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**The multiplier effect of convertible local currencies :
case study on two French schemes**

Oriane Lafuente-Sampietro¹

Abstract:

Convertible local currencies are alternative monetary instruments issued by groups of citizens to circulate in a given territory. They are used by businesses and citizens who accept it as means of payments constituting, hence, a monetary community. Their impacts on economic activity are mainly related to their circulation within the user community. Businesses that have received local currency as payment must spend it with other members. A local currency, thus, acts as a constraint favoring the development of new commercial relations in the network and increasing the demand among local businesses involved in the scheme. In this article, we model the income circulation between convertible currencies users as a local multiplier, called *the convertible local currency multiplier*. By using the Local Multiplier 3 empirical approach (Sacks, 2002) on two convertible currencies transactions data, we compute an indicator summarizing the income generated for the monetary community by the change and expense of euros into a local currency. This new indicator enables not only consumers to estimate the impact of their actual consumption in local currency, but also potential public decision-makers to know the total effect of their expenses when they use local currency on their territory to finance some of their policies. For example, this indicator could be used to measure the direct and indirect effects of a subsidy paid in local currency to institutions, businesses or households. The computed multiplier is greater than two for both currencies, which is in the higher range of LM3 estimated in the literature.

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1. Introduction

Local currencies are monetary instruments belonging to the larger family of alternative currencies. Alternative currencies are defined as monetary instruments circulating alongside national currencies, with the objective of favoring socio-economic transformations in the community within which they circulate (Blanc, 2018a). Local currencies are issued by groups of citizens, local governments or non-profit organizations in a given territory. They circulate within a network of businesses and citizens that accept it as means of payments. One of the most distinguishing features of local currencies is their issuing mechanism: the exchange of national currency for local currency at a fixed exchange rate. When a consumer or a business wants to obtain a local currency, they can either receive some units as payment or convert national currency in local currency at an exchange office. The national currency given in exchange for local currency is, for the most part, kept in a reserve fund allowing users to convert their local currency back to national currency under specific conditions. Convertible local currencies appeared in North America in the 1990s since then; they have spread around the globe, notably in Brazil and France where these schemes are fairly popular. Blanc, Fare and Lafuente-Sampietro (2020) have inventoried 82 schemes in France in 2019, which implies that more than 30% of French municipalities have potentially a local currency. These projects are very diverse in terms of size and structure, ranging in France from a dozen professionals and twenty users to nearly 1,000 businesses and 3,000 individual users. On average, these projects comprise a hundred of businesses and between 200 and 400 individual users.

Local currencies are, among other things, conceived as potential tools for territorial economic development (Fare,2016). As monetary instruments, they fulfill essentially the purpose of payment (Blanc, 2018b) and do not allow, for the moment, the financing of economic activity

by monetary creation through credit. Thus, their impacts on economic activity are mainly related to their circulation inside a community. Businesses that have received local currency as payment must spend it with other members of the network. The local currency, subsequently, acts as a constraint favoring the development of new commercial relations in the network of businesses and increasing domestic demand among local businesses involved in the scheme. Therefore, it serves as a tool to keep incomes within its community of users.

In this article, we aim to represent the income's impact of the exchange of national currency into local currency by consumers of the monetary community. To do so, we compute a new indicator: the *convertible local currency multiplier*, by adapting the concept of local multipliers to the convertible local currencies' communities. The local multiplier is an indicator summarizing the direct and indirect effects of a monetary injection into an economy in terms of income. It derives from the Keynesian multiplier in open economy and has been adapted to territorial economy through the economic base theory. Its empirical application has led to the emergence of diverse methodologies (input-output model, employment change). In this article, we use the empirical approach developed by the New Economic Foundation² (Sacks 2002). Sacks (2002) presents an indicator called Local Multiplier 3 (LM3) whose goal/objective is to help local decision-makers to evaluate the impact of their policies on a very small scale. It consists of tracking the expenditures of different stakeholders in a project over three waves after the initial expenditure in order to estimate which proportion remains in the local economy and which proportion escapes from it. This local multiplier estimates the proportion of expenses that accrue to a given set of businesses as well as how the businesses and their employees use the income obtained through this first expense. The LM3 approach suits convertible local

2 The NEF is a foundation promoting the transformation of the economy to make it socially, democratically and environmentally more sustainable. Its missions include both the production of research and the support for on-the-ground projects alongside other organizations or local public authorities.

currency structures and available data, as it computes the multiplier at a microeconomic level. More precisely, the LM3 examines the exchanges between microeconomic actors in order to compute a mesoeconomic indicator at a community level. It follows a defined monetary injection whose impacts are only reported to the local actors taking part in the exchange chain, rather than a broader local community. Moreover, it enables to measure a multiplier even for small injections and a small community, which is the case for convertible local currencies.

The adaptation of the LM3 indicator to the convertible local currency schemes in the convertible local currency multiplier makes the income effects of the use of the currency more visible. The computed indicator represents the income created for a monetary community by the expense of one unit of convertible currency. Quantitative studies on monetary circulation in convertible local currency's schemes have been, so far, difficult to conduct due to the lack of data, while they have focused mostly on monetary velocity (De la Rosa and Stodder, 2015; Stodder, 2009). This new indicator enables consumers to estimate the impact of their actual consumption in local currency, as well as potential public decision-makers to identify the total effect of their expenses when they use a local currency on their territory to finance some of their policies. For example, this indicator could be used to measure the direct and indirect effect of a subsidy paid in local currency to institutions, businesses, or households. The use of a local digital currency as a medium of subsidy payment would then make it an effective tool for controlling and evaluating the impacts of the policy.

To compute it empirically, we replace the local community of the LM3 with the users of the convertible local currency, called the monetary community. We also use a different type of data, namely complete transactions data files. Sacks (2002), estimates LM3 via consumers and business surveys, asking who has received the first expense, how they use their income, and then goes up the supply chain on three exchanges to survey their providers and employees. With

digital convertible local currencies, we do not need to survey the economic actors anymore. Indeed, since the second half of the 2010s, several local French currencies have developed digital formats, which keep track of the transactions of their members in a transaction file. The digital format of the local currencies makes it possible to have quasi-complete data on all the exchanges carried out between the members of the local currency. We will, therefore, use these data to compute the convertible local currency multiplier. They are probably more accurate and easier to obtain than data from surveys usually used in LM3 studies (Sacks, 2002), which require each trading partner to list their suppliers and the proportions in which they spend their income.

In the second section, we will treat in further detail the local multiplier concept, the related literature, and the choice of the LM3 approach. In the third section, we investigate the theoretical links between the use of a convertible local currency and the multiplier size. We, then, present the precise methodology used in this study to compute the multiplier from local-currency transaction data in the fourth section. The data and results of our study are presented in the fifth section and discussed in the sixth one.

2. Theoretical framework: local multipliers and LM3

The local multiplier is based on the concept of the Keynesian multiplier which stems from the idea that income received will be partly spent and partly saved (Keynes, 1936). The spent portion is a source of income for businesses with which they, then, can either pay their wages or spend it directly on other businesses, causing waves of incomes and expenses. The saved or hoarded portion constitutes an income leak for the economy. The multiplier is, thus, the factor by which an initial expenditure is multiplied in order to find the successive incomes it generates. The initial concept is dynamic and focuses on the effects of an increase in demand in one or all sectors of the economy, through investment, final consumption, and intermediary consumption expenditures throughout the production chain, as well as the distribution of income. In this way, the increase in demand at a given point generates a cascade of income flows. The multiplier is, hence, particularly suitable for measuring the effect of an increase in public expenditure on a national economy and for targeting the sectors to subsidize and/or to maximize the overall effect. The general multiplier in a closed economy can be described by using the following formula:

$$k = 1/(1 - c) (1)$$

with k the multiplier and c the marginal propensity to consume, i.e., the proportion of a unit of additional income that would be spent, rather than saved or hoarded. As such, the greater the marginal propensity to consume, the greater the multiplier, and the more an initial expense the more new income will be generated.

In an open economy, the multiplier integrates new income leaks. Indeed, some actors may use their income to import goods or services from foreign countries. These expenditures are directed to actors residing in foreign countries and constitute a leak of income for the national community. The multiplier in open economy can be represented by the following formula:

$$k_n = 1/(1 - c_n) = 1/(1 - c + m) \quad (2)$$

with k_n the national multiplier, c_n the marginal propensity to consume products from the national community and m the marginal propensity to import; the share of an additional unit of income used for the consumption of goods or services produced outside the country. Thus, the more residents from the country use their income to acquire goods and services from another country, the more the national multiplier decreases.

The territorial economy field and especially the economic base theory have taken the concept over and adapted the national multiplier in an open economy into a local multiplier to study the impact of an expenditure on a regional or territorial economy (Bond, 1990). In this context, the income leaks do not come only from savings, but also from the consumption of goods and services produced outside the given territory. This consumption is a source of income for actors who do not belong to the area or the community and, consequently, constitutes a leakage from the perspective of the territory. The formula is the same as the one of the multiplier in an open economy:

$$k_r = 1/(1 - c_r) = 1/(1 - (c - m_r)) = 1/(1 - c + m_r) \quad (3)$$

with c_r the marginal propensity to consume locally and m_r the marginal propensity to import non-local products. c_r is the marginal propensity to consume minus the marginal propensity to import, it can so be written as $c - m_r$.

This decomposition highlights the two income leakages that reduce the local multiplier:

- $1 - c$ the marginal propensity to save. It increases when c , the marginal propensity to consume, decreases.
- m_r the marginal propensity to import.

The local multiplier participates in the analysis of territorial economic development. It is strongly related to the economic base theory (Garrison, 1972; Bond, 1990; Mulligan, 2008; Davezies and Talandier, 2009), which analyzes how territories capture incomes in a basic sector and make them circulate inside their domestic economies in a second time. Initially, only export activities were considered to generate income for the territory, but currently more and more analyses emphasize the importance of other income sources such as social transfers (Davezies, 2008) or tourism incomes (Ruault, 2017). Markusen (2007) developed a consumption base theory in which income does not necessarily have to be captured from outside of the territory but might be generated and maintained through a strong domestic sector. These works highlight the importance of the residential local consumption and an in-place economy (Poinsot and Ruault, 2019) capable of meeting the needs of local demand, while visitors are apt to reduce the leaks of income on the territory. Indeed, the more income stays captive in the territory, the richer the local economy becomes (Sacks, 2002). Florentin and Chabanel (2016) also overtake the tension between autarky and a widely open economy by underlying that stimulation of the local demand may also help to mature and diversify the territorial economy and, thus, favor its competitiveness at a national and international scale.

The local multiplier has been empirically computed in two main ways. The first and oldest in the literature estimates the multiplier at an aggregate level from accounting data with input-output models (Hermannsson, 2016). It often starts from a public injection such as the European regional aid and uses input-output models to estimate the multiplier. This method can involve models of great complexity, requiring many assumptions and a lot of data that may not always be available at a small local level to parameterize them (Rickman, 2005; Stoeckl, 2012; Mulligan, Jackson and Krugh, 2013, Mardones and Silva, 2021). It has been used by economic administrations to evaluate the impact of public policies. The second computational method

,found in the literature, follows Moretti (2010) and focuses on local employment variations induced by the increase in employment in a given sector and by certain types of jobs. While this approach has led to the development of further research (Jofre-Monseny, Silva and Vázquez-Grenno, 2020; Cerqua, 2020; Kazekami, 2017; Van Dijk, 2018; Florentin and Chabanel, 2016), it moves away from the initial direct mechanism of income circulation. Both of these two initial approaches operate at an aggregate level; observing the variations of the entire local economy after a stimulus in terms of incomes or employment. Convertible local currencies are, for now, very small schemes and we make the assumption that their possible impacts would not be substantial enough to be observable at an aggregate scale.

We are, thus, interested in computing the multiplier from the directed exchanges between the involved economics actors at a microeconomic scale. This is what is proposed by the New economics foundation (NEF) with the Local Multiplier 3 (LM3) (Sacks, 2002). The LM3 is estimated by using a microeconomic method to assess the effect of a public policy on a territorial community and seems well-suited for the analysis of local currencies. Its initial aim is to help local decision-makers to evaluate the impact of their policies. For example, Sacks (2002) argues that it could be used to choose between two suppliers or contractors carrying out construction work.³ This method is intended to be very empirical and used on a small scale. It involves tracking the expenditure of different stakeholders in a project over three waves after the first expenditure, in order to estimate which proportion remains in the local economy and which proportion escapes from it. Additionally, the LM3 is evident and discussed in empirical

3 NEF assisted the North Norfolk District Council and the Knowsley Metropolitan Borough Council in assessing the impact of their construction contracts on their local economies. By calculating multipliers, it measured the economic repercussions of choosing a local or external contractor in terms of local revenues generated by the initial expenditure, as well as the impact of the contract on the local economy and the impact of the contract on the local economy as a whole.

studies (Silovská and Kolaříková, 2016; Thatcher and Sharp, 2008). The methods used to compute this indicator are mainly estimates from business and consumer surveys. They, hence, allow to estimate the proportion of expenses that accrue to a given set of businesses and, then, how the businesses and their employees use the income obtained through this first consumption. However, their results are the product of surveys and are, therefore, only indirect estimates of the multiplier. The LM3 approach suits convertible local currencies, as it focuses on small communities by following microeconomics incomes flows between stakeholders. Convertible local currencies are small schemes, so that their impacts may not be observable at a larger scale than the user's community such as the entire territorial community. The focus on microeconomic actors and their direct exchanges enables to measure and model the income flows inside the user's community.

3. How do convertible local currencies interact with the multiplier effect?

The community using a local currency is far from covering the totality of a territorial community. Therefore, the multiplier calculated within it, is specific to the local currency community of users. We call it “the convertible local currency multiplier” which functions as an internal multiplier of the incomes received and spent in local currency. In this section the impact of the local currency on its internal multiplier will be investigated first, while the potential effects of a local currency on the territorial economy will be investigated in a second part.

a. The convertible local currency multiplier

A local currency restricts the market to which its users have access. Indeed, it can only be used by a small number of companies and institutions from the territory that they have chosen to adhere to.

As presented above, the local multiplier can be written as follows:

$$ki = 1/(1 - ci) = 1/(1 - c + mi) \quad (4)$$

In this framework, the use of local currency will influence the two parameters c and m_i , which together form the marginal propensity to consume inside the network of local currency users c_i . In the case of a local currency, the marginal propensity to import m_i constitutes not only the consumption of goods and services produced outside the territory, but also the consumption of goods and services produced by actors external to the local currency’s network. It will be empirically computed, same as the conversion of local currency back into national currency. This kind of conversion is often possible for companies, but remains ethically discouraged and may be subject to costs, either directly in the form of conversion fees or indirectly through the

procedures required to carry out the conversion. The amount kept from conversion fees is often used to finance social or environmental projects of non-profit organizations or businesses from the network. Incomes received in local currency are, thus, more captive to the network- user than the incomes received in national currency, while they can only circulate almost exclusively in the network. This mechanism should reduce the marginal propensity to import m_i and, consequently, increase the multiplier mechanically.

To this first mechanism is added an effect on the other term of the marginal propensity to consume c , which represents the hoarding of money. There are two main effects of the convertible local currency rules on the saving mechanisms going in opposite directions. First, the local currency does not remunerate savings and can, therefore, provide an incentive to quickly spend the income received in local currency and to save in euro, thus increasing the internal c . Secondly, the small size of the network, which does not cover the entire local economy, can make difficult, for some businesses, the access to the goods and services necessary for production and, therefore, increase the hoarding of revenues received in local currency, until they find a way to use it. This effect has been described by Degens (2016), who reports that that below a certain amount of currency received, the actors prefer to hoard money until obtaining a sufficient amount for a specific purchase. The effect of the local currency on the parameter c is therefore uncertain.

As a result, the effect of the local currencies structures on the size of their internal multipliers, compared to the external local multiplier is uncertain. While it probably reduces the marginal propensity to import non-local products, its effect on hoarding is not clear, nor is the magnitude of the variation in these parameters.

b. Convertible local currency and territorial economy: increase in demand or substitution effect?

As mentioned above, this first multiplier is purely internal to the local currency. Because of the small size of the schemes, which cover only a tiny part of the economy of the territories, it is unlikely that an increase in the convertible local currency multiplier would be empirically observable in the entire local multiplier. It is, moreover, interesting to look more closely at the externalities of the use of a local currency on the rest of the economy of a given territory.

Indeed, the local currency, through the constraints it sets on its members for the use of their income, encourages the construction of new commercial relations within its community. However, these new relations may be to the detriment of other actors in a given territory.

For example, consider an individual A , who before using the local currency spent their income on enterprises MI , TI and EI . Enterprise MI is a member of the local currency, enterprise TI is not a member of the local currency but belongs to the territory and enterprise EI is external to the territory. In a second step, A joins the local currency and will, therefore, reorganize its consumption basket with the new constraint imposed by the currency.

There are several possible scenarios:

- 1) A will continue to consume in the same way, except that they will now pay MI in local currency. Their average propensity to consume locally and to import does not change. There is only a pure substitution of the means of payment, but no change in the real exchange. Changes may occur at the level of MI if the receipt of additional local currency induces it to change its consumption and investment behaviors.

2) *A* will consume from *MI* in local currency and will replace its consumption from *TI* by spending at *M2*, another member of the currency. In this case, *M2* has gained a new customer, but at the expense of another company of the territory. There is therefore no territory-wide increase in the average propensity to consume locally at *A* level. The income maintained in the territory at the consumption stage of *A* remains the same, even if the income in the monetary community has increased.

Even though, this effect seems to be pure substitution, we have to mention that by changing their supplier, actors probably also modify their consumption structures. Indeed, the new supplier might be more expensive or might provide a slightly different product, forcing businesses to adapt and, for example, increase the share of their income they spent on this product. In this case the share of income used in the territorial economy increases as well.

3) *A* will consume from *MI* in local currency and will replace its consumption from *EI* by spending from *M3*, another member of the currency. *M3* has gained a new customer at the expense of a company from outside the territory. The average propensity to consume locally is increasing this time both within the network and within the territory.

The local currency, therefore, has an ambiguous effect on the territorial economy. Under certain conditions, it can redirect demand towards its businesses; which fulfils its original aims. However, it can also favor the companies that are members of the scheme to the detriment of other companies in the area, or it can simply choose not to shift consumption and investment behaviors by substituting only exchanges in local currency to exchanges in national currency between the same partners.

These examples highlight a central point for interpreting the effect of local currencies. Local currencies do not necessarily increase demand and, thus, generate new production and growth.

We model two kinds of substitutions: a purely instrumental substitution between two monetary instruments and a substitution between new and old business partners. Convertible local currencies change merely the orientation of demand towards new actors through the constraint they impose on their users. If this effect occurs, the demand will be additional for the members of the network and possibly at a territorial scale, but probably to the detriment of other enterprises. This effect does not represent a limitation of the schemes; its purpose is to favor the local currency members, even to the detriments of other actors external to monetary community. The change of partners might also induce a change in the expenditures structures and increase at the margin the total average propensity to consume, if the new purchases are more expensive than the previous ones.

4. Methodology: computing the convertible local currency multiplier from transaction data

Empirically, we are going to adapt Sacks (2002) LM3 approach to a new kind of data in order to compute the convertible local currency multiplier. The transaction files compile all transactions between businesses, between consumers and businesses, as well as the payment of wages in local currency. For each user, we can, therefore, calculate their average propensity to consume within the network, that is to say, the share of their receipts in local currency spent in the network during the year. Their average individual propensity to consume is , therefore, the ratio between their expenses and their income during the year.

In the multiplier formula, c is the marginal propensity to consume, namely the derivative of the average propensity to consume and the share of an additional unit of income that will be consumed rather than saved. The multiplier calculated from marginal propensities to consume locally represents the effect of a new injection of income on the economy, i.e., the effect of the

injection of an additional unit. However, we have neither in the LM3 surveys nor in the transactions data access to the entire average propensity to consume function for each potential level of income, but only to the one at a given time with a given income. We, thus, use this static average propensity to consume in replacement of the marginal propensity to consume in order to compute the convertible local currency multiplier. The substitution of the average propensity to consume with the marginal one in the formula enables to sum up the effect of the injections that took place during the study year, even if it does not necessarily make it possible to estimate the effect of an additional injection.

To compute the multiplier, we have to identify an initial monetary injection and, then, to monitor its repercussions. Thus, from the first group of actors having received a first external income, we will identify the actors with whom they buy their consumption or investment during three waves of exchanges. Sacks (2002) justifies the use of three waves because the contribution of each new wave is decreasing, since the marginal propensity to consume is less than or equal to 1:

As you can imagine, we could go on measuring people's spending forever, but we have to draw the line at some point. Since most of the time the spending takes place in the first three rounds, we stop there.

Sacks, 2002 : 19

We kept this choice because we also observe a drop in earnings in the fourth wave of exchanges, especially for one of the two currencies (Figure 1) and to enable comparison between the computed indicators and LM3 measured in other studies.

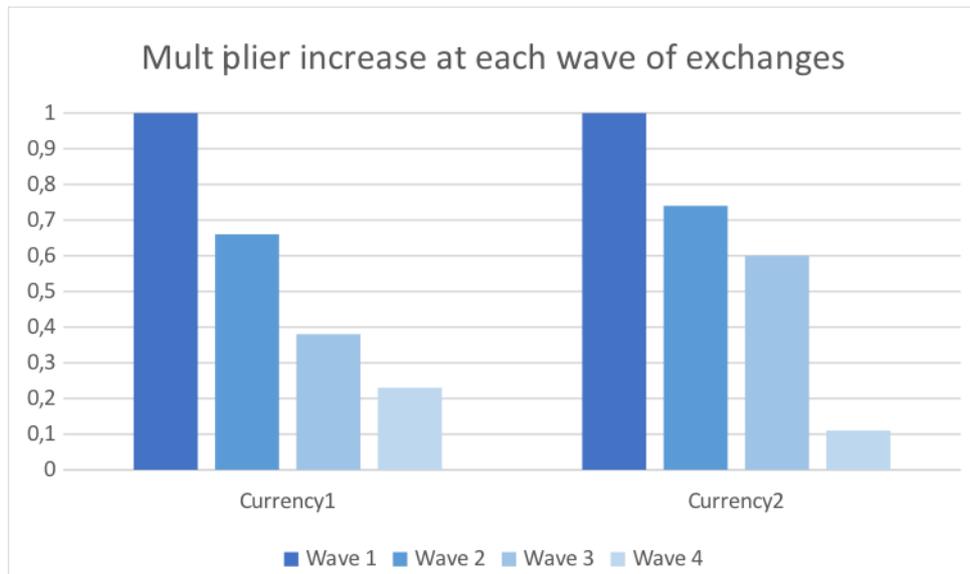


Figure 1 - Multiplier increase at each wave of exchanges

Concretely, we modeled the initial injection by the exchange of national currency in local currency. We, therefore, selected all the actors who changed euros into local currency during the year. These players, called *PI*, are then weighted according to their share in the total exchange spent. This first group of actors *PI* has an average propensity to consume equal to 1, because we only follow the spent change instead of hoarded one.

We, then, selected the other users to whom the first group (*PI*) spent local currencies. This second group (*P2*) is weighted by the proportion of the spent income they receive from each user of the first group (*PI*). Some actors can be both in *PI* and in *P2* groups, as some *PI* users might have spent their local currency units at businesses belonging also to *PI*, if they have exchanged euros in local currency. In this case, the businesses will appear both in *PI* and *P2* groups. *P2* actor's average propensity to consume is calculated as the sum of their expenses that took place in the year, divided by the sum of their receipts received during the year. Average propensities to consume may be greater than one, if actors use hoarded currency units from previous years. In this case, we fixed their average propensity to consume at one. The operation is, then, repeated on a third group of partners (*P3*), to whom the second group *P2* spent their local currency income. *P3* are also weighted by their share in *P2* spending.

Currency1's multiplier is restricted to its digital part. Currency1 users can still withdraw money from their digital account to get banknotes or deposit banknotes on their digital account. The withdrawal operation cannot be interpreted as a back conversion to euros and introduces a small bias. For this reason, we decided to assign the individual average propensity to consume to the withdrawn amount, so that they continue to circulate in an artificial way.

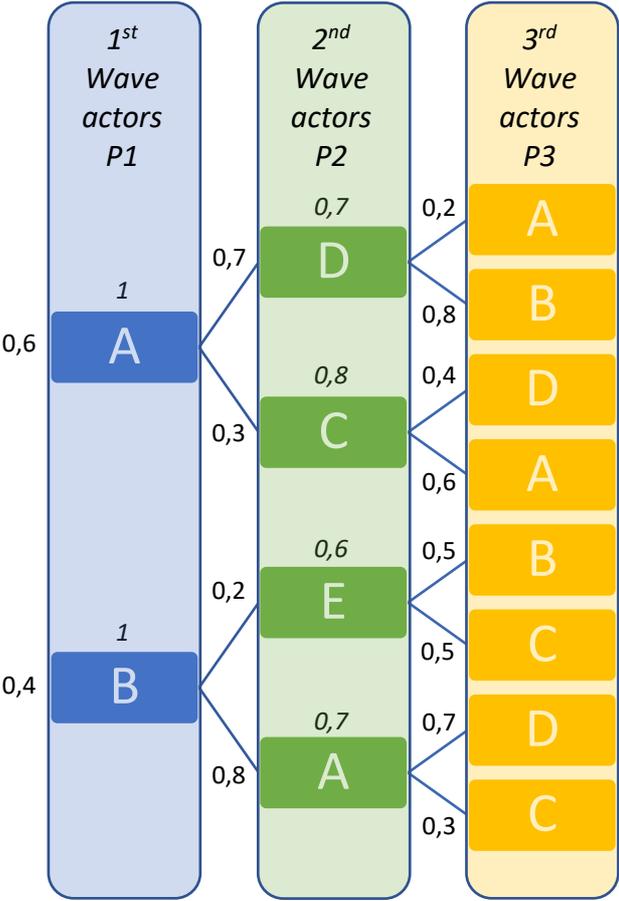


Figure 2 - Example of a fictive multiplier

Figure 2 presents graphically, in a fictitious example, the path followed by the currency after the exchange of euro in convertible currency. In this graph, each column gathers the actors using the money at a given wave. A and B are actors changing euros to local currencies and spending it at first. D, C, E and A are actors receiving currency from the actors of the first column. They are using the received currency at the actors of the third column A, B, D and C.

We find A in the three waves as B has made a purchase to A in the first wave, so as D and C in the second wave.

The figures in italics represent the average propensity to consume in the network of each actor and the right figures their weighting, i.e., their share in the consumption of the actors from which they receive an income. The average propensity to consume of the first wave actors is equal to 1, because we take into account only the spent change.

In this example, the multiplier of the first wave is:

$$M_1 = 0,6 \times 1 + 0,4 \times 1 = 1$$

And the one on two waves is:

$$\begin{aligned} M_2 &= M_1 + 0,6 \times 1 \times 0,7 \times 0,7 \\ &\quad + 0,6 \times 1 \times 0,3 \times 0,8 \\ &\quad + 0,4 \times 1 \times 0,2 \times 0,6 \\ &\quad + 0,4 \times 1 \times 0,8 \times 0,7 \\ &= 1,71 \end{aligned}$$

A monetary injection of € 100 would generate € 171 of income to the network economy in two exchanges.

This indicator is not dynamic, although the fact that it summarizes the way in which wealth circulated within the network in a given year starting from monetary injections, it cannot perfectly predict the effect that an additional injection would have. Indeed, the circulation in the network is highly dynamic and it is very likely that a new injection from another actor or a sudden massive injection would change the multiplier size, as the money would not follow the same trails and go through the same actors in the same proportions.

5. Data and results

a. Data

We have access to transaction data from two local French currencies in digital format, which we will call Currency1 and Currency2. Currency1 has a mixed paper and digital format, while Currency2 circulates only in digital format. The works presented in this article are restricted to the digital parts of the currency with a mixed format and, therefore, cannot be generalized to all of its activity.

Even if the databases contain all the transactions conducted by the members of the local currencies associated with their date and the status of the actors, they do not provide exactly the same additional information. Currency1, for example, distinguishes depositing or withdrawing local currency banknotes from digital accounts, which is not the case of the database of Currency2, since its format is merely digital.

Data are collected since the currencies' launch, i.e., since 2015 for Currency2 and 2014 for Currency1. Regarding the later, which has a mixed format, the use of digital was restricted to businesses until 2017. Currency2 had at the beginning a mutual credit part backed to the convertible currency schemes. This mutual credit ended in 2017; as a result, we cannot easily interpret the monetary supply before 2017. We have, thus, chosen to center our analysis on the data of the last full year at our disposal, i.e., 2019 for Currency1 and 2018 for the fully digital circulation of Currency2.

Table 1 – Descriptive statistics of transaction data

	Currency1	Currency2
Year of study	2019	2018
Total money supply at the beginning of the year	685 258	84 115
<i>Exchange of euros to LC in digital format</i>	864 584	47 832
<i>Exchange of LC to euros in digital format</i>	474 582	25 063
<i>Deposit from paper to digital</i>	237 062	/
<i>Withdrawal from digital to paper</i>	254 692	/
Total money supply at the end of the year	1 057 629	106 884
Volume of transactions	1 664 570	129 277
Number of transactions	28 097	1 820
Number of businesses having used the digital currency at least once in the year	433	106
Number of consumers having used the digital currency at least once in the year	1 556	346

In Table 1, we can observe the important difference in structure between the two currencies. Currency1 is a large currency, with a fairly well developed digital network used by individuals. Currency1 has launched the digital format to consumers only in 2017. It proposes a system of monthly automatic change for consumers, which has significantly increased Currency1's money supply in the last three years.

Currency2 was initially designed as a business-to-business schemes to favor the development of local commercial links between companies. It is, therefore, used mostly by the businesses of the network, which causes a lower number of transactions but with a higher amount. Its network is much smaller than Currency1, while Currency2 is currently merged with another local currency of the area to increase their scale.

If we report the number of transactions and their volumes to the active users, Currency1 users relied on their local currency in average 14 times in the year for a total amount of 837 currency1

units. In comparison Currency2 users operated their currency in average 4 times in the year, for a total amount of 286 currency2 units. The average amount per transaction is, on the other hand, higher for Currency2 users with on average 71 currency2 units used in each transaction, which is coherent with the business orientation of the schemes. Indeed, companies might use the convertible currency less often but for a higher amount.

b. Results

By using the formula presented above on the data of these two currencies, we compute the two convertible local currency multipliers.

Table 2 – Computed multipliers

	Currency1	Currency2
Multiplier	2.05	2.34
Unweighted average of the average individual propensity to consume	0.67	0.69

The two multipliers are greater than two (Table 2), meaning that in three exchanges, the initial sum injected in the network doubled its impact. Thus, when one euro is exchanged in Currency2, it provides 2.34 currency2 of income for the network’s members. The 35 123 currency2 exchanged and spent in 2018 will have generated 82 062 currency2 of income for its users. Similarly, the 729 575 euros exchanged in currency1 and spent in 2019 will have provided 1 493 931 currency1 of income for its network members.

These results are at the network level, but the multiplier can also be calculated for a specific network members. Indeed, we can follow the injection made by a specific actor and compute how much of this initial injection remains in the network after several exchanges. This individual computation may be useful to estimate the local impact of a subsidy or public contract, if a share of the payment is made in local currency.

We believe that these disparities stem from the size of the different networks, the density of the connections between their members, but also from the characteristics specific to each currency. Currency1 circulates widely and seems to have succeeded in creating connections between its members. However, its multiplier is smaller than Currency2. It may be that paper money circulates more actively in Currency1 territory and that our results are linked to a lack of adherence of users to the digital tool. Currency1 has also set up a monthly automatic conversion system for euros into local currency, which might slightly decrease their marginal propensity to consume, due to an influx of regular and significant currency amount on their accounts. Indeed, consumers might receive more currency1 units than needed on a regular basis and might hoard more. Businesses might also receive more currency1 units than before and exchange back more convertible currency to euros or hoard longer than before in an attempt to find new way to use their treasury in Currency1. Currency2 high multiplier can also be explained by the structure of its network. It might be that few businesses with an important average propensity to consume inside the network absorb the most part of money flows and use it to other big actors in very few transactions. In this case, the network will notice few moves, but each of them would incorporate a high volume of transactions.

We, also, run some robustness checks (Table 3) to analyze the variations of the multiplier in time and on the entire lifetime of the currencies.

Table 3 – Robustness checks

	Currency1	Currency2
In 2018	1.87	2.34
In 2017	1.63	2.37
Over the entire currency lifetime	1.95	2.40

Currency1 multipliers in the past years are much smaller than the one of 2019. Indeed, the extension of the digital schemes in 2017 has taken time to be effectively implemented, while currency users have had to adapt their consumption and supply practices to the new tool and networks. The increase in the multiplier over the years follows the entry of new actors in the digital schemes and the development of new connections in the network. Currency2 multiplier is more stable, as the scheme is older and might have reached a relative stability in its networks. Additionally, we have computed the multiplier for all the changed money since 2017 for Currency1 and 2015 for Currency2. Currency2 multiplier remains very stable, whereas Currency1 multiplier suffers more from the previous year's low results. As Currency1 multiplier was low in 2017 and 2018, it might be that a lot of currency has been hoarded from a one year to another, which impacts the average individual propensity to consume and, subsequently, the multiplier.

6. Discussion

The convertible local currency multiplier summarizes the income created by the circulation of money between the members of the currency community after the conversion of national currency into local currency. If we consider that this multiplier offers an important methodological advance for the study of local currencies and their effectiveness in keeping local income in local economies, we believe that it could be enriched by additional studies allowing to refine or broaden its implications.

One of the main limitations of this work comes from the absence of counterfactuals with which to compare local currencies' multipliers. At this point, we cannot really assess whether the convertible local currency multiplier is higher than the local multiplier of the territory. To conclude on the ability of local currencies to densify the circulation of wealth within the local economy, we need to know the multipliers of the territories on which local currencies circulate. This would determine whether local currencies are effective in maintaining local income in the territorial economy in comparison to national currency. Florentin and Chabanel (2016) estimated local multiplier for French employment pools with the LOCAL SHIFT[®] tool, which is based on the input-output methodology. They found a local multiplier of 1,39 for Currency1 area and 1,52 for Currency2. However, these multipliers are computed with a different methodology than LM3 and do not even come from the same conceptual approach. It is, thus, difficult to compare the results of the Local shift tool to the ones generated in this study. The measurement of LM3 on these two currencies territory could be the subject of an autonomous research work and would require in-depth consumers and business surveys. But even if these studies were conducted, methodologies would differ and a common definition of monetary

injections that could be compared to the conversion of euros into local currency should be found.

Keeping these limits in mind, we, nevertheless, propose to compare the order of magnitude of our results with LM3s calculated in other studies (Table 4).

Table 4 – LM3 found in other studies

Program	Studies	LM3
Local convertible currencies		1.63 – 2.34
Tourism in Šumava	Černá Silovská and Kolaříková (2016)	1.43 – 1.6
Hoštětín cider house	Kutáček (2007, 2008)	1.62
Eden community outdoors and Longley Organised Community Association Ltd, social business impact on local economy	Sacks (2002)	1.67 - 1.87
North Norfolk District Council, comparison between two contractors	Sacks (2002)	1.23 - 2.15

Černá Silovská and Kolaříková (2016) studied the effects of the tourist industry in the Šumava region of the Czech Republic and found LM3s of 1.43 and 1.6 depending on the municipality, which in their cases is consistent with the study of Kutáček (2008) on a cider house in the Czech Republic which got a multiplier of 1.62. Thatcher and Shrap (2008) found a multiplier of 1.81 in their study of the Cornwell food program. Sacks (2002) provided many examples, while their detailed results are presented in Table 4.

In view of these points of comparison, it seems that the multipliers greater than two found for the local currencies in our study still appear to be encouraging results in terms of the ability of local currency incomes to remain in their network.

However, the comparison between the above mentioned works and that carried out in this study remains limited. Indeed, while the underlying theory is the same, the data collection methods are very different, as are the territories and types of projects. Thus, comparison studies have had to rely on surveys of businesses and their employees to determine the path followed by

money over several waves. For our part, we had almost exhaustive transaction data available which allowed a more accurate multiplier calculation.

Another limitation of this indicator, which we have already mentioned, is that it does not allow us to conclude on the novelty of the exchanges that have taken place in local currency. Thus, the multiplier represents the circulation of income within its network, but it does not allow us to state that this circulation would not have taken place in the absence of the local currency. One cannot strictly speak of new or additional income for the members of the network since one cannot determine whether or not the local currency produced new connections between its members. Similarly, a high multiplier within the local currency may indicate that it circulates a lot and that the average propensity to consume locally is high within this means of payment to the detriment of savings and imports. However, it is likely that an average propensity to consume locally in local currency may be offset by an increase in the average propensity to save and import in national currency. Indeed, a local currency is only complementary and the actors using it arrange their local and non-local consumption, investments and savings with both means of payment. If the actors use only the local currency for their local consumption, they will continue to save and consume non-local goods in national currency. The latter, will, therefore have more weight in their consumption in national currency without having changed in absolute value. Thus, if the income of the users of local currency remains the same and their consumption basket is stable, but all of their local consumption is now performed in local currency, their average propensity to consume locally in local currency will be high. However, they will no longer make any local consumption in national currency. Their average propensity to consume locally in national currency will, therefore, be zero, while their average propensity to import and save in national currency will be increased proportionally.

Thus, the convertible local currency multiplier calculated here does not determine whether the local currency has a positive effect on the relocation of the economy or the increase in production more broadly. It is an internal indicator of its functioning, making it possible to measure whether money actually circulates within the network and whether it helps to control the leakage of income out of the local economy, when the income is distributed through it.

Indeed, the multiplier and the network analysis of the local currency community make it possible to follow precisely the circulation of a new injection within this group of actors and to ensure that the subsidies and its externalities will benefit the monetary community. In this context, the use of a digital local currency for public spending on the territory would make it possible to evaluate the actors benefiting the most and to measure the exact impact in terms of income, beyond the initial injection.

The current narrow size of local currency networks may limit their use for broader general territorial development policies. If local currency networks managed to integrate more territorial actors by enlarging their networks, they could become interesting tools for economic stimulation (at a territorial level) and the control of its externalities. However, in case of enlargement of the networks, care must be taken to keep the spirit of the systems. Indeed, one of the strengths of local currencies lies in the careful selection of member companies, ensuring the quality of their production and their commitment to the territory. The rapid development of the networks, to make them reach a sufficient size, could not only jeopardize this essential dimension, but it could, also, have an impact on the size of the multiplier.

From a methodological point of view, it has been chosen to summarize the circulation that took place in a given year by estimating all the parameters from the flows of the year. This choice allows us to be precise and stay close to the empirical situation of this given year. However,

this multiplier varies from one year to another with the structure of trade and especially with the use or non-use of money hoarded in previous years by the actors. In fact, their average propensity to consume is calculated from their expenses of a given year compared to their income of that year. The hoarded cash outflow can artificially inflate this parameter, whereas it artificially decreased it the previous year. Another solution would have been to measure the average individual propensity to consume since the actor's entry into the network. However, if this indicator would have been more stable, it would have been distant from actual trade in the study year. Indeed, the marginal propensities to consume would not have been exactly the one of the year, but computed on all the currency lifetime.

7. Conclusion

In this paper we propose to measure the circulation of income within convertible local currency networks using the Local Multiplier 3 indicators (Sacks, 2002). The functioning of local currencies is linked to the underlying mechanism of the multiplier. Indeed, by restricting the market available to its members, the local currency should reduce their average proportion to consume outside its network, at least for the income obtained in local currency. Thus, the convertible local currency multipliers, found in this study, are in a higher range compared to other studies applying this method, which seems to confirm this market partitioning effect as well as a significant circulation of income obtained in local currency within the monetary community.

However, these results should not be over-interpreted. Indeed, a high internal multiplier of the local currency does not mean that the local currency has allowed a relocation of economic exchanges. Therefore, exchanges taking place in local currency may be mere substitutes for exchanges that would have taken place in its absence between the same or other territorial

partners. The multiplier, consequently, does not allow any conclusion to be drawn as to the creation of new income or new production achieved through the local currency.

A high multiplier, however, makes it possible to guarantee that the income spent in local currency is well preserved in the community. It, therefore, gives the consumer or the public decision -maker guarantees regarding the economic community financed by its expenditure in convertible currency, beyond its own spending. It can, therefore, enhance the value of local currencies as tools to control the use of an income or subsidy beyond the initial expenditure.

6. References

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