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Maëlle Della Peruta
Dominique Torre

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Virtual Social Currencies for Unemployed People: Social Networks and Job Market Access*

Maëlle Della Peruta∗ Dominique Torre †
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Abstract

Alternative currencies continue to develop all around the world, taking various forms (material or immaterial) and fulfill various functions. They are created in order to promote the local economy development and to fight against social exclusion. They are principally aimed to low income people (retired or unemployed people, or people who are living with a low wage). In this paper, we analyze the particular case of virtual currency circulation inside a local community of unemployed people. We elaborate on the assumptions that the organization of LETS and the circulation of complementary currencies have two properties: (i) they help unemployed workers to overcome the double coincidence of want necessity of an informal sector founded on barter exchange; (ii) they help to maintain and develop workers’ skills outside job, helping them to observe opportunities of employment even as long-term unemployed workers. We study the global properties of a job market associating traditional short-term and long-term unemployment to the organization of LETS. Using a theoretical Pissarides-style model, we find that the initial level of trust of agents in the complementary currency(cies) but also the effective properties of this(these) currency(cies) are crucial for LETS to become permanent institutions. We also find that if the stationary equilibrium of the job-market includes LETS, then LETS have a positive influence on the rate of employment, on the expected utility of employed workers, and are Pareto improving when the benchmark case is a job market without any LETS.

JEL Classification: E42, E24

Keywords: Social currencies, complementary currencies, unemployment, informal sector.

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†University of Nice Sophia-Antipolis - GREDEG - CNRS, 250 rue Albert Einstein, 06560 Valbonne, France. E-mail: maelle.della-peruta@gredeg.cnrs.fr, dominique.torre@gredeg.cnrs.fr
1 Introduction

According to the newspaper Libération (May 27, 2014), there are currently 4000 alternative local currencies in circulation around the world, and 60 in circulation or planned in France.

Each one has particular characteristics. They can be exchanged by a material or an immaterial way, into a network including firms or formed by a group of individuals. Units of complementary currencies can be bought (SOL, Bristol and Brixton Pounds) or created by a mutual exchange of services (LETS). They often allow an extra purchasing power to their users. Users of complementary currency can benefit from a supplementary unit when they purchase it or from some discounts granted by retailers participating. LETS members can benefit from a fixed sum of currency when they enter the system or from a credit when they initiate to purchase into the LETS.

Most of complementary currencies promote social issues. They have generally been created in order to promote and develop local environment and economy and to fight against social exclusion, compensating the lack of money and social network of their users (Seyfang, 2002; Blanc, 2006).

LETS systems do not require any banking account and can then be used by unbanked people. They only require time and the creation of services which will be offered to other members to acquire complementary currency units. By promoting social issues and by its open access for everyone (no need to buy units of currency), LETS attract low income people (especially unemployed and retired people) who wants to reach / maintain a minimal level of consumption. A large majority of studies realized on LETS and Time Banks in UK and in United-States show that low-income and unemployed users are effectively the target audience of these complementary currency systems (Seyfang, 2001, 2002, 2003; Collom, 2011; Lasker et al., 2011).

While the popularity of LETS and complementary currencies is growing, it is then relevant to ask if they could achieve their goals: fighting against social exclusion and against unemployment.

Local exchange systems are not known for creating jobs, which was evidenced by surveys linking LETS and employment (Williams et al., 2001). Except complementary currencies designing specially to provide jobs to unemployed people (Woergl in Tirole and the Palmas in Brazil), LETS employs mainly volunteers to manage and organize the system. If they don’t formally create jobs, how can they help unemployed worker to re-enter the job market?

Unemployment spells, especially long ones, may cause irreversible damages on unemployed people, like a loss of motivation and a depreciation of skills (Mincer and Ofek, 1982; Pissarides, 1992; Böheim and Taylor, 2002; Edin and Gustavsson, 2007). This is named the “scar theory” (Heckman and Borjas, 1980, in Flaig et al., 1993). During inactivity, unemployed workers don’t exercise their job and can’t
maintain and improve their valuable experience and their knowledge. Their human capital depreciates (Heckman and Borjas, 1980, in Flaig et al., 1993). Unemployed workers are engaged in a “state dependence”, which means that being unemployed and having been experienced a long period in unemployment decrease their probability to find a job in the future (Flaig et al., 1993). This idea is also evocated this state dependence in the “hysteresis effects” literature. Employers still prefer to not hire long-term unemployed due to the human capital depreciation during inactivity spells and still prefer employed short-term unemployed or workers already in job, judged “more competitive” (Bourdet and Persson, 1991, 1991a).

However, unemployed worked can fight against this skill depreciation during an unemployment spell. During employment, an employee increases his productivity by involving everyday his specific competences related to his job. He acquires “familiarity” with his job. If he loses his job, he will not lose completely his competences. The depreciation of skills can be avoided by their use during unemployment spells (Johnson and Van Doorn, 1976). Workers learn from experiences, they “learn by doing”. So, the amount of skills accumulated is positively correlated with time spent in activity and its depreciation is positively correlated with non-use of it. (Killingsworth, 1982; Mincer and Ofek, 1982; Desjardins and Warnke, 2012).

If competences can be maintain by their use during inactivity spell, that’s in that way LETS can help unemployed workers to re-enter the job market. To participate in a LETS, members have to offer their services to earn complementary currency units. Launching a new activity is costless, and we have seen that LETS attract essentially low-income people. That’s why in participating in a LETS, members will prefer to offer services related to their previous job, for which they have competences, rather than to launch a new activity or a secondary activity (Peacock, 2001). By offering an activity related to their previous job into a LETS network, unemployed people have the possibility to maintain and actualize their specific skills and, in this way, improve their employability. Participating in a LETS is similar to self-employment jobs (launching an activity and offering services against remuneration), without the risks related to self-employment activity (no administrative and accounting issues) and with the help of the organisers who are in charge to connect members (Gomez and Helmsing, 2008; Williams et al., 2001).

As seen previously, unemployed workers tend to face a depreciation of their human capital, especially of their specific competences, during unemployment spells, which will affect their probability to find a job. But the loss of a part of their skills is not the only obstacle they have to deal with. Unemployed people, following the loss of their job, can also lose a part of their social network, which conducts to a loss of a part of professional information like job opportunities (Williams, 1996). Here again, LETS can help unemployed workers to face this problem. By linking members, LETS fights again social exclusion by re-constructing and extending the social network of unemployed people (Williams, 1996; Seyfang, 2001, 2002, 2003; Ozanne, 2010; Lasker et al., 2011).
The scope of the present paper is to explore the influence of social virtual currency circulation between unemployed workers into a community on job market and employed workers welfare through benefits resulting of exchanges into this community on employability and social links of unemployed workers. Thanks to the possibilities offered by the complementary currency/cies in LETS, unemployed workers exchange each other services and goods for an extra income. This is a first property of LETS. To offer these products, they maintain their levels of skills and competences, and particularly the levels of those skills related to their previous jobs (Peacock, 2001).

We then assume in this paper that participating in a LETS avoid any loss of skills and productivity during unemployment spell, as already pointed out by literature (Mincer and Ofek, 1982; Pissarides, 1992; Böheim and Taylor, 2002; Edin and Gustavsson, 2007) and increases for LETS members the instantaneous probability to be recruited ( Flaig et al., 1993). In these assumptions, we ask three research questions: (i) on which condition such LETS can maintain or not at equilibrium? (ii) Which is the influence of such LETS on the level of employment? (iii) What is the effect of LETS on welfare?

The following sections answer these questions using a benchmark model analysing the transition of workers between three positions on the job market: workers can occupy a job position, they can, also be short-term unemployed workers or long term unemployed workers. We then study the changes in the stationary equilibrium of this job market after the introduction of LETS. The main results of this setting are (i) that trust inside and outside LETS are important determinants of the permanence of LETS, (ii) that when permanent, LETS increase the level of employment, (iii) that in this case, they improve welfare without generating conflicts of interest.

## 2 The benchmark model

The benchmark model depicts an economy with $n$ workers where the probability to observe employment opportunities decreases during the time each worker remains unemployed. To simplify the setting we suppose that the in the economy, workers can take three possible positions:

- Employed workers are in proportion $e$ of the total active population. They earn the periodic wage $w$ and have the probability $q$ to lose their job at the end of the period.

- Unemployed people distribute in two sub-categories.

- Short-term unemployed workers are in proportion $s$: they receive the unemployment benefit $b$ and have the probability $\alpha$ to find a job during the current period. If they do not observe an opportunity of employment, they integrate the group of the long-term unemployed workers.

- Long-term unemployed workers are in proportion $l$. They receive the same
unemployment benefit $b$ than the short-term unemployed ones but their probability to observe an opportunity to employment is only $\alpha'$ with $\alpha' < \alpha$ (1).

![Diagram](image)

**Figure 1: Transition pattern in the benchmark model**

The model is analyzed at stationary equilibrium, which is a state such that (i) the number of employed and unemployed workers remains constant during time, once the environment remains unchanged, and (ii) the expected intertemporal utility a worker occupying a given position is also constant during time. The condition (i) determines stationary amounts of $e$, $s$, and $l$ satisfying equations (1), (2) and (3):

$$qe = \alpha s + \alpha' l$$

$$qe = s$$

$$(1 - \alpha)s = \alpha' l$$

with by definition, $e + s + l = 1$. Solving the system gives the equilibrium level of employment $e = \frac{\alpha'}{(1 - \alpha)q + \alpha'(1-q)}$. Studying in comparative statics this expression shows that employment increases with the capacity to find a new job in each position of the job market, and with a decrease of the rate of destruction $q$ of existing employment positions. Long term unemployed workers are in proportion $l = \frac{\alpha'q}{q(1-q) + \alpha'(1+q)}$ and short term unemployed ones are in proportion $s = \frac{\alpha'q}{q(1-q) + \alpha'(1+q)}$. A comparative static analysis shows that their number increases with the increase of the rate of destruction of jobs $q$ and decreases with an increase of the capacity $\alpha$ to find a job as short term worker or as a long term unemployed worker $\alpha'$.

The intertemporal utility associated with each position after consumption is deduced from the Bellman equations (4) to (6)

$$V_e = (1 - q) \frac{w + V_e}{1 + r} + q \frac{b + V_s}{1 + r}$$

$$V_s = \alpha \frac{w + V_e}{1 + r} + (1 - \alpha) \frac{b + V_l}{1 + r}$$
\[ V_i = \alpha' \frac{w + V_e}{(1 + r)} + (1 - \alpha') \frac{b + V_i}{(1 + r)} \]  

where \( V_e, V_s \) and \( V_l \) figure respectively the intertemporal utilities of an employed worker, a short-term unemployed worker and a long-term unemployed one, after consumption while \( w \) and \( b \) represent respectively the instantaneous wage of an employed worker and the unemployment benefit of an unemployed worker\(^1\). The system (4) to (6) also solves and gives the equilibrium values of the intertemporal utility in each position that a worker can occupy on the labor market. The instantaneous components of their utilities are respectively given by the monetary value of wages \( w \) and of the unemployment benefit \( b \). The system solves easily. Each intertemporal utility is a function of the parameters \( q, \alpha, \alpha' \) but also \( w \) and \( b \). The study of \( V_e, V_s \) and \( V_l \) in comparative statics states that (see Appendix 1) each intertemporal utility increases with \( w, b, \alpha \) and \( \alpha' \) and decreases when \( q \) increases. All these relations are intuitive: smaller is the probability of a worker to be fired, greater is his utility in each position of the job market. The same intuition is confirmed concerning the influence of the potentiality to be hired when unemployed and utilities. The other relations comparative statics properties have also intuitive contents.

3 Introducing a LETS

A LETS is introduced in this section as a network providing two kinds of services. First, the LETS provides the possibility to exchange informally services among unemployed people, without being limited by the “double coincidence of needs” condition. The complementary currency then increases the efficiency of the informal sector. The instantaneous benefit from being unemployed then increases from \( b \) to \( b' \). Second, the LETS maintains the level of skill of unemployed workers and their capacity to face in the job market with an unchanged probability \( \alpha \) to be successful at each period. The LETS plays then the role of a “learning by doing device”. The use of a complementary currency is however nothing but evident for workers more able to accept barter then to trust a private system of intermediation eventually founded on the capacity of other unemployed workers to accept as payment this complementary currency. Outside LETS, workers have heterogeneous levels of confidence in the properties of the complementary currency and in the potentiality of the LETS in general. Suppose as a working assumption that the levels of confidence of employed workers on the reliability of complementary currency are then given by a coefficient \( \lambda \) defined on a segment \([0, 1]\). When \( \lambda_i \) is close to 0, worker \( i \) has a low level of confidence into the complementary currency; when \( \lambda_i \) is close to 1, this level of confidence is conversely high.

With LETS, A fourth position then emerges for workers, besides the three positions analyzed in the benchmark model. It corresponds to the participation to a

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\(^1\)We suppose as a simplifying assumption that this benefit does not vary with the time each worker remains unemployed. When this decreases during time - which is a reasonable assumption -, the results of the paper are strengthened.
LETS. The transition process between the four possible positions of the job market are then depicted by Fig (2):

![Figure 2: Transition pattern in the model with LETS](image)

With the introduction of the LETS, when an employee loses his/her job, he/she becomes an unemployed worker and faces two possibilities: becoming a “traditional” unemployed worker (namely a short-term unemployed worker) or participating in a LETS. A short-term unemployed worker can also decide to join a LETS before becoming a long-term unemployed worker. When inside a LETS, an unemployed worker experiences the complementary currency and its level of confidence evolves upward or downward. This level then evolves from its initial level $\lambda_i$ to $\lambda$ with $0 < \lambda \leq 1$. $\lambda$ reflects the effective properties of the LETS and depends both of the objective reliability of the complementary currency and of the organization of the LETS. As a first approximation, $\lambda$ will be taken as given \(^2\).

As there are two possible positions that unemployed workers can occupy outside LETS, there are also two possibilities to join LETS for unemployed people, namely joining them directly just after being fired, or after a first attempt to recover a job as a short-term unemployed worker. As it is more valuable to be a short-term unemployed worker than a long-term one, workers joining LETS directly correspond only to the highest values of $\lambda_i$. Those joining them only after a while correspond to smaller values of $\lambda_i$ as they are only interested in LETS when there is to choose between LETS and the few efficient long-term unemployment worker position. A second consequence can then be deduced from the above assumptions: it is expressed in Lemma 1.

**Lemma 1.** If an unemployed worker integrates a LETS with a level of trust $\lambda_i$ smaller than the level of trust $\lambda$ of the unemployed workers inside LETS all workers

\(^2\)In a more complex setting, $\lambda$ could be made dependent on time and on the members of the LETS.
integrating LETS only leave them as employed workers.

Proof: Consider the worker \( i \) such that \( \lambda_i < \lambda \). If this worker is a short-term unemployed worker having failed to find a job, his/her choice is between becoming a long term unemployed worker, i.e. having an utility equal to \((1 - \alpha') \frac{b + V_i(\lambda_i)}{(1 + r)} + \alpha' \frac{w + V_i(\lambda_i)}{(1 + r)}\) and becoming a member of a LETS, i.e., having an utility equal to \( V_e(\lambda_i) = (1 - \alpha) \left( \frac{b' + V_e(\lambda_i)}{(1 + r)} + \alpha \left( \frac{w + V_e(\lambda_i)}{(1 + r)} \right) \right) \). If he/she chooses to integrate a LETS, the second term is greater than the first one. When this same unemployed worker is inside the LETS, his/her intertemporal expected utility is \( V_e(\lambda_i) = (1 - \alpha) \frac{b + V_e(\lambda_i)}{(1 + r)} + \alpha \frac{w + V_e(\lambda_i)}{(1 + r)} \) if he/she remains in the LETS and \((1 - \alpha') \frac{b + V_i(\lambda_i)}{(1 + r)} + \alpha' \frac{w + V_i(\lambda_i)}{(1 + r)} \) if he/she leaves the LETS. It is easy to verify that if \( V_e(\lambda_i) = (1 - \alpha) \frac{b' + V_e(\lambda_i)}{(1 + r)} + \alpha \frac{w + V_e(\lambda_i)}{(1 + r)} \) \((1 - \alpha') \frac{b + V_i(\lambda_i)}{(1 + r)} + \alpha' \frac{w + V_i(\lambda_i)}{(1 + r)} \) then \( V_i(\lambda_i) = (1 - \alpha) \frac{b' + V_i(\lambda_i)}{1 + r} + \alpha \frac{w + V_i(\lambda_i)}{(1 + r)} \) \((1 - \alpha') \frac{b + V_i(\lambda_i)}{(1 + r)} + \alpha' \frac{w + V_i(\lambda_i)}{(1 + r)} \).

Note that if all the agents choosing to join the LETS have a level of confidence in the complementary currency greater than \( \lambda \), the LETS can emerge or not at equilibrium. Suppose for instance that the agent \( i \) with the smallest \( \lambda_i \) choosing to join the LETS is such that \( \lambda_i \) is far greater than \( \lambda \): in this case, one may have \((\lambda_i b' + V_e(\lambda_i)) < b + V_i \) but \((\lambda_i b' + V_e(\lambda_i)) > b + V_i \). With an out-of-equilibrium analysis, we could then observe there a temporary emergence of the LETS followed by their rapid collapse.

Another property on utilities is interesting to prove:

Lemma 2. When a worker i never chooses to integrate a LETS, his/her intertemporal utility does not depend on his/her level of confidence in the LETS.

Proof: When the agent \( i \) is in this case, its instantaneous utility is given by \( w \) when he/she is employed, or \( b \) when he/she is unemployed. Accordingly, his/her expected utility never depends on \( \lambda_i \).

At last a third interesting property is easy to prove:

Lemma 3. At stationary equilibrium, all workers (employed or not) devoted to join LETS when unemployed, expect (perfectly) at its level \( \lambda \) the trust of the complementary currency inside the LETS.

Proof: Suppose that its remains employed workers with a level of trust \( \lambda_i \) such that \( \lambda_i \neq \lambda \) and planning to join LETS when fired. Then, the expected utility of these agent as employed workers will move subsequently, once they will have joined LETS. We are then not yet at stationary equilibrium. At stationary equilibrium, all current, past or future participants to the LETS are then the same perfect evaluation \( \lambda \) of the acceptability of the complementary currency.

With the help of lemmas (1) to (3), the stationary equilibrium of the economy can be deduced.
3.1 The equilibrium size of the LETS

Like for the benchmark model, the stationary equilibrium is characterized by the stationarity of the population and of the expected intertemporal individual utilities in each position of the job market. Given lemmas 1, 2 and 3, if stationary equilibrium exists, two distinct subpopulations then coexist. The first sub-population gathers workers integrating LETS when unemployed and expecting perfectly the level of acceptability of the complementary currency / the level of efficiency of the LETS. The second sub-population is characterized by those workers who remain outside LETS when unemployed. Their level of trust in the complementary currency / evaluation of the efficiency of the LETS are heterogeneous but as they do not use LETS, this heterogeneity has no influence of their utility, whatever the position they occupy on the job market. The threshold agent separating the two sub-population is the agent $i^*$ such that $\lambda_{i^*}$ is just sufficient to decide him/her to join the LETS if he/she is not recruited directly as a short-term unemployed worker and not leaving this LETS after having observed $\lambda$. Knowing $\lambda_{i^*}$ is then crucial to determine the size of the two sub-populations.

Note that the stationary equilibrium can correspond to cases where the LETS finally collapse. It is the case when $\lambda$ is very small. In this cases, all unemployed workers integrating initially the LETS finally leave it for the traditional long-run unemployment position. We could consider that this situation becomes realistic if the development of the informal sector in the LETS convinces Government to undertake actions able to cut the unemployment benefits of the members of the LETS or to make the use of complementary currencies illegal. It is also the case if there are more classical crises of confidence with non-reliable management of the complementary currency inside the LETS.

If we concentrate on the cases where the LETS does not collapses, the agent $i^*$, is obtained as the solution of the following equations system of 7 equations:

$$V_s(\lambda_i) = \alpha w + V_e(\lambda_i) + (1 - \alpha) \frac{\lambda_i b' + V_c(\lambda_i)}{1 + r}$$ (7)

$$V_e(\lambda_i) = (1 - q) \frac{w + V_e(\lambda_i)}{(1 + r)} + q \frac{b + V_s(\lambda_i)}{(1 + r)}$$ (8)

$$V_c(\lambda_i) = \alpha \frac{w + V_e(\lambda_i)}{(1 + r)} + (1 - \alpha) \frac{\lambda b' + V_c(\lambda_i)}{(1 + r)}$$ (9)

Equations (7) to (9) solve in $V_e(\lambda_i)$, $V_s(\lambda_i)$, and $V_c(\lambda_i)$, providing then, a a function of $\lambda_i$, the expected intertemporal utilities in each position he/she stays, of a worker planning to integrate a LETS after the tradition short-term unemployment position. The following equations (10) to (12) correspond to the expressions of the expected intertemporal utilities for the workers preferring not to integrate LETS when they are unemployed.

$$V_s = \alpha \frac{w + V_e}{(1 + r)} + (1 - \alpha) \frac{b + V_l}{(1 + r)}$$ (10)
\[ V_e = (1 - q) \frac{w + V_e}{1 + r} + q \frac{b + V_s}{1 + r} \]  
(11)

\[ V_l = \alpha' \frac{w + V_e}{1 + r} + (1 - \alpha') \frac{b + V_l}{1 + r} \]  
(12)

Note that equations (10) to (12) replicate exactly the benchmark utility equations (4) to (6) since the situation/utility of workers never joining LETS does not change with the introduction of LETS. Finally, the seventh equation is obtained equalizing expressions of \( V_s(\lambda_i) \) obtained as solution of the system (7) to (9) and of \( V_s \) solution of the system (10) to (12), as a function of parameters \((w, b, b', q, \alpha, \alpha')\). Lemma 4 summarizes this stage of the resolution of the model:

**Lemma 4.** When LETS do not collapse, the proportion of workers integrating LETS when they are unemployed is given by 
\[ (1 - \lambda_i^*) \]  
where \( \lambda_i^* \) expresses as
\[ \lambda_i^* = \frac{b(1 + g(-1 + \alpha + q - \alpha gq + \alpha' gq)) + (-\alpha + \alpha') gw}{b'(1 + g(-1 + \alpha' + q - \alpha gq + \alpha' gq))} \]  
with \( g = \frac{1}{1 + r} \)

Proof: see Appendix 2.

Despite this expression of the size of “LETS’ current, past and future members” sub-population given by \((1 - \lambda_i^*)\) is not so simple, one can easily verify that this size increases with \( \alpha \) and decreases with \( \alpha' \), i.e. increases with the depreciation of the potentiality to be recruited when moving from the position of short-term unemployed worker to long term one. Comparative statics also shows that this population is growing - as intuition would expect it - with \( \lambda b \), i.e., with the performances of the complementary currency and more generally of the organization of the LETS.

### 3.2 Effects of complementary currency and LETS on employment and welfare

It is now possible to solve the remaining equations providing the missing conditions to determine the instantaneous size of the LETS at equilibrium, the level of equilibrium employment and the proportion of agents remaining instantaneously outside of LETS as unemployed workers. These proportions are solution of the system made by equations (13) to (16)

\[ q e = \alpha s + \alpha c + \alpha' l \]  
(13)

\[ q \lambda_i^* e = s \]  
(14)

\[ (1 - \alpha) s = \alpha' l \]  
(15)

\[ (1 - \lambda_i^*) s = \alpha c \]  
(16)

with by definition, \( e + s + l + c = 1 \).
The system solves easily and provides the stationary proportions of workers, occupying each position \((e^*, s^*, l^*, c^*)\) of the job-market when the stationary equilibrium includes non-empty LETS. These expressions are complex combinations of the parameters but however help to provide the two main results of the paper:

**Proposition 1.** When LETS do not collapse, they increase the level of employment

*Proof:* see Appendix 3.

This result interprets easily: as they help workers to find a job easily, LETS increase the supply-side efficiency of the job-market. When workers are unemployed, with the help of the LETS technology (including the complementary currency), long-term unemployed workers maintain their competencies at the same level they had as short-term unemployed workers. Without considering any feedback from the job-market demand side, the global effect of the LETS is the to enhance the employability of unemployed people and results in a global positive effect on the job-market and on the employment level.

There is another argument to explain the raise of the level of employment. Surveys conducted in LETS in UK and in Argentina concluded that LETS encourage the development of self-employment (Williams C.C. et al., 2001; Gomez and Helmsing, 2008). Developing an activity into a LETS provides advantages to members, as developing a client base which will continue to buy those products outside the LETS (Williams C.C. et al., 2001), testing products to evaluate if they are valuable on the formal market (Williams C.C. et al., 2001), and a self-training for the development of a micro-entreprise (Gomez and Helmsing, 2008). These elements facilitate the creation of a micro-entreprise for LETS members. In the survey conducted by Williams C.C. et al. (2001), of 810 LETS members respondents, 10.7

The result of Proposition 1 is strengthened by the following proposition:

**Proposition 2.** The intertemporal utility of employed workers increases at stationary equilibrium when there are active LETS

*Proof:* Employed people \(e\) associate two sub-populations. The first has the size \(\lambda_i e\) and gathers all workers who do not integrate LETS when there exist. For this population, the expected intertemporal utility given by \(V_e\) is the same than in the benchmark model. The second sub-population has the size \((1 - \lambda_i)e\). The expected intertemporal utility of each member of this second sub-population of “LETS users” (when they are unemployed) is given by \(V_e(\lambda)\), solution of the system (7) to (9) where \(\lambda_i\) is taken equal to \(\lambda\). Calculations provide the value 

\[
 u = \frac{g(b(-1+g-\alpha)q+(-1+q)(-1+q)(1+\alpha+q))}{(-1+g)(1+g(-1+\alpha+q))}
\]

with \(g = \frac{1}{1+r}\) which is greater than \(V_e\).

The “average expected utility” \(\lambda_i V_e + (1 - \lambda_i) V_e(\lambda)\) is then greater than \(V_e\) which corresponds to the expected intertemporal utility of employed people in the benchmark model.

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3 with the help of Mathematica software as the previous ones.

4 In another paper, the authors present an analysis of the demand-side effect, in a bi-sectoral model, involving a first-necessity goods sector and a technological goods one. The effect of LETS in founded positive on the demand side of the technological goods sector, negative on the first-necessity (formal) goods sector and ambiguous at the aggregate level (M. Della Peruta and D. Torre, 2012)
A last proposition proves that there are not conflicts of interest when LETS are used by unemployed workers.

**Proposition 3.** *LETS are Pareto-improving when compared to the benchmark situation without LETS*

*Proof:* For all agents \( i \) such that \( i < i^* \), the expected intertemporal utility does not change with LETS, whatever the position they have on the job market. For the others, the utility strictly increases in each position (when we substitute to the “inside LETS” position to the long-term unemployment position). These observations correspond a Pareto-improving situation.

As the organization of LETS and the use of the complementary currency(ies) do not weaken the properties of the traditional unemployment positions and decrease the advantages of those choosing to remain outside LETS when they are unemployed. This is why, the results of this model does not exhibit any conflicts of interest with the introduction of LETS. However, only the supply side of the job-market has been considered. With the introduction of the demand side, the informal activity generated by LETS may decrease the demand of employees in the formal sector and have a negative effect on some formal employs and utilities. Intuitively, smaller is the substitution between the goods and services circulation in LETS and outside them, or greater is the additional revenue generated in LETS allowing LETS’s members to buy goods not available in LETS, greater is the propensity for LETS to have a positive effect on the job-market demand size.

### 4 Concluding remarks

This paper analyzes the global effects of a social virtual currency circulation between unemployed workers into a community. We estimate that participating on a social currency system enables unemployed workers to maintain their skills, avoiding human capital depreciation occurring during unemployment spell, and to preserve and extend their social network. These benefits have a positive effects on unemployed workers employability and enable them to re-enter the job market more quickly. We first introduce a benchmark Pissarides-style model with two possible position for unemployed workers: short term unemployed workers have a higher instantaneous probability to find a job than long term ones. We then introduce LETS having two properties: (i) to improve, thanks to the complementary currency, the potentiality to exchange goods and services in the informal sector, and (ii) to maintain professional skills outside job. We find that trust in the complementary currency outside LETS and in LETS are crucial to make LETS permanent (to avoid LETS collapse). When LETS are permanent, we find that they increase employment, the level of expected utility of employed workers, and are Pareto-improving when compared to the benchmark case without LETS.

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5 see Della Peruta, Torre, 2012
An out-of equilibrium analysis, founded on numerical simulation could be interesting to observe the phases of emergence or collapse of LETS. Another extension would be to add demand-side effects generated by LETS on the job-market, i.e. the capacity of LETS to increase or not the demand for the goods and services produced by the formal sector.

References


Flaig, G., Licht, G., Steiner, V. (1993). Testing for state dependence effects in a dy-
dynamic model of male unemployment behaviour. *ZEW Discussion Papers* No. 93-07.


Appendix

Appendix 1: The benchmark model

Derivation of $e$, $s$, and $l$:

$$\begin{cases} \alpha s + \alpha' l = qe \\ (1 - \alpha') s = \alpha' l \\ e + s + m = 1 \end{cases}$$

$$e = -\frac{\alpha' - q + \alpha q}{q(-1 + \alpha)}$$

$$l = \frac{\alpha'}{q(-1 + \alpha)}$$

$$s = -\frac{\alpha' - q + \alpha q}{\alpha q}$$

Derivation of $V_e$, $V_s$, and $V_l$:

$$\begin{cases} x = (1 - q) \frac{1}{1+r} w + q b \frac{1}{1+r} + (1 - q) \frac{1}{1+r} x + q \frac{1}{1+r} y \\ y = \alpha w \frac{1}{1+r} + (1 - \alpha) b \frac{1}{1+r} + \alpha \frac{1}{1+r} x + (1 - \alpha) \frac{1}{1+r} t \\ t = \alpha' w \frac{1}{1+r} + (1 - \alpha') b \frac{1}{1+r} + \alpha' \frac{1}{1+r} x + (1 - \alpha') \frac{1}{1+r} t \end{cases}$$

with $x = V_e$, $y = V_s$, $t = V_l$

$$x = \frac{bg((-1 + \alpha q - \alpha' q) g + (-1 + \alpha' q) g + g(-1 + \alpha q) g - (-1 + \alpha q) g) w}{(-1 + g)(1 + g(-1 + \alpha' q - \alpha q) g + g(1 + \alpha' q - \alpha q) g)}$$

$$y = \frac{bg((-1 + \alpha q - \alpha' q) g + (-1 + \alpha' q) g + g(-1 + \alpha q) g - (-1 + \alpha q) g) w}{(-1 + g)(1 + g(-1 + \alpha' q - \alpha q) g + g(1 + \alpha' q - \alpha q) g)}$$

$$t = \frac{bg((-1 + \alpha' q - \alpha q) g + g(-1 + \alpha' q) g - \alpha' q g + g(-1 + \alpha' q - \alpha q) g)}{(-1 + g)(1 + g(-1 + \alpha' q - \alpha q) g + g(1 + \alpha' q - \alpha q) g)}$$

$$g = \frac{1}{1 + r}$$

The comparative static analysis is made after expressing the derivatives of $x = V_e$ according to $q$, $\alpha$ and $\alpha'$.

$$\frac{\partial x}{\partial q} = \frac{bg((-1 + \alpha q - \alpha' q) g + (-1 + \alpha' q) g + g(-1 + \alpha q) g - (-1 + \alpha q) g) w}{(-1 + g)(1 + g(-1 + \alpha' q - \alpha q) g + g(1 + \alpha' q - \alpha q) g)} - \frac{g(1 + (-1 + \alpha' q) g) g(-1 + \alpha q) g(b - w)}{(-1 + g)(1 + g(-1 + \alpha' q - \alpha q) g + g(1 + \alpha' q - \alpha q) g)}$$

$$\frac{\partial x}{\partial \alpha} = \frac{bg((-1 + \alpha q - \alpha' q) g + (-1 + \alpha' q) g + g(-1 + \alpha q) g - (-1 + \alpha q) g) w}{g^2((-1 + \alpha' q) g(1 + \alpha q) g(b - w))}$$

$$\frac{\partial x}{\partial \alpha'} = \frac{bg((-1 + \alpha q - \alpha' q) g + (-1 + \alpha' q) g + g(-1 + \alpha q) g - (-1 + \alpha q) g) w}{(-1 + \alpha' q) g(1 + \alpha q) g(b - w)}$$

$$\frac{\partial x}{\partial \alpha} = \frac{(-1 + g)(1 + g(-1 + \alpha' + q - \alpha q + \alpha' q) g)}{(-1 + g)(1 + g(-1 + \alpha' + q - \alpha q + \alpha' q) g)^2}$$

Given the definition values of parameters, the first term is always negative, while the other ones are still positive.
Appendix 2: The model with LETS

Proof of Lemma 4:

Expression of $V_e$, $V_s$, and $V_l$:

$$
\begin{align*}
x &= (1 - q) \frac{1}{1+r} x + (1 - q) \frac{1}{1+r} b + q \frac{1}{1+r} y \\
y &= \alpha w \frac{1}{1+r} x + (1 - \alpha) b \frac{1}{1+r} + (1 - \alpha) \frac{1}{1+r} z \\
z &= \alpha' w \frac{1}{1+r} x + (1 - \alpha') b \frac{1}{1+r} + (1 - \alpha') \frac{1}{1+r} z
\end{align*}
$$

with $x = V_e$, $y = V_s$, and $z = V_l$. These variables express as:

$$
\begin{align*}
x &= b g(1 - q - \alpha g - \alpha' g) q + g(1 - q - \alpha' g + (-1 + q)(1 - \alpha g - \alpha' g) q) w) \\
y &= b g(1 - q + q - \alpha g + g(1 - q - \alpha' g) q + g(1 - q - \alpha' g) q) w) \\
z &= \frac{b g(1 - q + q - \alpha g + g(1 - q - \alpha' g) q + g(1 - q - \alpha' g) q) w)}{(-1 + q)(1 + q - \alpha g - \alpha' g + \alpha g' q)}
\end{align*}
$$

with $g = \frac{1}{1+r}$

Expression of $V_e(\lambda_i)$, $V_s(\lambda_i)$, and $V_l(\lambda_i)$:

$$
\begin{align*}
u &= (1 - q) w \frac{1}{1+r} x + (1 - q) \frac{1}{1+r} b + q \frac{1}{1+r} w \\
v &= \alpha \frac{1}{1+r} x + \alpha \frac{1}{1+r} x + (1 - \alpha) \frac{1}{1+r} x + (1 - \alpha) \frac{1}{1+r} x \\
t &= \alpha \frac{1}{1+r} x + \alpha \frac{1}{1+r} x + (1 - \alpha) \lambda_i b' \frac{1}{1+r} x + (1 - \alpha) \frac{1}{1+r} x
\end{align*}
$$

with $u = V_e(\lambda_i)$, $v = V_s(\lambda_i)$, $t = V_l(\lambda_i)$. These variables express as:

$$
\begin{align*}
u &= g(1 - q + q - \alpha g + g(1 - q - \alpha' g) q + g(1 - q - \alpha' g) q) w) \\
v &= g(1 - q + q - \alpha g + g(1 - q - \alpha' g) q + g(1 - q - \alpha' g) q) w) \\
t &= g(1 - q + q - \alpha g + g(1 - q - \alpha' g) q + g(1 - q - \alpha' g) q) w)
\end{align*}
$$

with $g = \frac{1}{1+r}$

Derivation of $\lambda^*$: the threshold value $\lambda^*$ of the level of trust of the agent indifferent between integrating a LETS or joining the long-term unemployed worker position is given after equalizing $V_s$ and $V_s(\lambda_i)$:

$$
\frac{g(-1 + q)(1 + q - \alpha g - \alpha' g + \alpha g' q) w)}{(-1 + q)(1 + q - \alpha g - \alpha' g + \alpha g' q)} = \frac{b g(1 - q + q - \alpha g + g(1 - q - \alpha' g) q + g(1 - q - \alpha' g) q) w)}{(-1 + q)(1 + q - \alpha g - \alpha' g + \alpha g' q)}
$$

The solution is $\lambda^* = \frac{b(1 + q - \alpha g - \alpha g + g(1 - q - \alpha' g) q + g(1 - q - \alpha' g) q) w}{b'(1 + q - \alpha g - \alpha g + \alpha g' q + \alpha g' q)}$.
Proof of Proposition 1:

Derivation of \(c, s, l, \text{ and } c\): These sub-populations are obtained as solutions of the following system:

\[
\begin{align*}
\alpha c + \alpha s + \alpha l &= qe \\
\frac{q(b(1+g(-1+\alpha+q-\alpha g+\alpha' gq)))}{b'(1+g(-1+\alpha'+q-\alpha g+\alpha' gq))} &= s \\
(1-\alpha)s &= c' \\
f + e + s + m &= 1
\end{align*}
\]

The solutions are:

\[
\begin{align*}
c &= \frac{\alpha' b'(b(-1+\alpha'+q-\alpha g+\alpha' gq)+b(-1+g(-1+\alpha+q-\alpha g+\alpha' gq))+\alpha' gw)}{\alpha' g} \\
e &= \frac{-\alpha'(q+\alpha' q)b'(1+g(-1+\alpha+q-\alpha g+\alpha' gq)) + (1-\alpha)\alpha' g}{b'(1+g(-1+\alpha+q-\alpha g+\alpha' gq))} \\
s &= \frac{\alpha' g}{b'(1+g(-1+\alpha+q-\alpha g+\alpha' gq)) + (1-\alpha)\alpha' gw} \\
f &= \frac{-b'(1+g(-1+\alpha+q-\alpha g+\alpha' gq)) + (1-\alpha)\alpha' g(b'(1+g(-1+\alpha+q-\alpha g+\alpha' gq)) + (1-\alpha)\alpha' gw)}{b'(1+g(-1+\alpha+q-\alpha g+\alpha' gq)) + (1-\alpha)\alpha' gw}
\end{align*}
\]

With:

\[
\begin{align*}
h &= \alpha' g(b(-1+gq) + \alpha' + q + \alpha gq) + b(-1+g(1+\alpha' gq) + \alpha' g) \\
p &= \alpha' g(b(1+g(-1+\alpha' + q + gq + 2\alpha' gq)) + (\alpha' b' + \alpha' q + 2\alpha' gw)) \\
a &= \alpha(b(1+g(-1+q))q + \alpha' g(b' + b' gq + g(bq + w)) + \alpha(bq - b'(-1+g(1+q(-1+gq)) + gq(b(-2+g+2qg+2w))))
\end{align*}
\]

A comparison between the values of \(e\) in the benchmark model and with LETS shows that, whatever the values of parameters:

\[
-\frac{\alpha'}{\alpha' + q + \alpha' q} < \frac{\alpha(g(b(-1+g-\alpha g+\alpha(-1+\alpha gq)+\alpha gw)+\alpha' g(b' + b' gq + b(gq + w))) + (\alpha' (b' - b'(-1+g(-1+\alpha gq)) + gq(b(-1+\alpha+q-2\alpha qg-2\alpha gw))))}{\alpha' g(b'(1+g(-1+\alpha' gq + \alpha' gq)) + (1-\alpha)\alpha' gw)}
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