

COMPLEMENTARY CURRENCY SYSTEMS: EMPLOYABILITY AND WELFARE

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Complementary Currency Systems: Employability and Welfare*

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Abstract

Complementary currency systems have developed around the world. Some are associated with local communities and aimed at developing local economic activity, social links or employability among the unemployed people. This paper uses a theoretical model to provides answers to practical questions associated with the implementation of complementary currencies aimed at eliminating the “scar effect” and facilitating recruitment in the formal sector. What are the condition for a successful complementary currency? Should credit be managed in the same way depending whether welfare or employment the chosen objective? The results point to the role of confidence in the adoption of a complementary currency, and also interest in a controlled level of mutual credit if employment is the main objective of complementary currency implementation.

JEL Classification: A13, D61, E42, J46

Keywords: Complementary currencies, scar effect, employability, mutual credit.

1 Introduction

Unemployed people have difficulties to maintain their competences. Their motivation decreases, their skills become obsolete as technologies evolve, and professional networks narrow (Mincer and Ofek, 1982; Pissarides, 1992; Böheim and Taylor,

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2002; Edin and Gustavsson, 2008). Unemployment inflicts “scars” which make past unemployment a good predictor of the capacity to be hired (Heckman and Borjas, 1980; Arulampalam, Gregg and Gregory, 2001; Clark, Georgellis and Sanfey, 2001; Knabe and Rätzel, 2011). Being unemployed and having experienced a long period of unemployment decrease the probability to find a job in the future (Flaig *et al.*, 1993). Thus, there is a “hysteresis effects” in unemployment. The longer the period of unemployment, the greater the loss of human capital, and the lower the probability of the unemployed workers finding a job. Despite dedicated public policies, the “scar effect” persists even in periods of recovery, and the long-term unemployment rates in low and high-unemployment states are very close (Krueger, Cramer and Cho, 2014).

Among the devices suggested to fight the “scar effect”, implementation of a complementary currency is not high on the list. However, there are several interesting examples that have been developed around the world, such as Brazil’s *Banco de Palmas* introduction of *Palmas*, or micro-credits in a complementary currency to individuals and professionals to develop professional activities generating jobs. Complementary currencies can take material (notes or vouchers) or immaterial (centralized credit/debit systems, electronic wallet available via mobile phones and computers) forms. Some involve only retail payments, some can be exploited for business transactions, and some can be converted into the national currency. Some complementary currencies are valuable reserves; in other cases, their value decreases if it is hoarded (described as a “melting” currency). Incomes derived from use of a complementary currency is subject to the same regulatory regime as formal incomes, for instance, to income tax. Complementary currency systems can provide incentives, such as discounts, or credits to their members. These incentives soften cash in advance constraints which constitute a barrier to transactions in small communities. They also improve the complementary currency’s acceptability and facilitate its adoption.

If a complementary currency is aimed at improving employability, it must have other specific properties. Intuition suggests that its circulating quantity must be sufficiently to fuel Local Exchange Trading Systems (LETS) activity. Encouraging credit in complementary currency then becomes a way to increase the circulating quantity of currency. However, availability of credit also encourages unemployed workers to consume without producing. All excess credit could exempt at least temporarily holders of it from working in the LETS. If unemployed workers are not active, they are unable to maintain their skills which defeats one of the main objective of complementary currency. Then, if the objective is to improve employability should credit be excluded from the LETS advantages? If so, what would be the

consequences for welfare of LETS activation? More generally, what could be the normative properties of LETS if they promote employability?

In this paper we try to determine an optimal LETS design to improve employability by addressing the following questions:

(i) Under what conditions could a complementary currency system, dedicated to maintain employability, emerge and remain active?

(ii) Should provision of credit be excluded if the objective of the LETS is to improve employability?

(iv) Is there a convergence between the properties of the LETS that promote employment and those that improve welfare?

Section 2 reviews the related literature, section 3 proposes a theoretical model to determine short and long-term unemployment at stationary equilibrium and to capture population movements between employment and unemployment. In sections 4 we extend the model to analyze the conditions of emergence and activation of a complementary currency system and address our first question. We study the properties of the formal employment and welfare economy (section 5) in order to answer questions (ii) and (iii). Our results show first the importance of confidence in the emergence and activation of a LETS. Then, also confirm that the affect of credit is not neutral on either employment or welfare: a small amount of credit promotes the emergence of a complementary currency system, improves its performances in terms of formal employment and increases welfare. Few credit is necessary to reach the optimal level of employment, but a larger amount is necessary to optimize welfare.

2 LETS and employability: a review of literature

A LETS is a “local association of members putting products and services at the service of others members, these exchanges being measured in an exchange unit chosen by the adherents” (Attout *et al.*, 2013). It is an exchange community in which goods and services are produced and sold among participants. Inside this community, transactions generally are based on a complementary currency which is an accounting unit used to evaluate each transaction. Participants are usually members of the association responsible for managing the LETS. They commit to make products and/or competences available in the network. The association connects members according their needs and competences (Seyfang, 2006). There are some examples of very successful such as *NU-Spaarpas* in the Netherlands which has

10 000 resident members and 100 participating local shops, and *Les Accorderies* in Quebec which has 2000 members and includes 700 types of services.

Exchanges inside LETS do not require bank account making them accessible to everyone. They require only that members contribute their time to make goods or services available to other members. In return for a sale, they acquire complementary currency units which can be spent to acquire other goods or services from the LETS. Because LETS promote social issues and are freely accessible (e.g. no requirement for “capital” in an official currency to be converted into the complementary currency), LETS attract low income people (especially unemployed and retired individuals) to use the possibilities offered by the network to achieve / maintain a sufficient living standard. Studies of LETS and Time Banks (where services are paid for as units of time as a complementary currency) in the UK and the US show that low-income and unemployed users are indeed the target audience of these complementary currency systems (Seyfang, 2001, 2002, 2003; Collom, 2011; Lasker *et al.*, 2011).

Several studies of LETS identify the links between LETS membership and employability by examining the opportunities opened by participation in a complementary currency community (Williams, 1996; Williams *et al.*, 2001a; Williams *et al.*, 2001b; Gomez and Helmsing, 2008; Gelleri, 2009; Boyle, 2014). They show direct links between LETS membership and employability in the case of job creation, and indirect links, related to the LETS improving the employability of its members. However, only a few jobs are created directly inside LETS, LETS employ mainly volunteers to manage and organize the system (Williams *et al.*, 2001b). A small minority of complementary currency systems are designed to provide jobs for unemployed workers for example the township-currency of Woergl in Tirole / Austria (Gelleri, 2009), or to support the creation of local micro-enterprises for example *Banco De Palmas* in Brazil.

Indirect employment is more relevant. LETS enable members to maintain their skills and to acquire new ones, which improves the employability of unemployed workers. Surveys of LETS members reveal that participation in a complementary currency system allow the to maintain or develop new ones (Williams *et al.*, 2001a; Williams *et al.*, 2001b; Gomez and Helmsing, 2008; Boyle, 2014). Since LETS are based on mutual exchanges of services, LETS members can benefit from training and accumulate valuable new competences in the labor market (Gomez and Helmsing, 2008). LETS members can also develop new skills through volunteering and participating in the management of the system. This allows them to develop new

abilities, especially computer and administrative skills, which they can exploit in their job search (Williams *et al.*, 2001a; Williams *et al.*, 2001b).

Through participation in a LETS, members, and especially unemployed members, can upscale their skills in order to improve their employability. As a condition of membership members have to offer their services to earn complementary currency units. Launching a new activity is costly and members will prefer to offer services related to their current or previous job, which they have competences, rather than launching a new or a secondary activity (Peacock, 2000; Gomez and Helmsing, 2008). By offering an activity related to their previous job within a LETS network, allows unemployed people to mobilize their specific competences and to maintain them, and thus to improve their employability.

Communities using their own currency contribute to the development of self-employed work - or serve as a springboard to self-employment (Gomez and Helmsing, 2008; Williams *et al.*, 2001b). Unemployed people benefit from additional revenue to cushion them from the risks generally associated with the first months and years of a formal self-employment activity. They are free of administrative and accounting burdens, and have a ready pool of customers from among the community's members. In addition, within the LETS network, members can test new products to evaluate whether they will satisfy demand in the formal market (Williams *et al.*, 2001b). This activity provides self-training for the development of micro-enterprises (Gomez and Helmsing, 2008). Williams *et al.* (2001b) found that among 810 LETS member respondents, 10.7% declared that "their LETS had helped them become self-employed". Similarly, Gomez and Helmsing (2008) found that in *Clubs de Trueque* / Argentina, 78 of 140 respondents tested their activity in the regular economy, and 40 respondents were still active after one year.

Unemployed workers lose part of their social network and sources of professional information on job opportunities (Williams, 1996). By linking members, LETS overcomes social exclusion by re-building of and extension to unemployed people's social network (Williams, 1996; Seyfang, 2001, 2002, 2003; Ozanne, 2010; Lasker *et al.*, 2011). Complementary currency communities enable people from various backgrounds and professions to meet and create ties (Granovetter, 1973). These weak ties bring information, not provided by intimate circles of colleagues and relatives, and especially information on job opportunities (Granovetter, 1973; Lin, 1995; Mercklé, 2011). LETS membership reduces social isolation thereby helping unemployed individuals' "job readiness" re-enter the job market (Boyle, 2014).

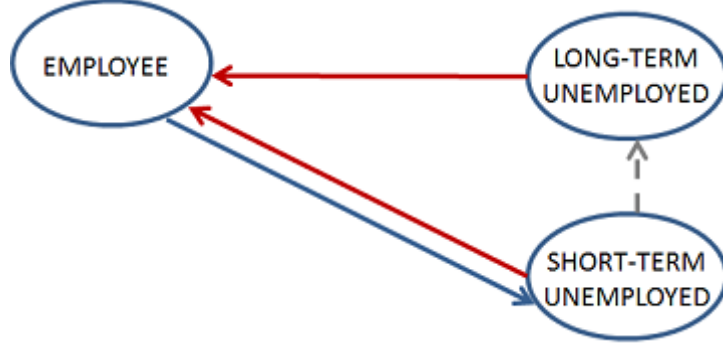


Figure 1: Transition pattern in the benchmark model

3 The benchmark model

The benchmark model represents an economy with n workers where the probability to observe employment opportunities decreases over 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 belong to one of 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 employment opportunity, they join the group of long-term unemployed workers.

- Long-term unemployed workers are in proportion l . They receive the same unemployment benefit b as the short-term unemployed but their probability to observe an opportunity to work is only α with $\alpha < \alpha'$ (scar effect).

The model is analyzed at stationary equilibrium, i.e. at the state such that the number of employed and unemployed workers remains constant over time, as long the environment remains unchanged. The stationary equilibrium equations are (1), (2) and (3):

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

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

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

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

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 respectively the intertemporal utilities after consumption of an employed worker, a short-term unemployed worker and a long-term unemployed, while w and b represent respectively the instantaneous wage of an employed worker and the unemployment benefit of an unemployed worker. w and b are expressed and paid in official currency and spent on good and services that are consumed immediately. The system (4) to (6) also solves and gives the equilibrium values of the intertemporal utility in each position a worker can occupy on the labor market. Each intertemporal utility is a function of the parameters q , α , α' , w and b . The comparative statics study of V_e , V_s and V_l establishes that (see Appendix) each intertemporal utility increases with w , b , α and α' and decreases when q increases. All these relations are intuitive: the smaller the probability that the worker will be fired, the greater is his utility in each position in the job market. The content of the other comparative statics properties is also intuitive.

4 Introducing a LETS

In this section we introduce a LETS. Each member of this LETS produces goods or services according its competences. These goods and services are exchanged in the LETS, with the help of a complementary currency which serves to evaluate each transaction and to avoid the “double coincidence of needs”. The position of each member in the complementary currency is given by a centralized account managed electronically by the LETS administration: payments and transfers are made electronically via mobile phones. All purchases inside the LETS must be paid in the complementary currency which is not accepted outside the LETS.

The LETS integrates employed and unemployed workers. However, employed members have less time to devote to LETS activities. If b' and c respectively represent the instantaneous expected revenue and the instantaneous expected cost of a full time active member of the LETS, the net revenues of an unemployed and an employed members are respectively $a_u(b' - c)$ and $a_e(b' - c)$ with $0 < a_e < a_u < 1$. Now, the instantaneous benefit from being an unemployed worker inside the LETS increases from b to $b + a_u(b' - c)$. Similarly, the instantaneous benefit of being an employed worker inside the LETS increases from w to $w + a_e(b' - c)$.

Additionally, LETS members benefit from a “mutual credit” of a given amount of complementary currency enabling them to buy before having sold/produced. Similarly, this credit improves the probability to sell a good or service produced inside the LETS. This credit then lubricates the LETS and compensates its limited dimension. It takes the form of an authorized overdraft on the account of each member, immediately available when an agent joins the LETS. This overdraft is interest free. However, its amount is limited and it must be cleared when the member leaves the LETS. Since it is not technically possible to distinguish all positions of individual members relative to the use of this overdraft (*i.e.* to distinguish at each moment receivable and payable accounts) we consider the expected advantage of the credit for a given member of the LETS in the form of a positive increment of utility depending on the amount of the authorized overdraft.

It is not always evident for workers to accept complementary currency as payment. Outside LETS, workers show heterogeneous levels of confidence in the properties of the complementary currency and the potential of LETS in general. Let us make the working assumption that the levels of confidence of employed workers in the reliability of the complementary currency are given by a coefficient λ_i defined on a segment $[0, \bar{\lambda}]$. This confidence in the reliability of the circulating complementary

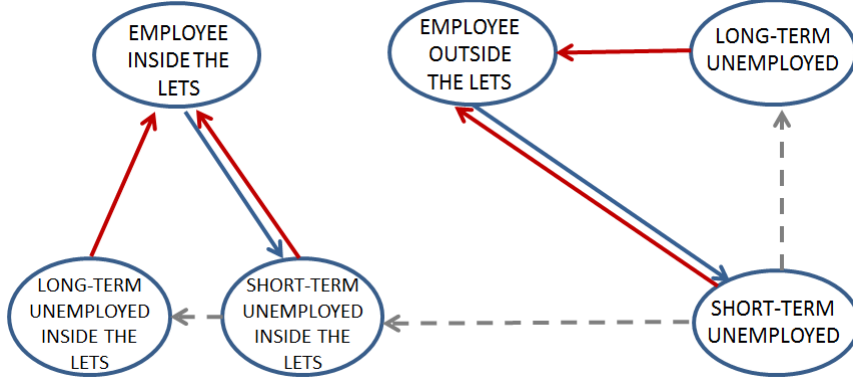


Figure 2: Transition pattern in the LETS model

currency affects workers' expectations about their capacity to earn profits inside the LETS. According to their level of confidence λ_i , they will anticipate a greater or lesser profit, and decide to participate or not in the LETS. When λ_i is close to 0, worker i has a low level of confidence into the complementary currency and the potentiality of the LETS to modify her purchasing power. Conversely, when λ_i is close to $\bar{\lambda}$, her level of confidence is high. Since $\bar{\lambda}$ can be greater than 1, this allows for under and over-confidence..

Then, the expected instantaneous benefit from being a member of the LETS can be expressed as follows:

$$A = b + a_u(\lambda_i b' - c) + a''C \quad (7)$$

where A expresses the expected instantaneous benefit from being an unemployed worker inside the LETS.

$$B = w + a_e(\lambda_i b' - c) + a''C \quad (8)$$

where B expresses the expected instantaneous benefit from being an employed worker inside the LETS.

With the introduction of the LETS, when an employee loses his/her job, he/she becomes a short term unemployed worker. He/she can be recruited again immediately or not. If he/she remains unemployed, he/she can decide to join the LETS instead of becoming a long term unemployed worker¹. People outside the LETS do not know the exact advantages and disadvantages of the LETS. They compare the advantages of being inside or outside LETS as long terms unemployed workers

¹We show below that there is no interest for an unemployed worker to apply a LETS immediately after being fired nor as a long term unemployed worker

according their respective levels of λ_i . Only unemployed workers who are optimistic about the properties of the LETS will join the system. These unemployed workers correspond to the highest values of λ_i . Namely, short term unemployed workers not recruited immediately choose to join the LETS or not according to V_l given by expression (6) compared with their expected value of the same position V_{ll} inside the LETS. This value is obtained as a solution to the following system:

$$V_{ll}(\lambda_i) = (\alpha + a'''(\alpha' - \alpha) - \gamma C^2) \frac{B + V_{el}(\lambda_i)}{1 + r} + (1 - (\alpha + a'''(\alpha' - \alpha) - \gamma C^2)) \frac{A + V_{ll}(\lambda_i)}{1 + r} \quad (9)$$

$$V_{el}(\lambda_i) = (1 - q) \frac{B + V_{el}(\lambda_i)}{1 + r} + q \frac{A + V_{sl}(\lambda_i)}{1 + r} \quad (10)$$

$$V_{sl}(\lambda_i) = \alpha' \frac{B + V_{el}(\lambda_i)}{1 + r} + (1 - \alpha') \frac{A + V_{ll}(\lambda_i)}{1 + r} \quad (11)$$

The term $\alpha + a'''(\alpha' - \alpha) - \gamma C^2$ of equation (9) encapsulates two different effects. The first, associated with the term $a'''(\alpha' - \alpha)$ expresses the expected gain in employability associated with working in the LETS, and maintaining skills for short term unemployed people. The term γC^2 refers to negative consequences of the availability of credit for unemployment. Credit can decrease the incentive to work in the LETS and limit the employability gains for the long-term unemployed members of the LETS. Some members can choose to differ their activity inside the LETS until their credit is exhausted. In this case, the larger is the overdraft allowed, the longer production will be delayed and the smaller is the average of employability of long term unemployed workers inside the LETS.

Solving systems (4)-(6) and (9)-(11) separately, provides the values for V_l and V_{ll} which - when equalized - give the threshold value λ_i^* of λ_i . The following proposition is related to studies the comparative static properties of λ_i^* .

Proposition 1. *The number of unemployed workers choosing to join a LETS increases with $\bar{\lambda}$, with α' and decreases with $(\alpha' - \alpha)$. It is not still monotonous with C .*

Proof: Given λ^* , the size of the population introducing the LETS is given by $t = \frac{\bar{\lambda} - \lambda^*}{\lambda}$. (see development the expression of t^* for the non-negative values of the different populations of employed and unemployed workers, inside and outside the LETS in Appendix I). Elementary comparative static analysis provides the rest of the lemma ■

Some of these results are intuitive. For instance, given that workers are uniformly distributed on the segment $[0, \bar{\lambda}]$, the higher is $\bar{\lambda}$, the greater will be the number of agent's choosing to integrate the LETS. Increasing $\bar{\lambda}$ is equivalent to increasing the average optimism relative to the performance in the LETS. Similarly, the smaller is α or the greater the difference $(\alpha' - \alpha)$, the higher will be the number of workers interested in LETS. Both these comparative statics experiments consider the effect of an increased difference between the employability of short and long term unemployed people. The LETS tends naturally to be more attractive if it helps to maintain the employability of long term unemployed people. The effect of credit is more ambiguous: in this case there are two effects in a trade-off relation. An increase in the allowed level of overdraft increases the average instantaneous revenue of LETS members. Simultaneously, all increases in the authorized overdraft ultimately decrease the employability of unemployed workers. Since this negative effect dominates if the amount of credit is increased indefinitely, the relation between C and LETS population is negative for some level of amount of credit. Finally, the relation between C and the LETS population can be decreasing, or initially increasing then decreasing. The same two possibilities apply to credit and employment.

The number of workers that join the LETS does not necessarily determine the effective composition of the LETS. It determines it only if workers are pessimistic about the performance of the LETS, and especially the amount of revenue it supports. On becoming a member of the LETS, workers can observe the effective instantaneous utility, given by:

$$A' = b + a_u(b' - c) + a''C \quad (12)$$

when they are unemployed and

$$B' = w + a_e(b' - c) + a''C \quad (13)$$

when they are employed. Similarly, the broader the LETS, the greater the number of opportunities to “produce”, and to provide and accept services. Then, all things equal, employability increases with the population of the LETS. This property of the LETS is not expected by members. The equation (9) then takes its effective form (14) when the LETS is activated.

$$V_{ll} = (\alpha + \beta t^*(\alpha' - \alpha) - \gamma C^2) \frac{B + V_{el}}{1 + r} + (1 - (\alpha + \beta t^*(\alpha' - \alpha) - \gamma C^2)) \frac{A + V_{ll}}{1 + r} \quad (14)$$

where t^* is the size of the LETS.

At this stage, it is possible to express the dynamics of workers' sub-populations located at different positions in or outside the LETS. It is possible also to express the intertemporal expected utility of each. For instance, the stationarity equation can be written as:

$$qe_{nl} = \alpha' s + \alpha l \quad (15)$$

$$qe_{nl} = s \quad (16)$$

$$e_{nl} + l + s = (1 - t^*) \quad (17)$$

$$qe_l = \alpha' s_l + (\alpha + t^*(\alpha' - \alpha) - \gamma C^2) l_l \quad (18)$$

$$qe_l = s_l \quad (19)$$

$$t^* = e_l + s_l + l_l \quad (20)$$

where e_l , s_l and l_l respectively are the proportion of employed, short term employed and long term employed workers in the LETS and e_{nl} , s_{nl} and l_{nl} represent the same populations outside the LETS.²

Equations (15) to (20) represent the stationary populations occupying the six possible positions, inside and outside the LETS. The Bellman equations inside the LETS are provided by equation (14), associated to equations (21) and (22),

$$V_{el} = (1 - q) \frac{B' + V_{el}}{1 + r} + q \frac{A + V_{sl}}{1 + r} \quad (21)$$

$$V_{sl} = \alpha' \frac{A' + V_{el}}{1 + r} + (1 - \alpha') \frac{A' + V_{ll}}{1 + r} \quad (22)$$

When the effective level of utility V_{ll} calculated by equations (14), and (21)-(22), is greater or equal to the level calculated by equations (7) and (11), all those who at a moment chose to join the LETS remain definitive members of the system. In the opposite case, the LETS reduces volume after a first excess of optimism relative to its performances. In this case, the size of the LETS decreases following initial

²All these population variables are between 0 and 1. If a negative value is obtained for one of these variables, this value is substituted by 0 and the result is that the LETS does not emerge or conversely corresponds to the full economy

excessive optimism relative to its performance. In this case, the LETS collapses since, having a full information about the performance of the LETS, workers are as homogeneous inside the LETS as they were heterogeneous outside it, on the question of the performance of the LETS.

5 Results

We can now discuss the LETS from the point of view of employment and welfare. We begin by considering two properties of the LETS without credit.

Proposition 2. *If the LETS emerges, remains active and distributes no credit, it increases employment.*

Proof: If the LETS emerges and is active, the level of employment inside the LETS is given by e_l , the solution to equations (15) to (19). It is easy to verify that, when $C = 0$, whatever t^* ³, the rate of employment inside the LETS e_l/t^* is higher than the rate of employment outside it $e_{nl}/(1 - t^*)$, this last being equivalent to the rate of employment e of the benchmark. As a consequence, the broader the LETS, the higher will be the overall level of employment in the economy ■

This proposition is a simple consequence that, without credit, the LETS maintains the skills of unemployed workers and improves the employability of long term unemployed workers. This proposition does not mean that a LETS always emerges if $C = 0$. Expectations could be too pessimistic to allow this emergence. Since outside the LETS, potential entrants tend to value the advantages of credit more highly than other benefits of the LETS, this emergence might even be restricted if $C = 0$.

To illustrate this proposition, we analyze graphically the various cases where $C = 0$ and the LETS emerges.

Let consider initial values:

$$q = 0.2 ; \alpha = 0.5 ; \alpha' = 0.75 ; w = 90 ; b = 50 ; b' = 15 ; c = 5 ; \gamma = 0.0001 ; a''' = 1.5 ; a'' = 0.1 ; r = 0.3 ; \bar{\lambda} = 3 ; \beta = 2 ; C = 2.$$

³see the complete expression in appendix

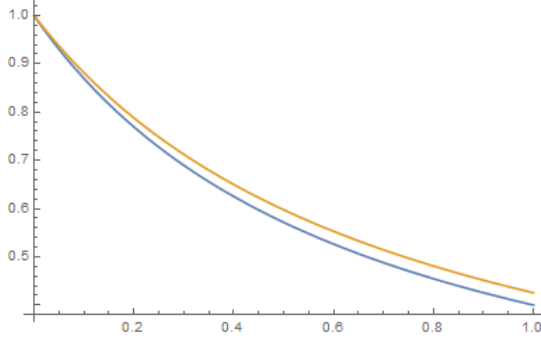


Figure 3a : Levels of employment (baseline values)

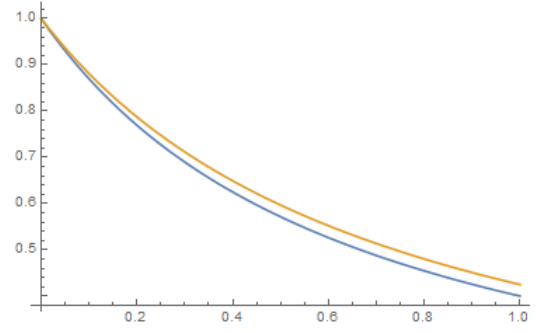


Figure 3b : Levels of employment $C = 0$

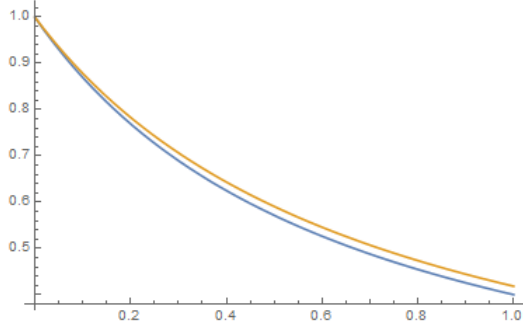


Figure 3c : Levels of employment $C = 0$ and $b' = c$

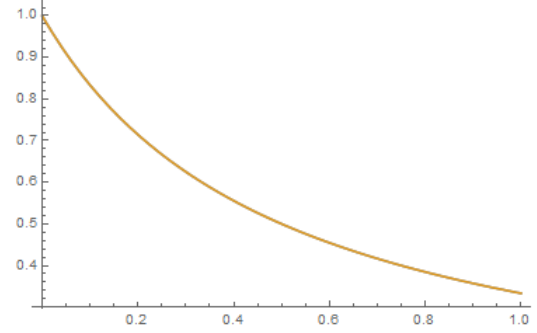


Figure 3d : Levels of employment $C = 0$ and $\alpha = \alpha'$

Figure 3: Comparison between levels of employment in the benchmark model and the model with a LETS

We assume that $a_e = 0.5$ and $a_u = 1$, according to the difference in the time available to produce in a LETS for unemployed and employed workers.

Levels of employment in the benchmark model and in the model with LETS are illustrated graphically (figure (3)). The abscissa axis represents the probability to lose a job, q , and the ordinate axis shows the employment levels. The level of employment in the benchmark model is plotted in blue and in the LETS is plotted in yellow. The figure 3a represents the situation of a LETS providing mutual credit (baseline values): the level of employment is a decreasing function of q . The others figures represent the various cases where the LETS emerges without credit ($C = 0$) and improves employment level.

The figure 3b compares between levels of employment when there is no mutual credit distributed into the LETS, $C = 0$, other things being equal. The level of employment in the LETS model is still higher than in the benchmark model and the LETS emerges because the production and competence benefits remain equals. The figure 3c corresponds to the situation of a LETS without mutual credit, $C = 0$, and no production benefits, $b' = c$. If the revenue from LETS' participation is equal

to the production cost, then there are no monetary advantages to members. The level of employment in the LETS model is still higher than in the benchmark model, and the LETS emerges because the competence benefits remain equals. Finally, we test the situation without credit, $C = 0$, and without competence benefits, $\alpha = \alpha'$ (figure 3d). As expected, the levels of employment are the same in the LETS and benchmark models. The LETS still emerges because the production benefits remain equals, but it no longer enables the long term unemployed workers to maintain their competences.

Proposition 3. *When the LETS emerges, remains active and includes no credit, it increases welfare.*

Proof: Comparison of welfare in the benchmark and the economy with LETS for $C = 0$ is made by considering expressions (12) to (14) and (21)-(22) for $C = 0$. As neither the instantaneous payment nor the weight of the highest terms decreases in these equations, the value of V_{el} , V_{sl} , and V_{ll} cannot be smaller than the respective values of V_e , V_s , and V_l in the benchmark. It follows that $t^*(e_l V_{el} + s_l V_{sl} + l_l V_{ll}) + (1 - t^*)(e_{nl} V_{el} + s_{nl} V_{sl} + l_{nl} V_{ll}) > e V_e + s V_s + l V_l$ ■

The spirit of this proposition is similar to the previous one. Since the LETS is profitable in this case, because it provides extra revenue (even though it is small) to members, and because it can increase their probability to be hired, it increases the intertemporal utility of all members inside the LETS also the distribution between employed and unemployed workers. As a consequence, intertemporal utility is higher on average within the LETS than outside it. Finally, the broader the LETS the higher will be the level of welfare.

To illustrate this proposition, we analyze graphically various cases for which the LETS emerges even with $C = 0$. Initial parameters' values are kept equal.

Figure (4) compares the levels of long-term unemployed workers' welfare in the benchmark model and in the model with LETS. The abscissa axis represents the probability to lose a job, q , and the ordinate axis is the levels of welfare. The level of welfare is plotted in blue in the benchmark model and in yellow in the LETS model. The figure 4a represents the baseline situation of the LETS providing mutual credit, where the level of welfare is a decreasing function of q . The other figures in figure (4) represent various cases where the LETS emerges without credit and improves the level of welfare.

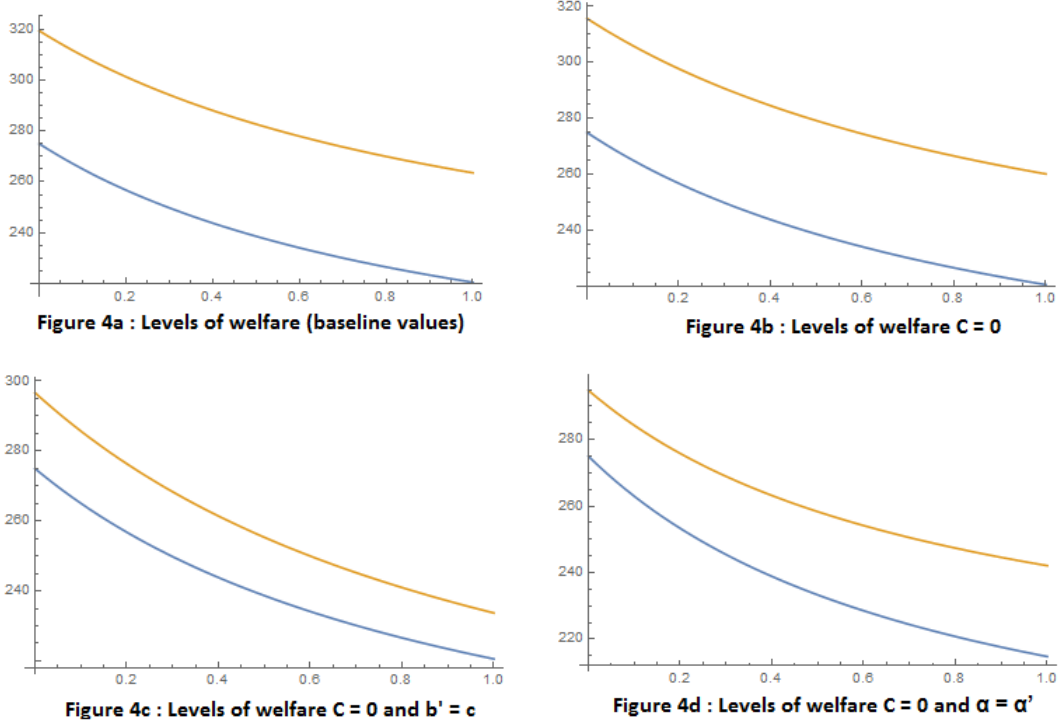


Figure 4: Comparison between levels of welfare in the benchmark model and the model with a LETS without credit

The figure 4b compares levels of welfare when there is no distribution of mutual credit in the LETS, $C = 0$, other things being equal. The level of welfare in the LETS model is still higher than in the benchmark model and the LETS emerges because the production and competence benefits remain equal, despite a smaller membership than in the initial situation. The figure 4c corresponds to the situation of a LETS without mutual credit and with no production benefits, $C = 0$ and $b' = c$. The level of welfare in the LETS model is less important than in the two previous situations because of the significant reduction in the benefits provided by the LETS but is still higher than in the benchmark model. The LETS emerges because the competence benefits remain equal. Finally, we test the situation without credit, $C = 0$, and without competence benefits, $\alpha = \alpha'$ (figure 4d). As in the previous situations, the LETS still improves the level of welfare by continuing to provide benefits for its members.

These two proposition have been studied with $C = 0$. Let us now study the role of credit in the LETS. We begin with the following lemmas:

Lemma 1. *The function $e_l(C)$ which, all things being equal, associates a level of employment in the LETS to each level of credit C , is continuous on the set of*

population variables defined.

Proof: The function $e_l(C)$ ⁴ is defined from 0 or $\underline{C}$ (the minimal amount of credit allowing the emergence of the LETS) according to the parameters and especially $\bar{\lambda}$. This expression is not continuous in $\mathbb{R}$ but is from 0 or $\bar{C}$. Consider first two limit cases: (i) the case of $\gamma = 0$, and (ii) the case $a'' = 0$. In the first case, all increases of C increases A , B , decreases λ^* , increases t^* , and finally e_l which increases more than e_{nl} decreases. This increase is continuous and monotonous until t^* makes the LETS attractive for the whole population (this observation reveals that this limit case is unrealistic since the performance of the LETS depend only on the amount of credit provided to members, as in a Ponzi game). In the second case, all increase of C has a negative impact on expression (9), tends to increase λ^* and to decrease t^* . In this case, all increases of C decrease e_l more than they increase e_l and the function $e_l(C)$ is strictly decreasing. This decrease is continuous and monotonous up to the value of C which empties the LETS. The general case is between these two extreme cases. Note that as soon as $\gamma > 0$, the negative impact of credit always dominates the positive one when C increases. The result is that even with a very small value of γ , it is possible to empty the LETS only if there is a sufficient increase in the average credit available to each member ■

Lemma 2. *The functions $V_{el}(C)$, $V_{sl}(C)$, $V_{ul}(C)$ which at each level of credit C associate a level of expected utility of employed, short term and long term unemployed workers in the LETS, are continuous on the set of definition of populations variables.*

Proof: Expressions (12) to (14) and (21)-(22) determine the equilibrium values of $V_{el}(C)$, $V_{sl}(C)$, and $V_{ul}(C)$ inside the LETS. They depend directly on C via the role of C in instantaneous utilities and expression (14), and indirectly, via t^* . The system is continuous in each term and t^* continuous in C in relevant subsets of variations of population variables. At last all expressions are continuous ■

Proposition 4. *When $\bar{\lambda} > \frac{c}{b'}$, there always exists a level of credit C^* which maximizes the rate of employment in the economy.*

Proof: Whatever the value of t^* , the average amount of credit obtained by LETS members has only two effects on entry conditions. It increases the expected instantaneous utilities (7) and (8) and decreases the weight of the first term in expression (9). The resulting effects on intertemporal utilities, then on λ^* and t^* are then ambiguous. Suppose however that $\bar{\lambda} > \frac{c}{b'}$. Then for $C = 0$, there is only one difference

⁴see full expression in appendix

between the benchmark Bellman equations and the entry Bellman system (9) to (11). This difference is caused by the term $(\lambda_i b' - c)$ in A and B . With $\bar{\lambda} > \frac{c}{b'}$, there always exists a subset of adopters (those with the highest values of (λ_i)) which decide to join the LETS. In this case, still for $C = 0$, we can verify that $t^* > 0$ and that in the final Bellman equations the condition $(b' > c)$ is sufficient to confirm the choice made by those who decided to join the LETS. From stationarity equations (15) to (20) we then can easily deduce that the new rate of employment $e_{nl} + e_l$ is greater than the benchmark rate of employment e , and still for $C = 0$. Given lemma (1), we can conclude that if $e^*(C)$ decreases with C close to $C = 0$, the optimal amount of credit is $C = 0$ while this optimal amount is such that $C > 0$ if the function $e^*(C)$ increases in the same neighborhood ■

As a consequence it is not always optimal to minimize the volume of credit to enhance employment. As entry in the LETS is the first objective, credit must be sufficient to allow the LETS to emerge.

Proposition 5. *The amount of credit C^w which maximizes welfare is usually higher than the level C^* which maximizes the level of employment.*

Proof: From the point of view of employment, the only motive to maintain a positive level of credit C is that if $\bar{\lambda}$ is too low, it is necessary to stimulate workers to participate by the announce of a sufficiently high average level of credit. With small values of γ , increasing credit from its level that maximizes employment could be welfare improving, as the positive effect of credit on consumption is not dominated by its bad effect on employment ■

To illustrate this proposition, on figure (5) we plot the level of employment and the level welfare, in order to identify the level of credit maximizing these two variables. The abscissa axis represents the average level of credit to LETS member C . Figure (5) is plotted with baseline parameter values. The level of employment is plotted in blue, and the level of welfare is plotted in purple. In the baseline value situation, the maximum level of credit maximizing the employment level, approximately 10 units of credit, is lower than the maximum level of credit maximizing the welfare level achieved with approximately 50 units of credit.

Now, let consider different levels in order to evaluate if the maximum level of credit maximizing the level of employment is always higher than the maximum level of credit maximizing the level of welfare (figure (6)).

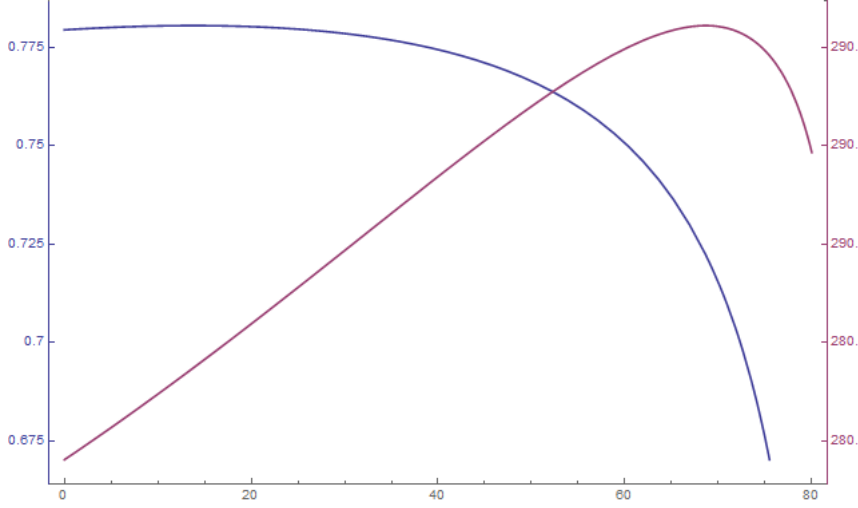


Figure 5: Comparison between levels of welfare and employment in the LETS model

First, we study the impact of movements in the probability to lose a job, q . We analyze two situations: q decreases or increases according to the baseline value situation, other things being equal.

Thus, q first decreases to 0.19, then increases to 0.21, other things being equal. The level of employment and the level of credit maximizing employment are higher in the situation where $q = 0.19$ than in the situation where $q = 0.21$. More important, increasing the probability to lose a job also increases the need to maintain competences during spells of unemployment. According to the ambiguous role of credit in maintaining competences, too much credit can discourage LETS members from producing, which does not allow competence improvements. According to the same mechanisms, the level of credit maximizing the level of welfare in the situation where $q = 0.19$ is higher than in the situation where $q = 0.21$.

Second, we study the impact of movements in the difference $(\alpha' - \alpha)$ (figure (7)). We analyze two cases where all things being equal competence improvement is decreased or increased depending on the initial situation. In the first case, $\alpha' = 0,6$ and $\alpha = 0,5$, $(\alpha' - \alpha)$ is now equal to 0.1 (baseline value of α is 0.25). In the second case, $\alpha' = 0.9$ and $\alpha = 0.5$, $(\alpha' - \alpha)$ is now equal to 0.4.

The level of employment in the case where $(\alpha' - \alpha) = 0.1$ is significantly lower than in the second situation, since the competence improvements enabled by the LETS is lower. In this case, the level of credit maximizing the level of employment is lower than in the case where $(\alpha' - \alpha) = 0.4$. The lower the competence benefit derived from the LETS, the more urgent the need to produce. According to the

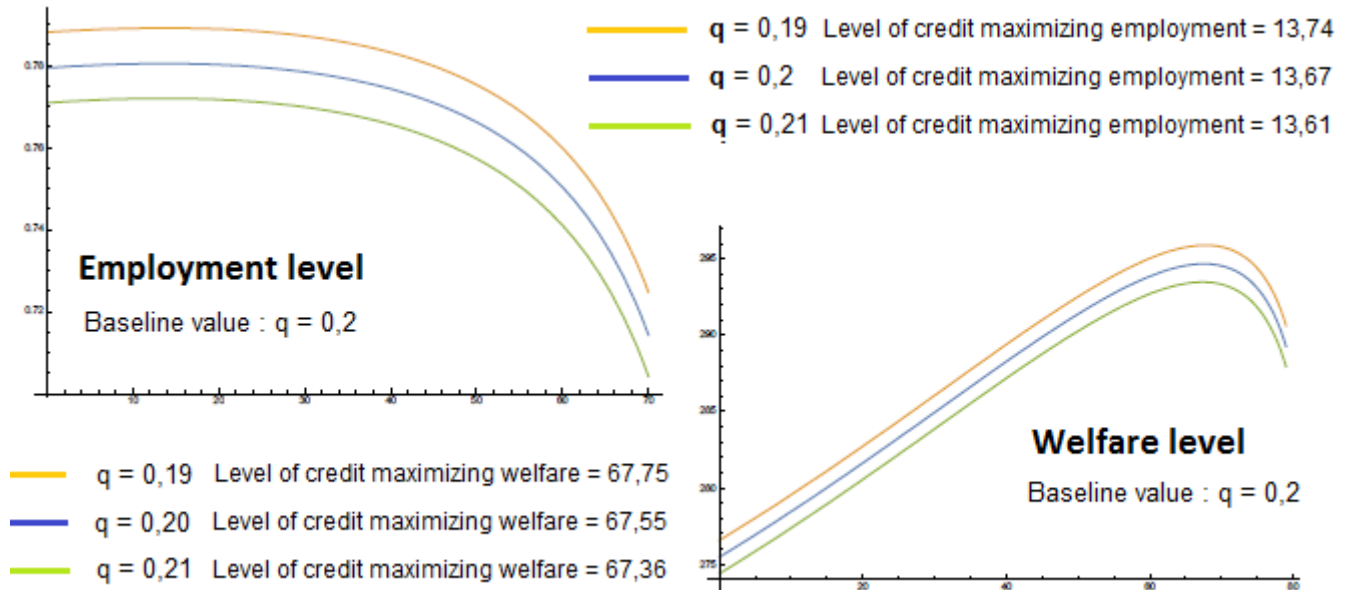


Figure 6: Comparison between levels welfare and employment in the LETS model

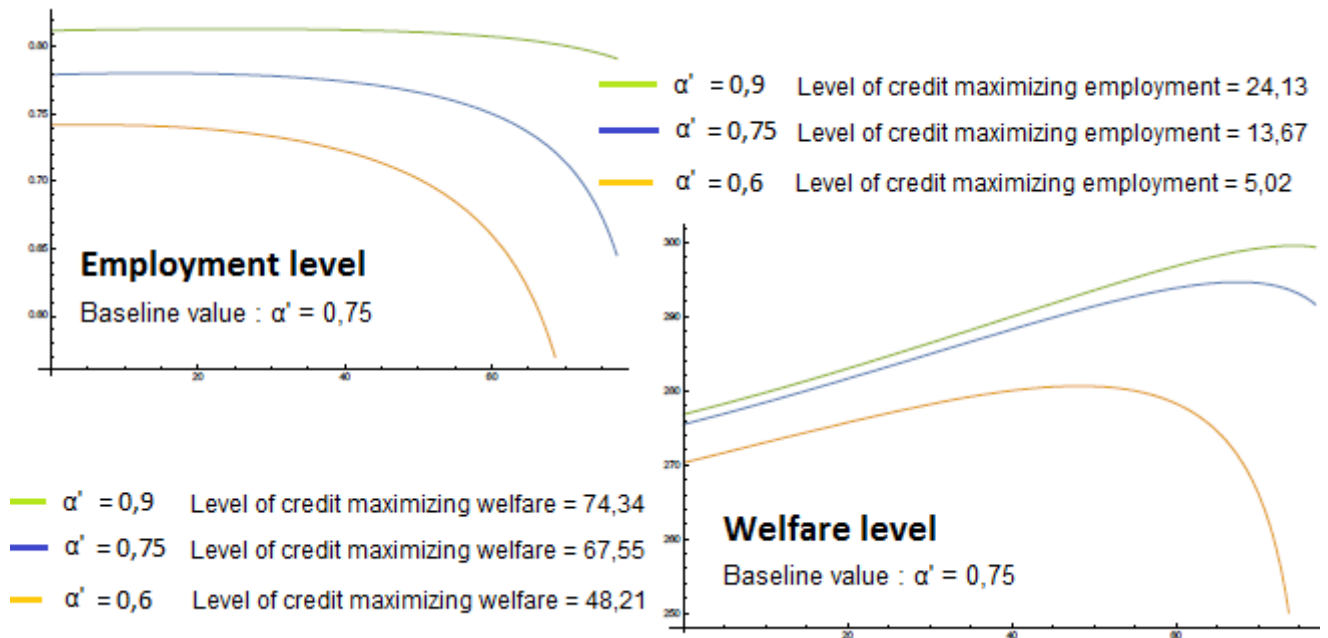


Figure 7: Comparison between levels of welfare and employment in the LETS model

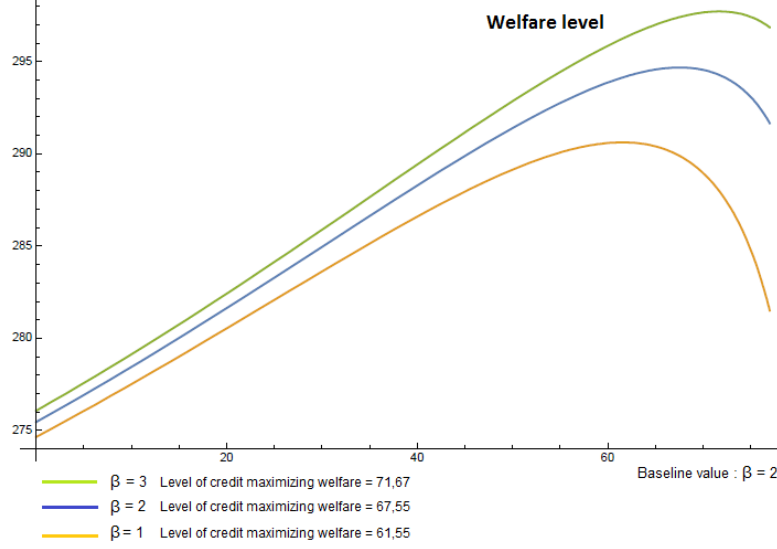


Figure 8: Level of welfare in the LETS model

same mechanisms, the level of credit maximizing the level of welfare in the first case is lower than in the second.

Thirdly, we investigate the impact of movements in the efficiency of the LETS relative to its size β (figure (8)). We analyze the two cases of decreasing or increasing efficiency, according to the baseline values, other things being equal. In the first case $\beta = 1$ and in the second one $\beta = 3$ (compared to $\beta = 2$ in the baseline case).

Changes in β affect only the level of credit maximizing the welfare, since it is not included in the level of employment calculation. If the efficiency of the LETS relative to its size is lower then the level of credit maximizing the level of welfare is also lower. If the LETS is less efficient, members will need to produce more to insure competence improvements with a relatively low level of credit.

Finally, we analyze the influence of the size of the LETS, applying a comparative static analysis involving variations of $\bar{\lambda}$ (figure(9)). Two situations are analyzed: size of the LETS decreases (which means that $\bar{\lambda}$ decreases) or size of the LETS increases according to the baseline situation, other things being equal. $\bar{\lambda}$ decreases from 3 to 2 and secondly increases to 4 in the second case.

When the size of the LETS increases, this is the result of a higher confidence in the LETS. Since the confidence is higher, the role of the credit is less important in the emergence of the LETS and still negative from the competence improvement point of view. Also, if the size of the LETS increases, members have more opportu-

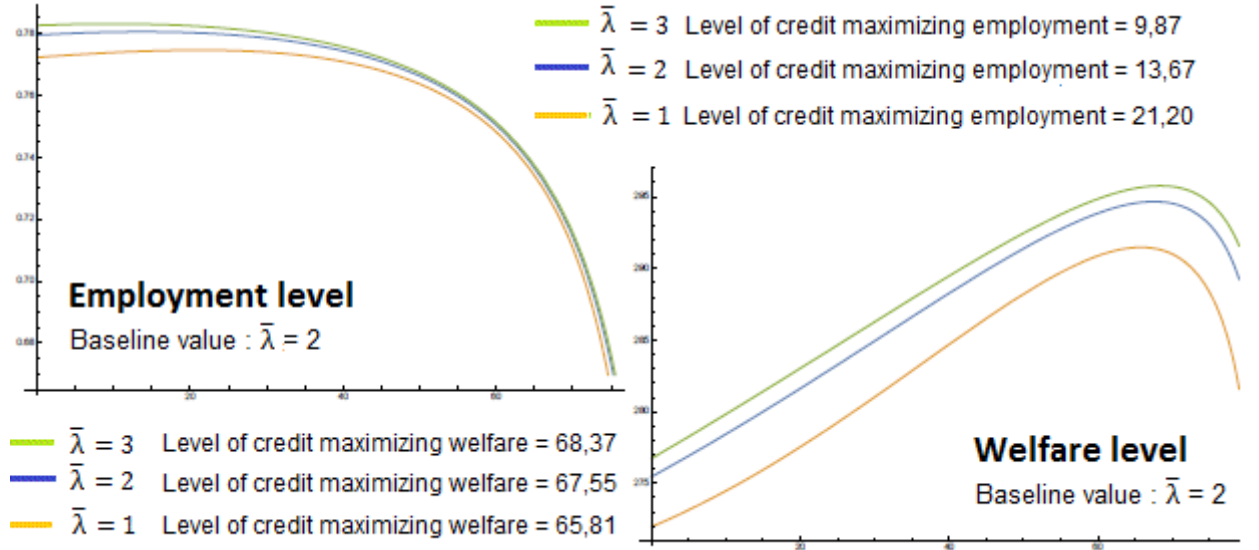


Figure 9: Comparison between levels of welfare and employment in the LETS model

nities to exchange and they need more credit for transactions.

Proposition 6. *In the case of an active LETS, in trying to determine the rate of credit able to increase the level of employment in the economy, the regulator will never tolerate a higher credit allowance for members than was permitted during the emergence of the LETS.*

Proof: If the LETS is active for a given level of credit $\bar{C}$, two conditions are validated: (i) $t^* > 0$ given $\bar{\lambda}$; (ii) C is such that the LETS does not collapse after emergence, *i.e.* V_{ll} expressed from equations (12) to (14) and (21)-(22) is greater than V_l solution in the benchmark corresponding to equations (4) to (6). Based on these properties, two cases are possible. While the solution in V_{ll} associated to expressions (12) to (14) and (21)-(22) could have an expression locally increasing with C from $C = 0$ to $C = \bar{C}$, this does not apply to a given t^* of e_l obtained from the solution to the stationary equations (18) to (20). Consequently, the maximal employment rate inside the LETS is obtained for the level of credit C^* which makes it equivalent for LETS members to remain in the LETS or to leave it. If the expression of V_{ll} associated to equations (12) to (14) and (21)-(22) always decreases with C from $C = 0$ to $C = \bar{C}$, then the maximal rate of employment inside the LETS is obtained when $C = 0$. Thus, in both cases, there is a possible regulation of the average individual level of credit which maximizes employment inside the LETS ■

Proposition 6 is a consequence of the differential effects of overdraft on entry, individual utility inside the LETS, and employability. Consider for instance a rela-

tively small value of γ and a relatively high value of a'' . Then, if $\bar{\lambda}$ is not too small, a relatively high amount of credit has two consequences: it enhances the utility of LETS members once in the LETS, which is evident from equations (12) and (13), and it also facilitates entry to the LETS based on its role in equations (7) and (8). Conversely, this credit allows LETS members - especially unemployed ones - to buy even if they have not produced or/and sold. Therefore, this credit reduces employability, and decreases employment e_l expressed from equations (18) to (20) inside the LETS. If a hypothetical “LETS regulator” acting as a planner tries to improve employment, the appropriate policy would be to maintain in this case a sufficient overdraft allowance to enable the emergence of a sufficiently broad LETS. Once established in a position of “excess initial pessimism” of entrants (*i.e.* with LETS members all finally satisfied of the effective performances of the LETS), the “LETS regulator” could reduce the amount of credit C in order to stimulate professional activity inside the LETS, thereby increasing employability and employment. The limit to this restrictive measure is provided by loss of liquidity related to the complementary currency within the LETS which decreases the utility of members and their interest in participating.

6 Conclusion

This paper analyzed the conditions in which a complementary currency system or LETS can contribute to improve employment and welfare. Based on our theoretical model, we find that fundamentals and beliefs are both there essential for the emergence and sustainability of a LETS. Fundamentals refer to the effective properties of the LETS which must provide incentives for members (additional revenue even small, and means to improve employability). In addition to these properties it is essential for there to be trust in the complementary currency and the performances of the system. In the presence of reasonably optimistic agents, a LETS will emerge. If it emerges in an environment of pessimistic members, it will have a higher chance of survival. The qualities of the LETS related to employability include the fundamental conditions referred to above and the presence of an internal mutual credit system to enable the smooth operation of the LETS and accelerate transactions in the complementary currency. Credit is another facilitator, but unexpectedly, decreases the employability of LETS members. It would be optimal but unreasonable to attract entrants with the possibility of large individual overdrafts and then restrict the amount of credit once they have joined the LETS. Since the objective of the LETS is maintaining or improving employability credit should be restricted but not totally excluded. In this sense, the intuition is only partly confirmed: too much

credit decreases employability but no credit decreases the size of the LETS, and in turn the number of unemployed people that can benefit from its advantages. Finally, it is interesting (and not counter-intuitive) to observe that the level of credit maximizing welfare is much higher than the level maximizing employment. This observation highlights out another objective of a complementary currency system, but one that is beyond the scope of this paper. They should be aimed also at improving agents' welfare (overall unemployed agents), and standard of living outside the formal economy. Investigating this would require a different model.

References

- Arulampalam, W., Gregg, P., Gregory, M. (2001) "Unemployment Scarring", *The Economic Journal* 111(475): 577-584.
- Attout A., Clerc L., Clout A., Fain A., Disneur L., Marchand A., Roland L. (2013) "Guide pratique des monnaies complémentaires", Réseau Financement Alternatif, <https://www.financite.be/fr/reference/guide-pratique-des-monnaies-complementaires>
- Böheim, R., Taylor, M. P. (2002) "The search for success: do the unemployed find stable employment?", *Labour Economics* 9(6): 717-735.
- Boyle, D. (2014) "The Potential of Time Banks to support Social Inclusion and Employability - An investigation into the use of reciprocal volunteering and complementary currencies for social impact", Joint Research Center Scientific and Policy Reports, Luxembourg: Publications Office of the European Union.
- Clark, A., Georgellis, Y. Sanfey, P. (2001) "Scarring: The Psychological Impact of Past Unemployment", *Economica* 68(270): 221-241.
- Collom, E. (2011) "Motivations and Differential Participation in a Community Currency System: The Dynamics Within a Local Social Movement Organization", *Sociological Forum* 26(1): 144-168.
- Edin, P. A., Gustavsson, M. (2008) "Time out of work and skill depreciation", *Industrial and Labor Relations Review* 61(163): 163-180.
- Flaig, G., Licht, G., Steiner, V. (1993) "Testing for state dependence effects in a dynamic model of male unemployment behaviour", *ZEW Discussion Papers from ZEW - Zentrum für Europäische Wirtschaftsforschung* 93-07 Center for European Economic Research.
- Gelleri, C. (2009) "Chiemgauer regiomoney: Theory and practice of a local currency", *International Journal of Community Currency Research*, 13(2009): 61-75.
- Gomez, G.M., Helmsing, A.H.J. (2008) "Selective spatial closure and local economic development: What do we learn from the Argentine Local Currency Systems?", *World Development* 36(11): 2489-2511.
- Granovetter, M. S. (1973) "The strength of weak ties", *American Journal of Sociology* 78(6): 1360-1380.
- Heckman, J., Borjas, G. (1980) "Does Unemployment Cause Future Unemployment? Definition, Questions and Answers from a Continuous Time Model of Heterogeneity and Time Dependence", *Economica* 47(187): 247-283.

- Knabe, A., Rätzl, S. (2011) "Scarring or Scaring? The Psychological Impact of Past Unemployment and Future Unemployment Risk", *Economica* 78(310): 283-293.
- Krueger, A., Cramer, J., Cho, C. (2014) "Are the Long-Term Unemployed on the Margins of the Labor Market?", *Brooking Papers on Economic Activity* 48(1): 229-299.
- Lasker, J., Collom E., Bealer T., Niclaus E., Young Keefe J., Kratzer Z., Baldasari L. and al. (2011) "Time banking and health: the role of a community currency organization in enhancing well-being", *Health promotion practice* 12(1): 102-115.
- Lin, N. (1995) "Les ressources sociales: une théorie du capital social", *Revue française de sociologie* 36(4): 685-704.
- Mercklé, P. (2011) *Sociologie des réseaux sociaux*, La Découverte, Collection Repères.
- Mincer, J., Ofek, H. (1982) "Interrupted work careers: Depreciation and restoration of human capital", *Journal of Human Resources* 17(1): 3-24.
- Ozanne, L.K. (2010) "Learning to exchange time: benefits and obstacles to time banking", *International Journal of Community Currency Research* 14(2010).
- Peacock, M.S. (2000) "Local exchange trading systems (LETS): A solution to the employment dilemma?", *Annals of Public and Cooperative Economics* 71(1): 55-78.
- Pissarides, C. A. (1992) "Loss of skill during unemployment and the persistence of employment shocks.", *The Quarterly Journal of Economics* 107(4): 1371-1391.
- Seyfang, G. (2001) "Working for the Fenland Dollar: An evaluation of local exchange trading schemes as an informal employment strategy to tackle social exclusion", *Work, Employment and Society* 15(3): 581-593.
- Seyfang, G. (2002) "Tackling social exclusion with community currencies: Learning from LETS to time banks", *International Journal of Community Currency Research* 6(2002).
- Seyfang, G. (2003) "Growing cohesive communities one favour at a time: social exclusion, active citizenship and time banks", *International Journal of urban and regional Research* 27(3): 699-706.
- Seyfang, G. (2004) "Time banks: rewarding community self-help in the inner city?", *Community Development Journal* 39(1): 62-71.
- Seyfang, G. (2006) "Sustainable Consumption, the New Economics and Community Currencies: Developing New Institutions for Environmental Governance", *Regional Studies* 40(7): 781-791.
- Williams, C.C. (1996) "Local exchange and trading systems: a new source of work and credit for the poor and unemployed?", *Environment and Planning A* 28(8): 1395-1415.
- Williams, C.C., Aldridge, T., Lee, R., Leyshon, A., Thrift, N., Tooke, J. (2001a) "The Role of the Third Sector in Paving a 'Third Way': Some Lessons From Local Exchange and Trading Schemes (LETS) in the United Kingdom", *International Journal of Community Currency Research* 5(2001): 1-12.
- Williams, C.C., Aldridge, T., Lee, R., Leyshon, A., Thrift, N., Tooke, J. (2001b) "Bridges into Work? An Evaluation of Local Exchange and Trading Schemes (LETS)", *Policy Studies* 22(2): 119-132.

Appendices

*Appendix I

The benchmark model

Derivation of e , s , and l :

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

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

$$\begin{aligned} x &= \frac{bg((-1 + \alpha' g - \alpha g)q + g(-1 + g - \alpha g + (-1 + g)(-1 + \alpha' g - \alpha g)q)w)}{(-1 + g)(1 + g(-1 + \alpha + q - \alpha' gq + \alpha gq))} \\ y &= \frac{bg(-1 + \alpha' + g - \alpha' g + g(-1 + \alpha' g - \alpha g)q) + g(\alpha'(-1 + g) - \alpha g)w)}{(-1 + g)(1 + g(-1 + \alpha + q - \alpha' gq + \alpha gq))} \\ t &= \frac{bg(-1 + \alpha + g - \alpha g + g(-1 + \alpha' g - \alpha g)q) - \alpha g w)}{(-1 + g)(1 + g(-1 + \alpha + q - \alpha' gq + \alpha gq))} \\ g &= \frac{1}{1+r} \end{aligned}$$

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

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

Given the definition values of parameters, the first term is always negative, while the other ones are still positive.

The LETS model

Expression of $t^* t^* = (1/\bar{\lambda})(-(((1+r)^2(q+r)(b-w)(-1+\alpha')(a'''(\alpha-\alpha') + C^2\gamma) - a''C((1+r)(r+\alpha) + q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a''' \alpha + (-1+a''')\alpha' - C^2\gamma) + (1+r)(r+\alpha-a''' \alpha + a''' \alpha' - C^2\gamma)) + c((1+r)(r+\alpha) + q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a''' \alpha + (-1+a''')\alpha' - C^2\gamma) + (1+r)(r+(-1+a_e)r\alpha' + a_e(\alpha-a''' \alpha + a''' \alpha' - C^2\gamma))))/(b'((1+r)(r+\alpha) + q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a''' \alpha + (-1+a''')\alpha' - C^2\gamma) +$

$$\begin{aligned}
& (-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+a'''\alpha'-C^2\gamma])))))/(b'((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+ \\
& \alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+a'''\alpha'- \\
& C^2\gamma)))))+\bar{\lambda})-1/\bar{\lambda}q\alpha'(-(((1+r)^2(q+r)(b-w)(-1+\alpha')(a'''(\alpha-\alpha')+C^2\gamma)- \\
& a''C((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+ \\
& (1+r)(r+\alpha-a'''\alpha+a'''\alpha'-C^2\gamma))+c((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+ \\
& \alpha-a'''\alpha+(-1+a''')\alpha'-C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+a'''\alpha'- \\
& C^2\gamma)))))/(b'((1+r)(r+\alpha)+q(1+r+\alpha-\alpha'))(q(1+r+\alpha-a'''\alpha+(-1+a''')\alpha'- \\
& C^2\gamma)+(1+r)(r+(-1+a_e)r\alpha'+a_e(\alpha-a'''\alpha+a'''\alpha'-C^2\gamma)))))+\bar{\lambda}))
\end{aligned}$$

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