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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.

1 Introduction

According to the estimations of The World Payments Report in 2012, using dematerialized ways to exchange money is still increasing and even growing faster than the

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volume of dematerialized exchanges previously forecasted. The number of online payments achieve a growth of 20% a year between 2009 and 2013, and this forecasted growth is faster for m-payments (payments with a mobile phone) reaching 52,7% a year during the same period around the world. It is generally considered that mobile payment transaction volumes will be more important than credit card payment volumes in the early twenties (World Payments Report, 2012).

At the same time, alternative currency systems continue to develop: LETS and SEL in France which are local exchange trading systems; the Time Banks which is a complementary currency based on the time of services exchange; the SOL in France which is a local currency exchanged between citizens and local producers; NU-Spaarpas in Nederland and Eco-iris in Belgium which are ecological currencies; etc. There are currently 4000 in circulation around the world, and 60 in circulation or planned in France (Libération, 27 mai 2013).

They take two forms: a material form (cash, SOL or bonds, SEL) or an immaterial one (centralized credit/debit systems, LETS), and they have their own characteristics:

They are only devoted to private transaction (Time Banks, SEL) or open to business transactions (SOL, LETS). They usually make possible multilateral uses: in this case, a credit line is created after the first transaction and this credit can circulate on further exchanges (SEL, Time Banks, LETS). Usually, they take the form of complementary currency convertible in national currency (SOL) or inconvertible (SEL), the currency storage can regularly decrease (Trueque in Argentina) or be charged, and incomes obtained from these systems can be submitted at the same regulations that the formal incomes (LETS). They can also offer systematic credit to the users (LETS).

The development of such currencies is encouraged from many years by the development of online communities. The more recent development of mobile applications available on mobile-phones and smart-phones offers new possibilities to use these currencies in mobile payments and transfers. Some of them have already been exploited inside local communities of unemployed people: we can easily predict that these experiences are only at their initial phase and that they will develop as rapidly than the rate of penetration of mobile services next years. Till now, these communities take the form of local official or informal associations (Blanc, 2005). Inside these communities, the circulation of the parallel money promote interactions between new agents, the so-called “prosumers”, who are both producers and consumers (Toffler, 1980, in J. Blanc, 2006).

A complementary currency is named “social currency” if it reaches three goals: localizing exchanges, boosting exchanges into the locality and transforming the nature of exchanges (Blanc J., 2006). A social currency is “an exchange system of goods, services and knowledge organized by and for small communities by ad hoc organizations. The community can take form of association of persons, formal or informal” (Blanc J., 2005).

These social currencies, which are a subset of the set of parallel currencies, have generally been created in order to promote and develop local environment and econ-

omy and to fight against social exclusion, compensating the lack of money of their users (Seyfang G., 2002; Blanc J., 2006). The new systems of payment generated by these communities do not require any banking account and can then be used by non-bancarized people. These alternatives currencies are then aimed to help low income people to reach / maintain a minimal level of consumption. Results of surveys 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 parallel systems of payment (Seyfang G., 2001, 2002, 2003; Collom E., 2011; Lasker J. and al., 2011).

Indeed, a survey realized in 2006 on a Time Bank system in United-States reveals that one-third of respondents have annual household incomes of less than \$20,000 (Collom E., 2011) and a survey realized in UK in 2002 reveals that 80% of Time Banks users are unemployed people and 70% live with less £13,000 by year (Seyfang G., 2003).

While the development of mobile technology improves the potentiality to develop efficient social currencies, it is then relevant to ask if this kind of parallel currencies, could achieve their goals: fighting against social exclusion and against unemployment ?

Surveys realized in communities using a complementary currency identify the possible links between community currency membership and employment by examining the opportunities opened up by taking part in local exchange systems.

Local currency communities are not known for creating jobs. The jobs directly created by the system and indirect links between these systems and employability. A survey realized in a LETS in UK reveals that only 4.9% of surveyed members have obtained a job directly through the LETS because organizers of the community are principally volunteers (Williams C.C. and al., 2001). Except some social monies created in order to get job to unemployed workers, like the township-currency of Woergl in Tirole in Austria (Gelleri C., 2009), local currency communities don't formally create jobs. If they don't, how can they help unemployed worker to re-enter the job market?

During the unemployment period, people can suffer of irreversible damages concerning a loss of motivation and a depreciation of skills (Mincer J. and Ofek H., 1982; Pissarides C. A., 1992; Böheim R. and Taylor M. P., 2002; Edin P.A. and Gustavsson M., 2007). This issue is also evocated in the "scar theory" which indicates that a long-term spell of unemployment can conduct to a depreciation of human capital (Heckman and Borjas, 1980, in Flaig G. and al., 1993). Unemployed are not able to maintain and improve his valuable work experience and his knowledge. These damages on human capital will have long-term effects on the worker employability that implied a "state dependence" for unemployed people. It means that being unemployed and having been experienced a long period in unemployment decrease their probability to find a job in the future (Flaig G., and al., 1993). That's why it exists some "hysteresis effects" in unemployment. The first effect is issue from the spell length of unemployment. More the spell of unemployment is length, more human capital is lost, and more the probability for unemployed to find

a job is low. Employers will prefer to not hire long-term unemployed due to this human capital depreciation. The second hysteresis effect takes place during periods of falling employment. Short-term unemployed, judged “more competitive”, than long-term unemployed, are more likely to be hiring. Even in healthy labour market period, unemployed person have difficulties to re-enter the labour market because employers prefer hire employees and short-term unemployed. There are some permanent hysteresis effects, due to loss of skills and due to stigma from employers to long-term unemployed, which implied that long-term unemployed are less likely to find a job (Bourdet Y. and Persson I., 1991, 1991a).

However, this loss of skills during unemployment is not a fatality. Productivity of an employee is related to specific competences used for a specific job. This productivity is increasing during employment helped by informal or formal training. More the employee stays in job, more he becomes “familiar” and competent in his job until he reaches a top point of productivity (maximum productivity). If the employee loses his job, he gradually losses these specific competences which was improved by time spent on job. But, these competencies, once acquired, are not totally lost. Once re-employed, the employee re-learns and re-reaches his maximum productivity. Nevertheless, more the time spent in unemployment is lengthy, more it will be lengthy to re-learn specific skills related to his job. There are factors which determine the timeliness of skill loss: the length of time spent in employment (more the time spent in a specific job is lengthy, less the skills are losing quickly), the nature of skill used (some skills are more easily lost), and if the employee has used this skill during the spell of unemployment (Johnson P.S. and Van Doorn J., 1976). This idea of learning during employment spell is also presented in the “learning by doing” theory. Workers learn from experiences. The amount of skills accumulated is positively correlated with time spent in activity and his depreciation is positively correlated with non-use of it (Killingsworth M.R., 1982; Mincer J. and Ofek H., 1982; Desjardins R. and Warnke A.J., 2012).

If these specific skills can be maintain and actualized by “traditional” training and internship programs during the spell of unemployment (Bourdet Y. and Persson I., 1991), there is another way. As seen previously, communities using a social currency don’t formally create jobs. However, they can improve the individual employability. To join these communities, members need to procure a good or a service to sell to other members. To produce this good or service, they need cash in order to launch their activity. Even if in some communities members can obtain a credit in community currency, unemployed people remain resourceless (credit offered by the community can be insufficient to launch an activity and unemployment benefit is usually used for current consumption). That’s why they will offer to other members an activity, essentially services, related to their previous job, activity for which they have required skills and for which they don’t have to invest in order to create the service. Launching a new activity (or a secondary activity), not related to the previous job, would be risky for unemployed people because it would require costly material and immaterial investments with no guarantee of return on investment (Peacock M.S., 2001). By offering an activity related to their previous, unemployed people

have the possibility to maintain and actualize their specific skills and, in this way, improve their employability.

Communities using their own currency are surroundings to develop a sort of self-employment jobs - or to serve as a springboard for access to self-employment (Gomez and Helmsing, 2008; Williams C.C. and al., 2001). Unemployed people transform their specific competences in revenue and purchasing power without risks encountered by launching a formal self-employment activity: no administrative and accounting burdens, customer base is already composed by community's members, opportunity to assess the relevance of the activity.

Loss of skills is not the only problem that unemployed people need to confront. With job loss, unemployed tend to lose their social network. As a consequence, they lose a part of information particularly about job opportunities and new activity development (Williams C.C., 1996). Communities using a social currency could help unemployed people to re-create a social link. Thanks to surveys conducted on members of community currency exchange systems, this help is revealed real. Community currency exchange systems give them opportunity to re-construct and to extend their social network (Williams C.C., 1996; Seyfang G., 2001) and know more local people (Seyfang G., 2003), to belong in a collectivity (Lasker J. and al., 2011), to again participate actively in the life of their community with help of coordinators who bring members together (Seyfang G., 2002), and to develop relationship skills (Seyfang G., 2001; Ozanne L.K., 2010).

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 M.S., 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 J. and Ofek H., 1982; Pissarides C. A., 1992; Böheim R. and Taylor M. P., 2002; Edin P.A. and Gustavsson M., 2007) and increases for LETS members the instantaneous probability to be recruited (Flaig G., and al., 1993). In these assumption, we ask three research questions: (i) on which condition such LETS can maintain or not at equilibrium? (ii) What 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 analyzing 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 perma-

nence 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 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 α 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 α' with $\alpha' < \alpha$ (1).

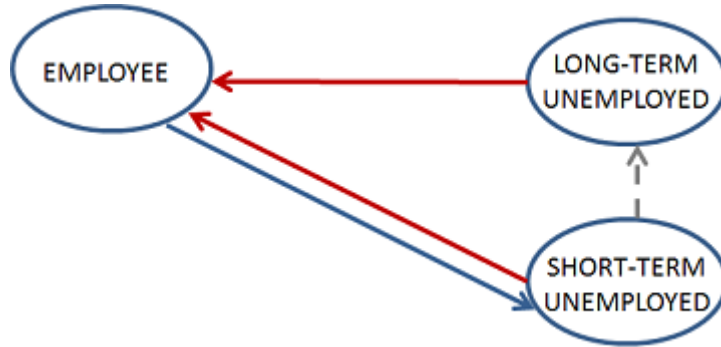


Figure 1: Transition pattern in the benchmark model

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 (3), (2) and (??):

$$qe = \alpha s + \alpha' l \tag{1}$$

$$qe = s \quad (2)$$

$$(1 - \alpha)s = \alpha'l \quad (3)$$

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 $l = \frac{q(1-\alpha)}{q(1-\alpha) + \alpha'(1+q)}$ and short term unemployed ones are in proportion $s = \frac{\alpha'q}{q(1-\alpha) + \alpha'(1+q)}$. 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 α to find a job as short term worker or as a long term unemployed worker α' .

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

$$V_e = (1 - q) \frac{w + V_e}{(1 + r)} + q \frac{b + V_s}{(1 + r)} \quad (4)$$

$$V_s = \alpha \frac{w + V_e}{(1 + r)} + (1 - \alpha) \frac{b + V_l}{(1 + r)} \quad (5)$$

$$V_l = \alpha' \frac{w + V_e}{(1 + r)} + (1 - \alpha') \frac{b + V_l}{(1 + r)} \quad (6)$$

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 worker¹. 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 , α , α' 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 , α and α' 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.

¹We 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.

3 Introducing a LETS

A LETS is introduced in this section as a network providing three kinds of services.

1. It encourages unemployed workers to stay active and to produce for the equivalent of a monetary utility b' . This value, when added to the other unemployment benefits compatible with this activity is supposed at least equal to b ².

2. LETS provide also a complementary currency. This additional currency is useful for avoiding unemployed people to face the “double coincidence of needs” condition. The complementary currency then increases the efficiency of exchanges in the informal sector. However, a complementary currency is not as easily acceptable than official currencies. This acceptability depends on two different components. One is the effective size c of the LETS. Wider is the LETS, easier is for each unemployed complementary currency holder to find an agent able to accept this currency as a mean of payment. The other is the organization and the reliability of the LETS. Better is the organization and the reliability of the LETS, greater is the confidence in the complementary currency, then the propensity to the LETS members to accept it.

When the complementary currency has all the properties of the official currency, the instantaneous utility of an unemployed worker in the LETS is given by b' . When the size or organization of the LETS are not optimal, the utility of each unemployed worker inside the LETS is given by $\lambda b'$ where $0 \leq \lambda < 1$ increases with the acceptability of the complementary currency. The specification $\lambda = ac(2 - c)$ expresses the required properties of the acceptability where a is an index of the LETS good governance ($0 \leq a \leq 1$). The signs of the derivatives in c ($\lambda'_c > 0, \lambda''_c < 0$) on the definition space of c , expresses that the acceptability of the currency increases with the size of the LETS, while the capacity to exchange of a member of the LETS is limited by his capacity to supply / to produce more.

3. Because they are active in the LETS, the LETS maintains the level of skill of unemployed workers and their capacity to find a job in each period as long term unemployed workers with an unchanged probability α that they have as short term unemployed ones. The LETS plays then the role of a “learning by doing device”.

3.1 Confidence in the complementary currency outside the LETS

Outside LETS, the term b' is perfectly observable: it depends on the efficiency of the “production technology” outside industrial organization. The term λ witch corresponds to currency acceptability is not. Outside LETS, workers have heterogeneous levels of confidence in the properties of the complementary currency and in the potentiality of the LETS in general. The size c the LETS is however observable and

²Suppose indeed that b' is smaller than the unemployment benefit b . In this case, unemployed workers have interest to work for free if they draw other advantages from LETS or to leave them if they have no other interest to stay in.

has an influence on the heterogeneity and the level of confidence of outsiders. When LETS are very small, the level of confidence in the complementary currency is also very small for all outsiders. When the LETS is very large, the level of confidence is also high and quite identical for all outsiders. In between, there is a higher degree of heterogeneity among the level of trust of outsiders³. To capture this variation of the distribution of beliefs in function of c , we suppose that agents' expectations are uniformly distributed on the segment $[c^2, c]$ whatever the observable size of c .

$\lambda_i, (i = \{1, 2, \dots, n\})$,
of λ by the agent, is un

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 λ defined on a segment $[0, 1]$. When λ_i is close to 0, worker i has a low level of confidence into the complementary currency; when λ_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 LETS. The transition process between the four possible positions of the job market are then depicted by Fig (2):

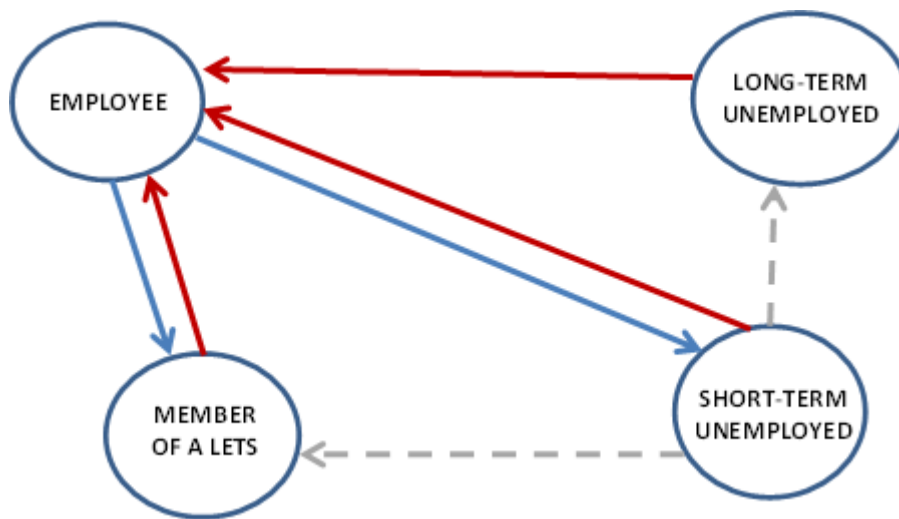


Figure 2: Transition pattern in the model with LETS

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 λ_i to λ with $0 < \lambda \leq 1$. λ reflects the effective properties of the LETS and depends both of the

³essayer de justifier cette distribution avec d'autres situations d'incertitude

objective reliability of the complementary currency and of the organization of the LETS. As a first approximation, λ will be taken as given ⁴.

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 λ_i . Those joining them only after a while correspond to smaller values of λ_i as they are only interested in LETS when there have 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 λ_i smaller than the level of trust λ of the unemployed workers inside LETS all workers 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 $(1 - \alpha') \frac{b+V_l(\lambda_i)}{(1+r)} + \alpha' \frac{w+V_e(\lambda_i)}{(1+r)}$ and becoming a member of a LETS, *i.e.*, having an utility equal to $V_c(\lambda_i) = (1 - \alpha) \frac{\lambda_i b' + V_c(\lambda_i)}{(1+r)} + \alpha \frac{w+V_e(\lambda_i)}{(1+r)}$. 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 $V_c(\lambda) = (1 - \alpha) \frac{\lambda b' + V_c(\lambda)}{(1+r)} + \alpha \frac{w+V_e(\lambda)}{(1+r)}$ if he/she remains in the LETS and $(1 - \alpha') \frac{b+V_l(\lambda_i)}{(1+r)} + \alpha' \frac{w+V_e(\lambda_i)}{(1+r)}$ if he/she leaves the LETS. It is easy to verify that if $V_c(\lambda_i) = (1 - \alpha) \frac{\lambda_i b' + V_c(\lambda_i)}{(1+r)} + \alpha \frac{w+V_e(\lambda_i)}{(1+r)} > (1 - \alpha') \frac{b+V_l(\lambda_i)}{(1+r)} + \alpha' \frac{w+V_e(\lambda_i)}{(1+r)}$, then $V_c(\lambda) = (1 - \alpha) \frac{\lambda b' + V_c(\lambda)}{(1+r)} + \alpha \frac{w+V_e(\lambda)}{(1+r)} > (1 - \alpha') \frac{b+V_l(\lambda_i)}{(1+r)} + \alpha' \frac{w+V_e(\lambda_i)}{(1+r)}$ ■

Note that if all the agents choosing to join the LETS have a level of confidence in the complementary currency greater than λ , the LETS can emerge or not at equilibrium. Suppose for instance that the agent i with the smallest λ_i choosing to join the LETS is such that λ_i is far greater than λ : in this case, one may have $(\lambda_i b' + V_c(\lambda)) < b + V_l$ but $(\lambda_i b' + V_c(\lambda_i)) > b + V_l$. 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

⁴In a more complex setting, λ could be made dependent on time and on the members of the LETS.

utility never depends on λ_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 λ the trust of the complementary currency inside the LETS.*

Proof: Suppose that it remains employed workers with a level of trust λ_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 λ of the acceptability of the complementary currency ■

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

3.2 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 λ_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 λ . Knowing λ_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 λ 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:

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

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

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

Equations (7) to (9) solve in $V_e(\lambda_i)$, $V_s(\lambda_i)$, and $V_c(\lambda_i)$, providing then, a function of λ_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.

$$V_s = \alpha \frac{w + V_e}{(1+r)} + (1-\alpha) \frac{b + V_l}{(1+r)} \quad (10)$$

$$V_e = (1-q) \frac{w + V_e}{(1+r)} + q \frac{b + V_s}{(1+r)} \quad (11)$$

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

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 λ_i^* expresses as $\lambda_i^* = \frac{b(1+g(-1+\alpha+q-\alpha q q+\alpha' g q))+(-\alpha+\alpha') g w}{b'(1+g(-1+\alpha'+q-\alpha g q+\alpha' g q))}$ 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 α and decreases with α' , *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 λb , *i.e.*, with the performances of the complementary currency and more generally of the organization of the LETS.

3.3 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)

$$qe = \alpha s + \alpha c + \alpha' l \quad (13)$$

$$q\lambda_i^* e = s \quad (14)$$

$$(1 - \alpha)s = \alpha' l \quad (15)$$

$$(1 - \lambda_i^*)s = \alpha c \quad (16)$$

with by definition, $e + s + l + c = 1$.

The system solves easily⁵ 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 feed-back 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 level⁶.

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*

⁵with the help of *Mathematica* software as the previous ones

⁶In 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 is 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)

Proof: Employed people e associate two sub-populations. The first has the size λ_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 λ_i is taken equal to λ . Calculations provide the value $u = \frac{g(b(-1+g-\alpha)q+(-1+\alpha)b'\alpha\lambda_iq+(-1+q-g(-1+\alpha+q))w)}{(-1+g)(1+g(-1+\alpha+q))}$ 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 ■

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 \hat{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 other ones, 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 ⁷.

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

⁷see Della Peruta, Torre, 2012

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.

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.

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Appendix

Appendix 1: The benchmark model

Derivation of e , s , and l :

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

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

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

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

Derivation of V_e , V_s , and V_l :

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

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

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

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

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

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

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

$$\begin{aligned}\frac{\partial x}{\partial q} &= \frac{bg(-1+\alpha g-\alpha'g)+(-1+g)g(-1+\alpha g-\alpha'g)w}{(-1+g)(1+g(-1+\alpha'+q-\alpha gq+\alpha'gq))^2} - \frac{g(1+(-1+\alpha')g)(-1+\alpha g-\alpha'g)(b-w)}{(-1+g)(1+g(-1+\alpha'+q-\alpha gq+\alpha'gq))^2} \\ \frac{\partial x}{\partial \alpha} &= \frac{g^2(1+(-1+\alpha')g)q(b-w)}{(-1+g)(1+g(-1+\alpha'+q-\alpha gq+\alpha'gq))^2} \\ \frac{\partial x}{\partial \alpha'} &= \frac{(-1+\alpha)g^3q(b-w)}{(-1+g)(1+g(-1+\alpha'+q-\alpha gq+\alpha'gq))^2}\end{aligned}$$

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 :

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

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

$$\begin{aligned}x &= \frac{bg(-1+\alpha g-\alpha'g)q+g(-1+g-\alpha'g+(-1+g)(-1+\alpha g-\alpha'g)q)w}{(-1+g)(1+g(-1+\alpha'+q-\alpha gq+\alpha'gq))} \\ y &= \frac{bg(-1+\alpha+g-\alpha g+g+g(-1+\alpha g-\alpha'g)q)+g(\alpha(-1+g)-\alpha'g)w}{(-1+g)(1+g(-1+\alpha'+q+\alpha gq+\alpha'gq))} \\ z &= \frac{bg(-1+\alpha'+g-\alpha'g+g(-1+\alpha g-\alpha'g)q)-\alpha'gw}{(-1+g)(1+g(-1+\alpha'+q-\alpha gq+\alpha'gq))}\end{aligned}$$

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

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

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

with $x = V_e(\lambda_i)$, $y = V_s(\lambda_i)$, $t = V_c(\lambda_i)$. These variables express as:

$$\begin{aligned}u &= \frac{g(b(-1+g-\alpha g)q+(-1+\alpha)b'\alpha\lambda_i q+(-1+q-g(-1+\alpha+q))w)}{(-1+g)(1+g(-1+\alpha+q))} \\ v &= \frac{g((-1+\alpha)b'\lambda_i(1+g(-1+q))-\alpha(bgq+w))}{(-1+g)(1+g(-1+\alpha+q))} \\ t &= \frac{g((-1+\alpha)b'\lambda_i(1+g(-1+q))-\alpha(bgq+w))}{(-1+g)(1+g(-1+\alpha+q))}\end{aligned}$$

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

Derivation of λ^* : the threshold value λ_i^* 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 $V_s(\lambda_i)$:

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

The solution is $\lambda_i^* = \frac{b(1+g(-1+\alpha+q-\alpha gq+\alpha'gq))+(-\alpha+\alpha')gw}{b'(1+g(-1+\alpha'+q-\alpha gq+\alpha'gq))}$.

Proof of Proposition 1:

Derivation of e , s , l , and c : These sub-populations are obtained as solutions of the following system:

$$\begin{cases} \alpha c + \alpha s + \alpha' l = qe \\ \frac{q(b(1+g(-1+\alpha+q-\alpha gq+\alpha'gq)))}{b'(1+g(-1+\alpha'+q-\alpha gq+\alpha'gq))} e = s \\ (1 - \alpha)s = \alpha' l \\ f + e + s + m = 1 \end{cases}$$

The solutions are:

$$\begin{aligned} c &= \frac{q(\alpha^2 g(2\alpha'+q)(b(-1+gq)+w)-\alpha(b(-2\alpha'(-1+g)+q+g(-1+\alpha'(3+2\alpha'g))q+gq^2)+\alpha'g(b'gq+2\alpha'w))+\alpha'(b'(1+g(-1+\alpha'+q+\alpha'gq))-q(b(1+g(-1+q+\alpha'gq))+\alpha'gw)))}{\alpha'b'(\alpha+q)(1+g(-1+\alpha'+q-\alpha gq+\alpha'gq))} \\ e &= \frac{\alpha(\alpha q(b(-1+g-\alpha g+g(-1+\alpha g)q)+\alpha gw)+\alpha'^2 g(b'+b'gq+q(bgq+w))+\alpha'(bq-b'(-1+g+g(-1+\alpha g)q)+gq(b(-1+\alpha+q-2\alpha gq)-2\alpha w)))}{\alpha'b'(\alpha+q)(1+g(-1+\alpha'+q-\alpha gq+\alpha'gq))} \\ s &= \frac{q(b(1+g(-1+\alpha+q-\alpha gq+\alpha'gq))+(-\alpha+\alpha')gw)}{b'(1+g(-1+\alpha'+q-\alpha gq+\alpha'gq))} \\ l &= \frac{\alpha q(b(1+g(-1+\alpha+q-\alpha gq+\alpha'gq))+(-\alpha+\alpha')gw)}{\alpha'b'(1+g(-1+\alpha'+q-\alpha gq+\alpha'gq))} \end{aligned}$$

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

$$-\frac{\alpha'}{-\alpha'-q+\alpha q-\alpha'q} < \frac{\alpha(\alpha q(b(-1+g-\alpha g+g(-1+\alpha g)q)+\alpha gw)+\alpha'^2 g(b'+b'gq+q(bgq+w))+\alpha'(bq-b'(-1+g+g(-1+\alpha g)q)+gq(b(-1+\alpha+q-2\alpha gq)-2\alpha w)))}{\alpha'b'(\alpha+q)(1+g(-1+\alpha'+q-\alpha gq+\alpha'gq))}$$