (Schraven, 2000). Thus, the MCS provides an alternative means of creating a currency.

Credibility and its relation to system stability:

The MCS can only be a viable alternative if it can facilitate a stable currency. Ultimately, the stability of a Community Currency System, such as the MCS, depends on its credibility with its members. This 'credibility' is similar to that of a bank, weighing up the assets and liabilities and their repayment probabilities. That is, if system credibility falls to zero, such that all members believe it will collapse, nobody will transact in the system and thus it collapses. Correspondingly, the value of the community currency also depends on the credibility of the system. When the credibility of the system falls, transactors will demand a premium on the price of goods (inflation) in order to be persuaded to accept its medium of exchange instead of alternatives. With national currencies, this is readily seen when comparing the modern German Mark before the Euro (high credibility, constant value, high stability) with many of the Latin American currencies (low credibility, falling value, low stability).

This credibility can be affected by both endogenous (internal) and exogenous (external) factors. For a given price-level, both the potential and actual productive capacity of the system relative to its potential and actual amounts of outstanding currency units determine system credibility endogenously. For example, a simultaneous reduction of productive capacity of the system and an increase in outstanding units would cause a reduction in credibility of the system. This is caused by the fact that now less production backs up more debt, which means that the risk of system collapse due to default has increased.

Exogenous factors, such as the inter-regional terms of trade (relative prices of traded goods), supply of national money and its inflation rate, 'animal spirits' and levels of confidence in the national or world economy may also affect credibility. MCS administrators have little control over these exogenous factors and these factors have no inherent tendency to lead to collapse, hence it is the endogenous factors we are concerned with here. Thus, our main interest is in how the system's money supply changes relative to its productive capacity, as this determines credibility, which in turn determines stability of the system.

The Commons problem of the MCS and its consequences for credibility:

The money supply is an aggregate, that is the sum of all circulating currency. Its definition is not clear-cut, testified by the fact that for national currencies economists commonly use five different definitions for the money supply (M0 to M4 respectively). For the MCS the money supply is taken to be the sum of all outstanding debts, which in a well-administered system equals the sum of outstanding credits. However, as noted before, within the MCS this money supply is not issued centrally for the system as a whole, at the macro-level, as in the Ithaca Hours system. Instead, at the micro-level, individual transactors determine the money supply through their decisions to issue units. For transaction purposes this is an improvement over the printed currency as a medium of exchange because transactors do not suffer from the synchronisation constraint (see Schraven 2001:12-13). That is, transactors cannot be constrained by a lack of currency when they wish to spend first and earn later because they are able to issue units to facilitate such exchanges. Nevertheless, as identified above, there is also the credibility criterion for evaluating the optimal aggregate money supply. Might it be possible that optimising behaviour of individuals at the micro-level, aggregates to sub-optimal outcomes at the macro-level? The answer is yes.

The problem that this question identifies is the 'Commons problem' or the 'Tragedy of the Commons' (Hardin, 1968). In the seminal article by Hardin, the problem is illustrated with the 'overgrazing of the commons'. In economic terms, for a given piece of land there is an optimal number of sheep that can be grazed, such that the land regenerates and the sheep attain an optimal size. Subtracting sheep would mean a fall in revenue (fewer sheep to shear and slaughter), as would adding sheep (slower regeneration, less wool and meat on each sheep). Now imagine several shepherds grazing their herds on a piece of commonly owned land. Each shepherd will make his decision based on his own herd, disregarding the effects on the other herds. In this case, adding one more sheep will reduce the size of his other sheep (as well as the size of the sheep in the herds of the others), so he will capture the entire benefit of grazing an extra sheep but only a fraction of the total costs. The same incentives apply to the other herdsmen, with the consequence that each herdsman will increase his herd until the benefit of adding another sheep is outweighed by the cost of the consequent size reduction of his other sheep. Consequently, the commons will be overgrazed. The same problem arises in other Common Property Resources, such as fisheries and air (pollution).

Credibility in the MCS is also a Common Property Resource (CPR) because, similar to common land, it is used and owned by the entire system. Moreover, as identified above, it is diminishable, for instance by increasing the money supply relative to productive capacity. Therefore, commons problem could also apply to the MCS. To illustrate, suppose there is an optimal level of credibility, where the collective benefit of issuing another unit in terms of facilitating transactions is exactly outweighed by the collective cost in terms of credibility reduction. At this point, the cost of an additional reduction in credibility (higher probability of system collapse) is lower for an individual than for the system as a whole. Hence, the individual will tend to 'over-issue' credits as long as their individual benefit of executing the transaction outweighs their individual cost of the associated reduction of system credibility. Similarly, the creditor only suffers a small proportion of the risk associated with this newly issued debt because it is guaranteed by the system. However, he captures the full benefit of the sale. The essence is that both those, who are most prone to 'over-issuing', and those, who can most easily monitor such cases, benefit from over-exploiting the CPR. In the limit this individualistic and optimising behaviour might cause individual and finally collective default on outstanding debts.

Despite the possibilities for mutual monitoring, MCSs appear susceptible to such opportunism of members, who could run up debts and subsequently refuse (or be incapable) to repay. The collapse of the Australian Baytown LETS can be attributed to this problem exacerbated by bad administrative practices. The system collapsed with a positive final aggregate balance of 2100 green dollars, as a consequence of several debtor departures (Jackson, 1997). The Commons problem is certainly real and, in my view, presents the most serious challenge to the MCS as a viable currency system.

However, as Ostrom puts it:

> "By referring to natural settings as "tragedies of the commons," "collective-action problems," "prisoner's dilemmas," "open-access resources," or even "common property resources," the observer frequently wishes to invoke an image of helpless individuals caught in an inexorable process of destroying their own resources."

> (Ostrom, 1990:8)

> "What makes these models so interesting and so powerful is that they capture

important aspects of many different problems that occur in diverse settings in all parts of the world. What makes these models so dangerous – when they are used metaphorically as the foundation for policy – is that the constraints that are assumed to be fixed for the purpose of analysis are taken on faith as being fixed in empirical settings, unless external authorities change them."

(Ostrom, 1990:6-7)

The point is, that members of MCSs are not necessarily confined to the analytically simplistic case where they can neither collectively prevent each other from over-issuing, nor alter this constraint through institutional supply. That is, there are solutions to the commons problem.

The two optimisation based solutions that pervade the economics literature are 'enclosure of the commons' (read: privatisation) and (external) centralised control. The first, which would mean selling the land to the shepherd(s), is not an option in case of a currency because the point of a currency is precisely that it is commonly used. The second, which could take the form of grazing quotas, is viable for the community currency but would return us to a centrally supplied currency, thus entail abandonment of the MCS project.

Nevertheless, the problem, as it tends to be posed, presumes optimising and individualistic behaviour to quite an extreme degree. In actual fact, behaviour might exhibit more collectivist inclinations, yielding endogenous institutional supply, and may include strategic, social, or altruist elements. These possibilities are analysed in detail below and used to argue that the MCS can in fact be configured to overcome the commons problem. These solutions neither rely on privatisation, nor on complete and absolute centralised control.

Eight MCS design principles: Institutional adaptations to alleviate the commons problem

The MCS is not a simple CPR, such as a lake or field, which properties are fixed. Instead, it is a complex system with inherent elements of central control and administration, which can be designed and configured. To this purpose, *Eight MCS design principles* are developed below and analysed in terms of their applicability. These design principles map onto the eight institutional design principles found by Ostrom (1990:91) to yield CPRs that are robust to the commons problem. Although her research mainly involved physical and environmental CPRs, the forces at work are similar, which means her principles can also be interpreted in terms of the MCS as is done here.

1. *Clearly defined boundaries*,

   These determine who is allowed to 'withdraw' resources from the CPR and the boundaries of the CPR itself. In case of the MCS these boundaries are perfectly defined in terms of system membership. Unlike large oceans, where it is difficult to prevent fishers from fishing by restricting access, within the MCS only members can issue units within the system. In practice exceptions may occur, such as in the Talente LETS, where LETS from other cities are also allowed to issue units through a national clearing system. Here, the boundary is maintained through a credit limit.

2. *Congruence between appropriation rules and provision rules*.

   Appropriation rules are concerned with the allocation of withdrawal rights from the CPR, that is the division of the benefits. Provision rules concern the responsibilities for building and maintaining the system, that is with the 'stock' of the CPR. In terms of the MCS, this means that appropriation rules are concerned with who can issue how many units at what time. Provision rules are concerned with preserving credibility. These could regulate issues such as acceptability of units by members, required supply of work into the system, and the means of collecting resources for maintenance of the system. For example, in the Talente LETS the appropriation rule is simply that each member can issue units up to a common credit limit. The maintenance provision rule is that members pay a membership fee both in LETS units and national currency and pay a small fee for each transaction. In terms of preserving credibility, there is a provision rule that members are expected to repay their debts, which if they fail to do so within the 'market', can be done by supplying work to the central administration.

   These appropriation rules almost certainly not consistent with the provision rules because there is no relation

between the (arbitrary) credit limit and the fees in terms of withdrawing and contributing to the CPR (system credibility). For instance, members are allowed to 'appropriate' up to their credit limit, which may be in excess of their expected supply of work into the system.

In practice, the choice of consistent rules will differ substantially across systems. As it is impossible to maximise over two variables, in this case credibility and transaction turnover, preferences of members will determine how these are traded off against each other. However, the rules must conform to the following principle in order to guarantee the minimum amount of credibility consistent with rationality.

The general provision principle that must apply is that the aggregate value of outstanding units must not exceed the aggregate value of the work that will be supplied into the system in the future. Otherwise, the outstanding debt would necessarily be too high to be repaid. Correspondingly, a consistent appropriation rule would be that individuals may not issue units exceeding the value of the services they intend to supply into the system in the future. This could be achieved through credit limits. In effect Ostroy and Starr (1974) have shown mathematically that a full and efficient execution of all potential transactions can be achieved if these rules are adhered to (see Schraven 2001:13-14 and 41-43 for further discussion). Nevertheless, the membership might prefer to restrict the maximum debt even further to reduce the risk of collective default, thus trading off transaction turnover against credibility. In practice, these principles mean that some form of credit limit must be implemented. This need not be formally and centrally enforced, although it might be. For example, in a system characterised by a strong sense of social responsibility or altruism an 'informal rule' stating that negative balances of members must never exceed the value of expected future supply into the might well suffice. In systems characterised by more individualistic and optimising members more complex and centrally enforced rules may be necessary (see the next section).

If despite existing rules imbalances arise, the central administration can fine-tune the system. For example, if the money is hoarded a 'demurrage charge' can easily be instituted in the form of a negative interest rate. Conversely, if people have difficulty spending their money, a positive interest rate, which increases the inter-temporal pay-off of working now, can alleviate this problem. Finally, if outstanding units are in danger of exceeding the implicit labour supply, system stability can be improved by putting a negative interest rate on both positive and negative balances, such that outstanding debt tends to zero.

Clearly, due to the imposition of such credit limits, the money supply cannot be perfectly flexible, except in the limit case where credit limits exactly equal future work supply. This probes the question of what the difference is between centrally supplied money and the MCS. Firstly, the MCS still (partially) resolves the synchronisation constraint symmetrically, that is allows people to spend first and earn later. Moreover, the central authority of the MCS merely sets the *potential* money supply in terms of credit limits. Individuals still decide to issue units in response to transaction needs, thus endogenously determining the *actual* money supply in response to changes in economic conditions, subject to the constraints of their credit limits. Consequently, potential damage due to predictive failure by the central authority is reduced. Moreover, the concept inherent in stamp scrip, the demurrage charge, can easily be implemented in the MCS.

Summarising, congruent appropriation and provision rules can be set within the MCS. Such congruent rules neither eliminate the flexibility of the MCS with respect to fluctuations, nor prevent complete exchange from being achieved, unless such complete exchange is traded off against increased credibility.

3. *Collective-choice arrangements*

These allow members subject to operational rules to change these rules themselves. This allows CPR institutions to adjust the rules to local conditions. Given the local and social nature of the MCS, such arrangements should not be difficult to implement. However, the ideological impetus of LETS and the potentially inflexible nature of computer software for administration may constrain operational rule changes in practice.

4. *Monitoring* and 5. *Graduated Sanctions*

In robust CPR institutions appropriation and provision rules are effectively monitored and such monitoring is accompanied by graduated sanctions for transgressors. These provide a flexible punishment mechanism, preventing the high cost of rigidly applying harsh sanctions for different or first time offences (Ostrom, 1990:186). For the MCS this means that monitoring must apply to credit limits (whether implicit or explicit and formal) and system maintenance. In practice, such monitoring may take the form of ensuring that credit

limits are set at the 'right' levels, such that they do not exceed planned supply of work into the system, are not exceeded by writing uncovered cheques, and that debts are repaid timely. Graduated sanctions can take the form of peer pressure, gossip and 'name-and-shame' (Reputational punishment), refusal to transact, temporary socio-economic ostracism, fines, or expulsion. The Talente LETS uses mostly centralised equivalents of these mechanisms.

There are several ways to argue that, despite non-recoverable costs to the punisher, which create a 'second-order free rider problem', monitoring and punishment will take place. These approaches either presume some self-interest based strategy or argue that people's behaviour is characterised by reciprocity (Fehr and Gchter, 2000) to yield this result.

The self-interest based approach can be illustrated by the strategy of 'quasi-voluntary compliance' (Ostrom, 1990:94-95). Here, people are willing to comply with the rules as long as they perceive that the collective objective is achieved and they perceive that others also comply, which means they wish to avoid being 'suckers'. Such contingent behaviour has been widely perceived as an alternative to coercion in order to achieve co-operative behaviour. That is, the "'private' benefit of monitoring in settings in which information is costly is that one obtains the information necessary to adopt a contingent strategy" (Ostrom, 1990:97). In the context of the MCS, this means that members would like to avoid being the last one to find out that system credibility has dropped below some threshold, which would trigger collapse and cause them to suffer proportionately more than others. To prevent this situation, people are willing to 'invest' in private information by monitoring. Akerlof (1984) shows in a general equilibrium model that it is possible for social customs that are costly to the individual to persist if a stable fraction of the population believes in them and punishes opportunists through for instance reputational repercussions.

The reciprocity approach relies not so much on self-interest but more on an imbedded psychological response. For instance, Fehr and Schmidt (1999, as cited in Fehr and Gchter, 2000:165) show theoretically in a 'free rider public good' framework that even a minority of reciprocal subjects is capable of inducing a majority of selfish subjects to co-operate, if they have an ability to punish. The power of such social norms is illustrated by Ellickson (1991), who argues convincingly in a 'property rights' framework, that people do not necessarily base their economic interactions on underlying legal entitlements, as the Coase theorem suggests. Instead, they develop and enforce adaptive norms of neighbourliness to govern their interactions. Considering that community currencies would tend to be used by groups or regions with economic (and social) interconnections, these theories are highly relevant and suggest that monitoring will take place given the right institutional arrangements.

6. *Conflict-resolution mechanisms*

These serve to mediate conflicts between members over the compliance and enforcement of appropriation and provision rules. The central administration unit in a MCS is a natural candidate for mediation between individual appropriators.

7. *Minimal recognition of rights to organise.*

This pre-empts inappropriate government regulation crowding out community regulation. This is potentially the greatest threat to the MCS. It would not be surprising if governments intervene, as the Austrian Central Bank did in the case of Wrgl stamp scrip, once MCSs start to facilitate a significant proportion of local transactions. Moreover, regulation concerning social security and the unemployed can have profound effects on the success of MCSs in increasing local employment. New Zealand's policies, which include unemployment benefit authorities referring applicants to the LETS in their area are encouraging in this light (see also Lietaer, 2001:164-65).

8. O*rganise activities in multiple layers of nested enterprises.*

Currently, most MCS, such as LETS operate mainly on a local level. However, there is already significant interregional and international co-operation and interaction. If MCSs were to increase coverage through an interregional network, as is currently attempted in Austria, it is essential that rules between and within layers are congruent. The analysis on congruence between appropriation and provision rules can also be applied to a CPR consisting of a network of MCSs.

This analysis of the (potential) institutional qualities of the MCS suggest that it is particularly well-suited to preserving its CPR. This result relies on a membership, which behaves strategically according to quasi-voluntary compliance or is characterised by some reciprocity . By invoking social norms or a self-interested strategy of 'quasi-voluntary compliance', congruent appropriation and provision rules can be policed without eliminating the capacity for endogenously supplying the medium of exchange in response to immediate transaction needs.

The extend to which these principles are adhered to in LETS is an interesting question from the LETS research field's perspective. However, as pointed out above, the exact formulation of consistent appropriation and provision rules may vary considerably over systems in terms of formality, centrality, and risk aversion. Rules, monitoring, and sanctions are likely to be less formally and consistently present and enforced in LETS systems with an ideologically motivated membership. As economically motivated optimising behaviour is not expected to be the norm in these systems, such rules are not necessarily essential to preserve the CPR. In any case, it serves to warn the prospective LETS researcher that, although this theory might well serve to illuminate the stability of systems with an ideologically motivated membership, it is designed to analyse those with a primarily economically motivated membership.

How social norms and quasi-voluntary compliance may yield a stable system: Economic factors at work

In addition to an analysis of institutional design, an understanding of the economic factors that govern the system's dynamics is essential for assessing the potential impact the commons problem. Suppose an MCS for which its members have a prior distribution of *'Friends'*, that is trusted transactors with whom they can trade at low transaction costs. Friends can punish rule breaking, hereafter *'Opportunism'*, through Reputational punishment (social repercussions) or by refusing to trade, thus eliminating the low-transaction cost exchange partners for the opportunist. This distribution of friends yields an initial number of opportunists for whom the utility of running up a debt and leaving outweighs the disutility from the reputational punishment and the loss of utility from future trading possibilities within the system.

During trading, transactors build up informational capital, increasing future valuation of trading possibilities, and make new 'friends', thus increasing potential reputational costs and reducing transaction costs. However, as they monitor in accordance with 'quasi-voluntary compliance' to avoid being a 'sucker', they encounter opportunists. Each encounter requires a downward adjustment of credibility, hence *future valuation*. If, due to the particular pattern of exchange and the initial distribution of friends, a small proportion of non-opportunists meets opportunists relatively often, some may have to adjust their credibility downwards sufficiently to become opportunist also, yielding an increasing number of opportunists. These interactions may lead to an eventual collapse of the system (see Appendix for an analysis of the process of collapse).

Alternatively, the number of encounters of non-opportunists with opportunists may be low and evenly distributed, leading to a minor 'communal tax' through opportunist debt default and in some cases opportunists reverting to becoming non-opportunists as a result of making more 'friends', yielding a stable system. Clearly, it is beneficial to admit new members with many 'friends' or with low disutility of supplying work into the system, that is a low valuation of debt default. For example, an unemployed person with a low disutility of supplying work, who is introduced into the system by one or more friends, is better for system stability than an investment banker, who has a high disutility of supplying additional work and no friends within the system.

This analysis allows several conclusions to be drawn. Firstly, as valuation of future trading possibilities is discounted, the system stability is inversely related to the discount rate (a measure of impatience and risk aversion). Secondly, through the valuation of future trading possibilities, system stability is positively related to the proportion of people's income transacted within the system. Thirdly, it is positively related to the quality of market matching provided by the system. Fourthly, it is negatively related labour mobility across regional, social, or occupational economic systems. As mobility increases, both the force of reputational punishment and the value of future trading possibilities diminish relative to the utility of exit. However, such an increase in 'geographical inter-connectedness' may also foster information exchange between systems, which allows inter-system entry barriers to be erected for opportunists.

Finally, the size of the system relates to its stability. Although the complexity of the relevant functions do not warrant a generic conclusion, the most plausible relationship appears to be an inverted U-shape, such that stability increases with size, then stabilises, and finally falls with further increases in size. As membership rises, both the

diversity of goods and services offerings and the size of potential demand increase, raising the valuation of trading possibilities. Simultaneously, the reputational punishment increases as the number of people that have to be faced after opportunist default rises. However, the average implicit communal tax, due to opportunist default, falls as it is spread over a greater number of people. These effects are unlikely to balance out at first. People appear to adhere strongly to 'fairness' principles even if losses and gains are small (Rabin, 1998:16-24), and establish 'social order without law' (Ellickson, 1991). Consequently, the reputational punishment is likely to increase with membership.

However, as membership increases beyond the lines of social control these arguments may be reversed. Firstly, monitoring becomes more expensive as the proportion of friends of the total membership falls because when transactors have no social connections, information and gossip is only available through the formal channels. For instance, Ellickson (1991:283) finds that people begin to resort to the law as soon as the social distance between them increases. Similarly, graduated reputational sanctions are harder to administer as the effectiveness of gossip diminishes when the group becomes too large. Whereas some gossip may be very effective in a small town where people meet regularly, in a large city it is unlikely to carry through the entire system, leaving pockets of uninformed members where the perpetrator can transact without increased transaction costs until harsher sanctions are administered through the formal channels. Thus, the nature of the commons problem combined with economic factors, such as the discount rate, utility premiums on exchange, and social capital, may determine the optimal size of the MCS in terms of system credibility and transaction turnover.

To conclude, the Commons problem, which forms an inherent part of the MCS, may be overcome by adhering to the *eight Mutual Credit System design principles* outlined above. The ability of MCS institutions to mobilise social norms or invoke quasi-voluntary compliance is critical in this respect. These institutional adaptations do not eliminate the benefits from the endogenous supply of the medium of exchange within the system. Moreover, combining the right mix of members with an appropriate size will yield a stable system. Therefore, the Mutual Credit System is a viable alternative to a Centralised Currency Supply System for the private management of a Community Currency.

Appendix:

Analysis of how the system may come to collapse:

Let the sum of credit limits (L) be equal to the expected total labour supply (S_0) in the system (for instance the sum of implicitly pledged working time of the membership (A)). If no member issues units in excess of their expected work contribution, and credit limits are distributed according to their individual labour supply, this 'money supply' is equivalent to each agent having sufficient money balances to execute all their trades, hence excess demands and supplies will be executed completely and efficiently (Ostroy and Starr 1974).

Suppose that some proportion of the membership is opportunist, such that they issue illegitimate units (d_a) that they do not intend to repay (e.g. they received individual credit limit $l_a > s_a$ expected individual labour suppy). As trades are executed, according to iterations i, at some point the remaining expected labour supply ($S_i = S_0 - T_i$, where T_i is the total transaction turnover in period t at iteration i) will be smaller than M_i (The outstanding units at iteration i). If the planned labour supply is common knowledge or if $L - T_i < M_i$ (i.e. outstanding units exceed the sum of credit limits minus transaction volume) it becomes common knowledge that 'illegitimate units' (counterfeit money) circulate in the system. Hence, al know that at the end of period t some people will be stuck with units, which are not backed by work.

If t is the last period, units could not be used in the subsequent period, thus are worthless. Consequently, people, who are not in debt, will only supply labour if the expected probability of being able to spend these units times the utility from their purchase exceeds the disutility from providing work first. At the last iteration, this probability is zero, hence this iteration will not occur, thus by backward induction nobody will work at the iteration before that, etc. Thus, the system collapses in the final period as soon as it becomes common knowledge that illegitimate units circulate.

A communal tax, which instantly debits all members accounts for a proportion of the outstanding illegitimate units, may alleviate this problem by eliminating risk. Clearly, people, who know that counterfeit units are present will anticipate this and if they expect the communal tax to be in excess of their valuation of remaining trading possibilities, withdraw from the system before such time, or even worse start issuing illegitimate units themselves, thus further curtailing the number of iterations in which transactions are made. This suggests, that the earlier these

units are 'discovered' and the community is taxed, the lower the probability of system collapse, because the higher the valuation of future trading possibilities. At the same time, if individuals can obtain information about illegitimate units before it becomes common knowledge, they may be able to avoid being a 'sucker', that is having positive balances as the system collapses or when prices start to inflate. Thus, a robust system must provide incentives for members to report illegitimate units, such that system instability can be eliminated as soon as possible through the communal tax. In practice, of course, this would only happen in case of serious perpetrations or in case of a destabilising cumulative effect, not when a single member exceeds their credit limit by a couple of units.

Now we can analyse the simplest case, namely the decision to default on debt, where D denotes aggregate debt. Default occurs when the disutility of fulfilling the work pledge implicit in the debt position net of the utility of future trading possibilities is exceeds the disutility of the reputational punishment. In the final period, trade collapses if D>V at any iteration, where V excludes those that have opted out of the system in anticipation of a communal tax, inflation tax, or risk of ending up with worthless units at the end of the period. Assuming a formal tax, then V is the sum of valuations of future trading possibilities within the system of the group of people (A) with $v_a>D/A$ (where D/A is the communal tax). Of course in practice, there will rarely be a 'final' period as referred to here. Then, the final period occurs when, at the end of the period, the implicit communal tax exceeds the aggregate future valuation of trading possibilities of the remaining members. Thus, due to limited public information it is never entirely clear when the system will collapse, which provides further incentives for members to gather information to form expectations through monitoring.

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