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TOWARD SPATIAL ANALYSES OF LOCAL CURRENCIES: THE CASE OF FRANCE

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ABSTRACT

This paper suggests that studies on local currencies (LCs) should engage in spatial analyses, as far as their territorial distribution is highly heterogeneous. It provides a statistical overview of the territorial features of LCs functioning in France, wherein their number has increased solidly and remarkably fast over the last decade. However, there is a huge variety in their extent, and their development has not been spatially even, especially with regards to the administrative subdivision of the country in departments (counties or departments that correspond to the NUTS-3 level of regions according to the administrative territorial classification of the EU). This uneven distribution let us presume that it is interrelated with different territorial conditions, which motivated our research. We build a size index of LCs and provide a cluster presentation of them as of 2018. A departmental territorial breakdown of data shows statistically significant spatial concentrations of LCs in France. We then provide insights into the reasons for such concentrations.

KEYWORDS

Local currencies, France, territorial distribution, spatial statistics, size index.

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1. INTRODUCTION

France is the country that experienced the most impressive dynamics in the emergence of local currencies in the years 2010. These currencies are issued by nonprofits (under the legal form of associations) as a counterpart of the same amount in euros brought by users and put into reserve accounts. Providers (which can be shops, producers and other market activities, public services and utilities, associations) may ask for the repayment of the local currency they receive at the association that should use its reserve accounts for this purpose. This definition narrows the scope of what is often called CCs or complementary or community currencies. Under Longhurst and Seyfang's taxonomy, local currencies must be distinguished from "service credits" (like time banks) and "mutual exchange" (like LETS) and "barter markets" (like the Argentinian Trueque) (Longhurst and Seyfang, 2013). Under Blanc's typology, the local currencies under scrutiny in the present paper refer to economic projects aiming at protecting, stimulating or orientating the local economy, and are implemented in what is called a third generation of CCs, which are characterized by convertible schemes that include local businesses (Blanc, 2011). In any case, one should not confuse the specific category of local currencies, used in this paper, with the generality of complementary or community currencies.

Local currencies are not a new phenomenon. In the early 1930s, during the first years of the great depression and in contexts of harsh budgetary restrictions and booming unemployment, a wide range of complementary currencies of various kinds were issued by local communities that tried to compensate for the shortages of the legal tender, in some countries of Europe as well as in the US (Gatch, 2008; Kennedy et al., 2012). A very few of them had been banned, such as the currency of the municipality of Wörgl in Austria, before such kind of initiative would blossom in the country. When local governments were committed in their issuance, this did not last much, while central or federal governments barely paid attention to them. The only experience that survived this period is the still existing WIR Bank, in Switzerland, a model of mutual credit system primarily for B2B (Stodder, 2009; Vallet, 2016) rather different from local currencies. The other initiatives did not survive the period of the Depression and disappeared within a few years.

In the recent decades, and as a part of the dynamics of alternative currencies that were experienced since the beginning of the 1980s, local currencies re-appeared under various forms. They barely originated from municipalities and other local governments but were mostly the result of civil society association. After a period in which they were issued as lump-sums paper currencies to new members (Trueque, Argentina; see e.g. Orzi and Plasencia, dir., 2007; Gómez, 2009 ; Saiag, 2015) or for registered providers (Ithaca HOUR ; see e.g. Jacob and alii, 2004; Grover, 2006), new schemes emerged from the end of the 1990s and blossomed in the following decade, that soon imposed the three pillars of parity to the national currency, backing by an equivalent reserve in the national currency, and a convertibility limited to professional members. That was the case, with nuances due to local choices, of the local currencies of Brazilian community development banks such as the Palmas, of various German "Regio" currencies such as the Chiemgauer, of the BerkShares in the US, the Bristol Pound in England, etc.

Though LCs are not necessarily the tools and results of crisis management, the procyclical feature of the current financial and monetary systems and the major shock of the crisis of 2008-09 contributed to a new interest in the potential beneficial effects of various kinds of alternative currencies, including the local currencies that are dealt with in this text. The other major source of interest in these schemes lays in their potential contribution to the ecological transition at local level. In any case, they are seen as possible tools for a move toward more vibrant and resilient communities.

In France, longstanding reflections but limited experiences were revived after the shock of 2008-09. The first projects started in the aftermaths of this crisis, with arguments combining the search for local responses to it, the will to contribute to a global shift toward an economy less dependent on the financial system and the need for experimentations for territorial resilience building and ecological sustainability. The limits of the then ongoing experience of the SOL currency were overstepped in 2010, with the creation of the first French local currencies based on the three pillars of parity, backing and partial convertibility (Fare, 2011; Blanc & Fare, 2018). In 2018, 75 local currencies circulated in the country (74 at the end of the year, after one shutdown) and a total of 86 had been implemented since the beginning of this wave, which makes probably France the second country in the world by the number of this kind of currencies[i]. In Brazil, the number of community development banks topped 100 in 2013, mostly associated to kinds of local currencies (called moedas sociais) (Rigo, 2014; Rigo and França Filho, 2017). The dynamics

in France proves to be over that of the many US HOURS of the years 1990s (Collom, 2005), as well as the German Regios of the years 2000s (Thiel, 2011; Volkmann, 2012). As will be seen, though still growing in 2018, it is likely that the movement already reached its peak in terms of yearly launch of new currencies. It might be said that it is time to get a systematic statistical overview of such dynamics.

If statistical overviews of national dynamics of local currencies can be found in the literature (e.g. Collom, 2005, on the US HOURS-like systems), spatial presentations have been mainly omitted so far, most probably due to the lack of systematic data. In the case of LCs in France, no systematic statistical overview of LCs exists, with the exception of Fourel, Magnen and Meunier (2015, p. 55 sq), on the basis of a survey in 2014, which provided some (actually scarce) data on 14 cases of circulating LCs and on 18 projects. Since then, the impressive rise in the number of LCs throughout the country calls for further systematic evaluation. Moreover, as will be shown, their territorial distribution is highly heterogeneous: parts of the country experience strong movements on LCs implementation and development, while other parts look like deserts on this matter. This paper was then motivated by the lack of spatial analyses, be they on French LCs or on other kinds of complementary currencies and in other countries. It states that studies on LCs should engage in spatial analyses.

So far, a few master theses on French LCs developed kinds of regional analysis, while no published academic paper was identified. Poveda (2015) zoomed on the Eusko, the successful local currency implemented in the Northern Basque country. Simon (2018) tried to embrace the whole national dynamics through the viewpoint of the French administrative breakdown of the "regions", but this level (that divides Metropolitan France into 13 regions) seemed too large to provide accurate conclusions.

The present paper aims at analyzing the main characteristics of the French dynamics of LCs, on the basis of an original database (see Appendix 1) that allows displaying its spatial dynamics. By analyzing these spatial dynamics, we may understand better and learn more about the territorial conditions of France. And the reverse might be true as well; analyzing the territorial socioeconomic conditions can contribute to the increase of our knowledge on the preconditions for the successful functioning of LC schemes. The authors' intention with the present paper is to launch new perspective in the academic research dealing with monetary innovations under territorial lenses by accounting for territorial specificities through a spatial quantitative analysis.

The paper starts with the presentation of the overall evolution of French local currencies during the period 2010-18, on the basis of this original data. As there is a huge variety in the extent of LCs, we build a simple and original size index of LCs and consequently define 5 clusters depending on this index (Section 2). Then, we deal with the spatial features of the territorial distribution of the local currencies in a NUTS-3 regional (i.e. departmental) breakdown by applying descriptive statistics and correlation analyses. This unveils a degree of spatial concentration that shows how the process of creation and implementation of this kind of schemes is not spatially even (Section 3). The paper then emphasizes the spatial heterogeneity of local currencies in France (Section 4).

2. THE EVOLUTION AND THE EXTENT OF LOCAL CURRENCIES IN FRANCE

Since the birth of the Abeille (in Villeneuve-sur-Lot) in early 2010, the rising field of local currencies structured around two overlapping networks. The first historical one is a network called "SOL Movement", which is based on a formal nonprofit, originating from the previous SOL scheme that led to a few experiences in France from 2006 to 2012 (Fare, 2011)[ii]. These experiences were not exactly local currencies as defined in the introductory section, but rather and mainly rewarding schemes for ecological consumption (though their scope was initially much broader). This network was rejuvenated in 2011-12 with the birth of the SOL-Violette (in Toulouse), a paper local currency based on the three pillars seen above that had been first implemented in France by the Abeille. This formal network not only serves as a forum for experience sharing, but also provides technical support and works at the improvement of the economic efficacy of the experiences by developing advocacy, promoting the involvement of local governments[iii] and looking for technical solutions such as the use of digital versions of the currencies (not in order to replace the paper notes but to be used beside them, as in various British schemes or in the case of the Chiemgauer).

The second network was built as an informal collective grouping of persons and experiences, starting with the case of the Abeille, and can be called the "MLCC network"[iv]. This informal grouping used to organize national encounters

twice a year and wrote a manifesto in order to frame what could be called, initially, "local complementary currencies", then, "local citizen complementary currencies", thus contrasting with local currencies from local governments or from merchant's associations[v]. Overall, this network used to be oriented toward the clear definition of the values and principles a local currency should be respectful of, thus playing a very normative role – e.g. considering as a requirement that the projects be implemented by citizen. It maintains a website that contains an extended database on French experiences and projects, though based on voluntary declaration of their promoters[vi].

Though separated and distinct in their nature, these two networks overlap in that local currencies' associations may participate in both of them, and also co-operate on various points. It should be added eventually that a few local currencies are external to both networks, such as a few cases of currencies issued and managed by local merchant's associations.

We built an original database of circulating LCs as of 2018, starting with the data provided by the website of the MLCC network that we refined by checking and completing it (Appendix 1). An overall number of 75 local currencies was identified as circulating in 2018, and a few others had circulated before but stopped their activities. Figure 1 displays the evolution of this number of local currencies in France from 2010 to 2018, taking into account the original cases of SOL schemes that circulated before 2010. This overall number is remarkable, though most of them are of a small size and their potentials are underused (Blanc & Fare, 2018).

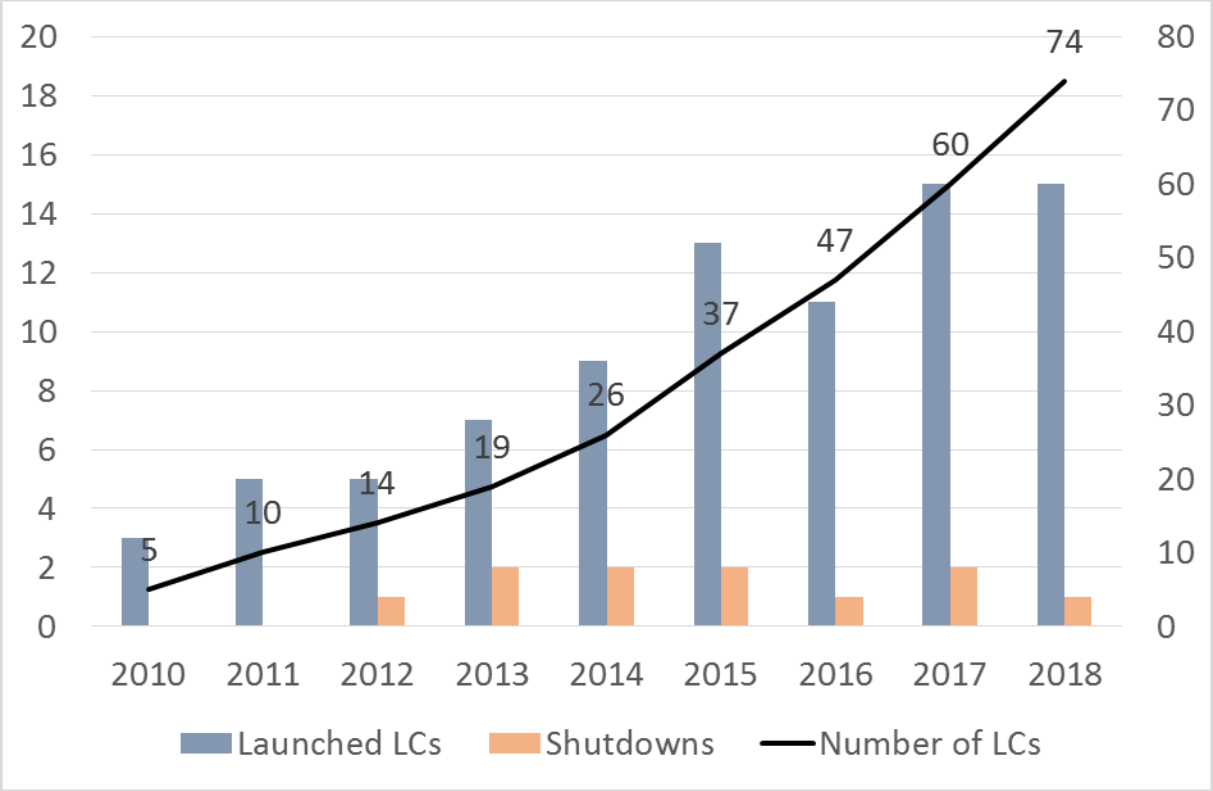

Figure 1: Number of local currency schemes in France, 2010-18. Left scale: launched and shutdowns. Right scale: net number of circulating LCs, end of year. Source: authors

We included in our database basic data on the number of individual users, the number of providers and the money supply of each circulating LC as of 2018 (see Appendix 1 for details on the way this dataset has been completed). While the important number of estimates prevents from developing in-depth calculations, it may be used however to provide a gross estimation of the overall extent of LCs as of 2018. Table 1 displays such an estimation. At first glance, the uneven size of the LCs is a major fact, since the median of the data distribution is far below the average. A small number of LCs are thus much more extended than the others and pull up the average significantly. The ten biggest LCs, i.e. 13.3 % of them, display 57.8 % of the money supply. The biggest one (by far), i.e. the Eusko (in the Basque country), makes 30 % of the overall money supply. The concentration is less important with regards to the number of individual users and providers. Moreover, the money supply median is much lower than the median for

the number of individual users and providers. This indicates that the success of LCs is not only related to the number of individual and professional users they manage to enroll, but it also and especially translates into the extent of their circulation. The biggest case (that is, the Eusko) displays indeed a ratio of money supply per individual user of nearly € 333, while the average is € 89. The importance of the money supply of the Eusko and of the 10 biggest cannot be explained by specific issuing rules, since almost all LCs were issued the same way in 2018. The development of digital versions of some LCs (which notably allow monthly conversions that push the money supply up) was too preliminary in 2018 to explain such gaps.

Table 1: Basic data estimates on the 75s French LCs as of 2018. Source: authors.

	Money supply	Number of providers	Number of individual users
All local currencies	€ 3,333,770	9,185	37,433
Of which: Eusko (cluster 5)	*30.0 %*	*7.1 %*	*8.0 %*
Of which: the 10 biggest (clusters 4 and 5)	*57.8 %*	*33.2 %*	*42.1 %*
Average	€ 44,450	122	499
Median	€ 19,000	90	311

In order to take account of the various size of these LCs, we built an original size index according to the following formula:

$$S_i = M_i \times (P_i + U_i)$$

With:

- S_i the size index of the currency (i)
- M_i its money supply
- P_i the number of accepting places (or so-called "providers")
- U_i the number of individual users (which, under the French legal framework, are supposed to be formal members of the issuing non-profit organizations)

We estimated this size index for each circulating local currency for the year 2018 and, in order to simplify this set of data as well as to overcome the problem of approximate estimations for several cases for which the data were not complete (see Appendix 1), we classified them into five clusters, from the smallest experiences (Cluster 1) to the most extended ones (Cluster 5) (Table 2).

This synthetic index can be used as a general comparison index on the size of local currencies (as previously defined, that is, based on the three pillars seen above), notwithstanding possible exchange rate issues between the national currencies that back them[vii]. Table 2 provides examples of non-French European or North-American cases for uses of international comparison. As clusters are built on classes of size indexes, the correction of data by purchasing power parities would probably not generate changes in this table.

In this paper, the clusters are used on a static way, since the observed cases are put into clusters as of their state of development in 2018. When thinking dynamically, the observer could think that the trajectory of a given LC should be to climb the steps of the clusters one after the other. However, a more detailed observation rather leads to think that, whereas LCs may change their clusters when maturing, many do not change significantly toward cluster 5. Some of the oldest LCs are indeed stuck in Cluster 1 (Commune), Cluster 2 (Luciole) or Cluster 3 (Abeille), and we may observe stagnation or a low pace of development of many LCs, while shutdowns of rather small ones have been

experienced during the period 2010-18. Conversely, high ranked LCs, which are schemes whose clustering is high, seem to have reached a high cluster one or two years after their launch.

Table 2: Clusters of circulating local currencies, France, 2018, and international comparison. Source: authors.

Cluster	Cluster 1 – LCs with inward circulation	Cluster 2 – Small LCs	Cluster 3 – Medium LCs	Cluster 4 – Extended LCs	Cluster 5 – Major LCs
Range of size index	$S_i < 10^6$	$10^6 \leq S_i < 10^7$	$10^7 \leq S_i < 10^8$	$10^8 \leq S_i < 10^9$	$10^9 \leq S_i < 10^{10}$
Number of cases (France, 2018)	11	32	22	9	1
Some cases (France, 2018)	Commune Trèfle	Bou'SOL Lignière Luciole Nissart Galais Lien	Abeille Florain MIEL Pive Pêche Rollon Roue 84	Cairn Doume Elef Gonette Léman SOL violette SoNantes	Eusko
Similar European and North-American cases (country, year of data)		Totnes Pound (UK, 2008)	Ithaca HOUR* (USA, 1998) Epi lorrain (Belgium, 2015) BerkShares (USA, 2017)	Brixton Pound (UK, 2016) Grama (Spain, 2018)	Chiemgauer (Germany, 2017) Bristol Pound (UK, 2017)

** Ithaca HOUR is not of the same type of local currencies as the others, as seen above, due to the lack of backing and of convertibility in U.S. dollars. We put this case in the table in order to get a broader view.*

Figure 2 displays a map of France with the location of the 75 existing local currencies in the metropolitan territory of France, weighted according to their cluster. This map shows that local currencies are distributed unequally on the French territory. The next section furthers the analysis on this phenomenon of spatial concentration.

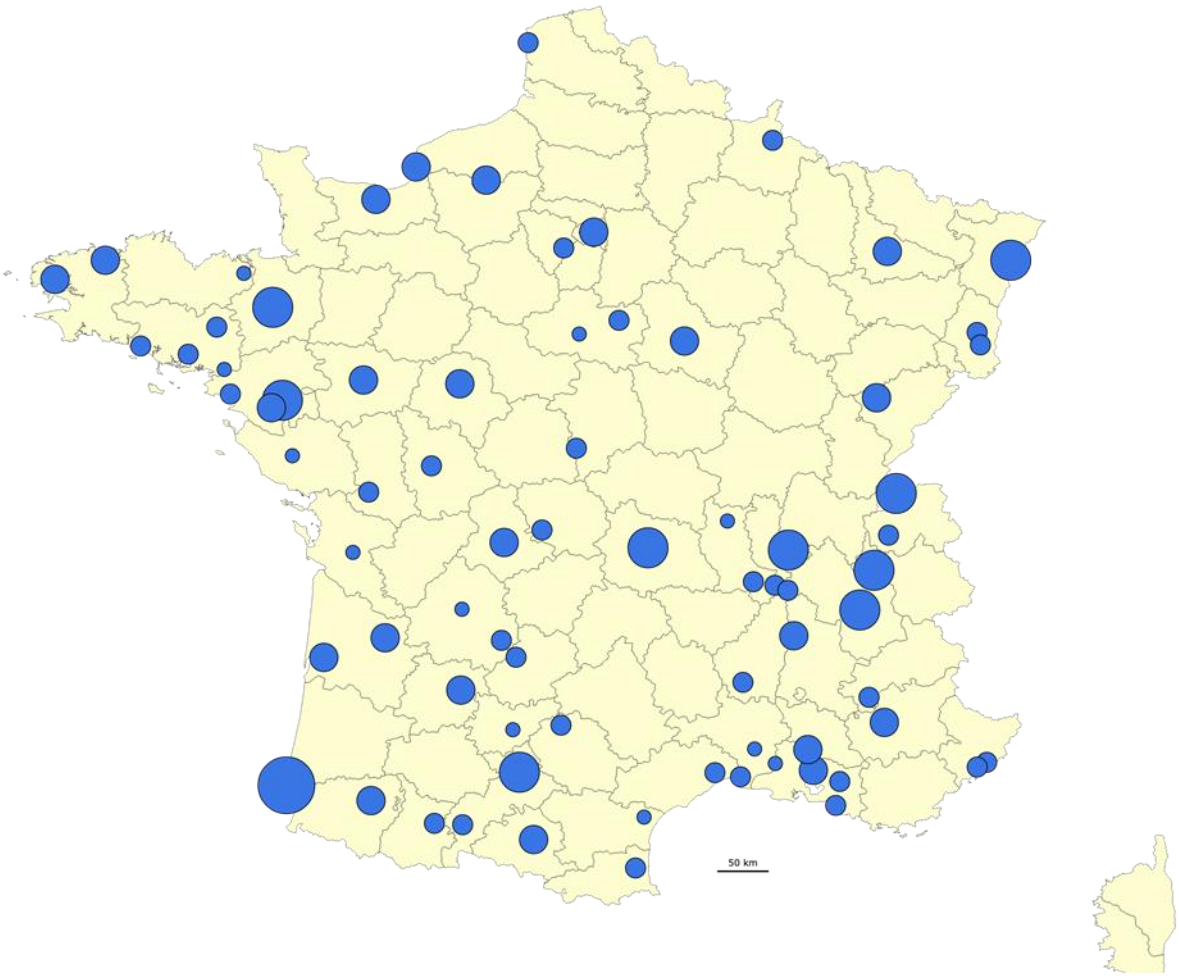

Figure 2: Location and size of the circulating local currencies in Metropolitan France in 2018. Source: Own editing. Map of Metropolitan France with departmental delineations.

3. THE SPATIAL CONCENTRATION OF LOCAL CURRENCIES IN FRANCE

As observed, the spatial distribution of local currencies in France is not even. Figure 3 displays the evolution of their localization between 2012 and 2018. They developed at first in the south and southeast of France, then spread over western and northwestern places, with a few eastern and northern cases. Figure 4 shows the map of France with the connectivity graph of the circulating LCs based on their GPS coordinates. The distance-based threshold value of neighborhood is adjusted to be the lowest where each point has at least one neighbor, in order to avoid isolates, which is 160.1 km in this case. Those schemes are considered as neighbors, and therefore connected by a line on the map, whose beeline proximity is within that distance value. Three major concentrations can be seen in the northwestern, southwestern and southeastern part of the country. If the spatial distribution were even, we might conclude that the socioeconomic conditions within the country are spatially even too, or that the territorial inequalities do not influence significantly the evolution of LC schemes. However, none of them is the case, as we see on the maps of Figure 3 and 4.

Figure 3: Localization of LC as of 2012, 2015 and 2018. Source: Own editing.

Figure 4: Connectivity graphs of the circulating LCs in France in 2018. Source: Own editing.

The uneven distribution is not only a matter of observing variety among departments with regards to the number of LCs in them, but also a matter of observing that this variety does not reflects the demographics. To do so, we calculated an estimated absolute value per department of the aggregated volume of LCs that circulate in them (Figure 5), derived from the size index presented above. The most populated areas of France, including Paris and the region Île-de-France (more than 10 million inhabitants), display very few numbers of LCs circulating with low volumes. Among the most populated departments of France, letting aside the departments that compose the Île-de-France region, the Nord (with Lille as a major metropolis) does not display any LC, while the Bouches-du-Rhône (with Marseille) experiences several but with low volumes. Figure 5 shows the distribution of the aggregated volume in the departments that experience such circulation.

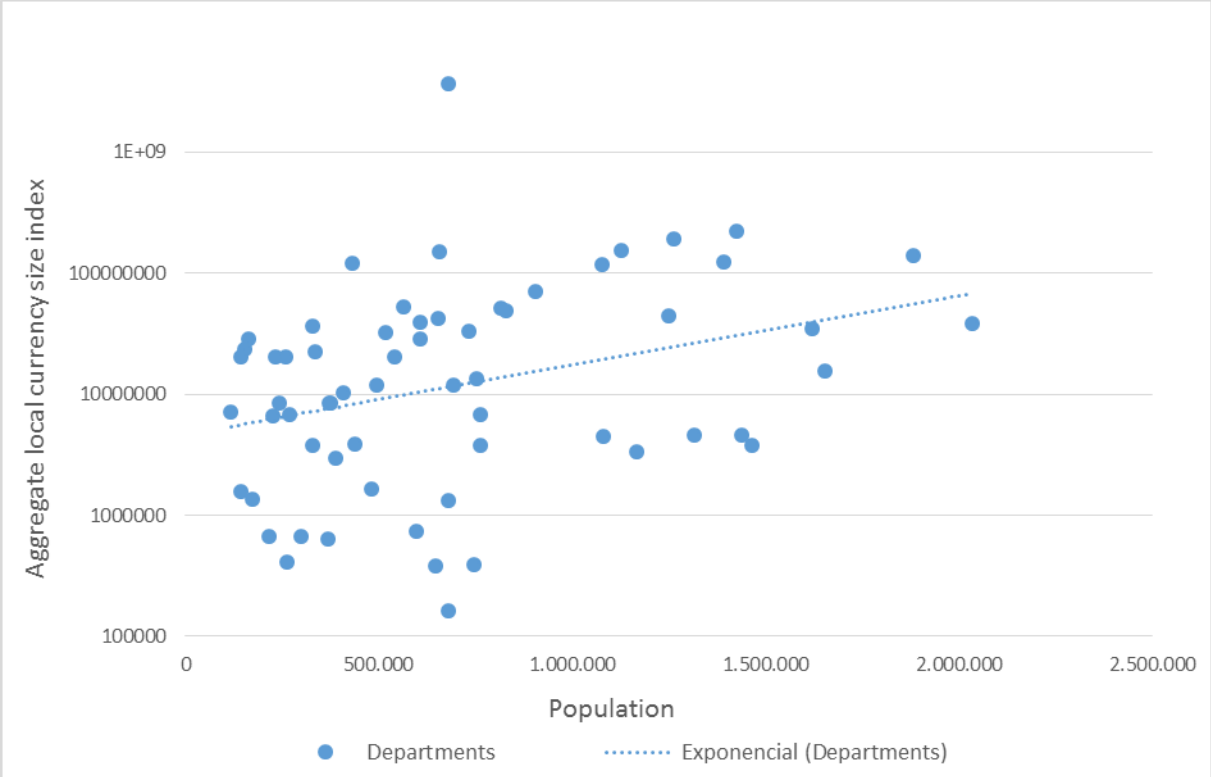

Figure 5: Estimated value of the aggregate LC size index and population per departments. Source: own editing.*

** Remarks: 1) The actual absolute value of the aggregated volume of LCs is given by the addition of the size indexes of the LCs of each department that experience the circulation of LCs. When a local currency circulates in various departments, we consider a rough share of this circulation per department. In the case of the Leman, which mostly circulates in Switzerland, we attribute a share of 33% of its circulation for France, equally distributed between the departments of Ain and Haute-Savoie. 2) Due to the important size index of the Eusko (department of Pyrénées-Atlantiques), the graph is shown in logarithmic scale.*

For Figure 5 presented above, we used an estimation of the actual absolute value of the aggregate LC volume. However, later on, we are going to use the aggregate ordinal cluster value of LCs per departments. The reason behind this is partly technical; in several cases, we do not have reliable data on the absolute value of volume of LCs, while we can still safely classify those cases into appropriate clusters. On the other hand, the number of schemes is still taken into consideration this way, but not as much as in the previous approaches that consider purely the number of schemes and ignore their volume.

We use below a departmental breakdown to implement a spatial analysis of LCs[viii]. Departments may appear as relevant territories for such an analysis, given their size, the availability of socio-economic data built by the INSEE[ix] and the fact that several LCs are expressly built to circulate throughout their department of implementation[x]. The 75 circulating LCs that were identified in France as of 2018 may be compared to the 96 departments that compose this territory. Departments allow thus a much finer grained analysis than the regional breakdown used by Simon (2018).

In order to prove statistically the existence of the territorial concentration, we calculated a departmental aggregate adding up the ordinal cluster value of the LCs that circulate in them. It is thus derived from the above-mentioned synthetic size index S and the subsequent clusters. Territorial concentration is often called spatial autocorrelation, which is a more technical term. A commonly used statistic is Moran's I that measures the degree of spatial autocorrelation of given values. Applying this statistic to our data, the population weighted global Moran's I analysis and its permutation test confirm the presence of the spatial autocorrelation of the aggregated cluster LC value at departments (Figure 6). The population weighted local Moran's I analysis shows statistically significant spatial concentration of low aggregated cluster value of local currencies at some of the northern departments, while there is another spatial concentration of high aggregated cluster value at some of the southern and southeastern departments (Figure 7).

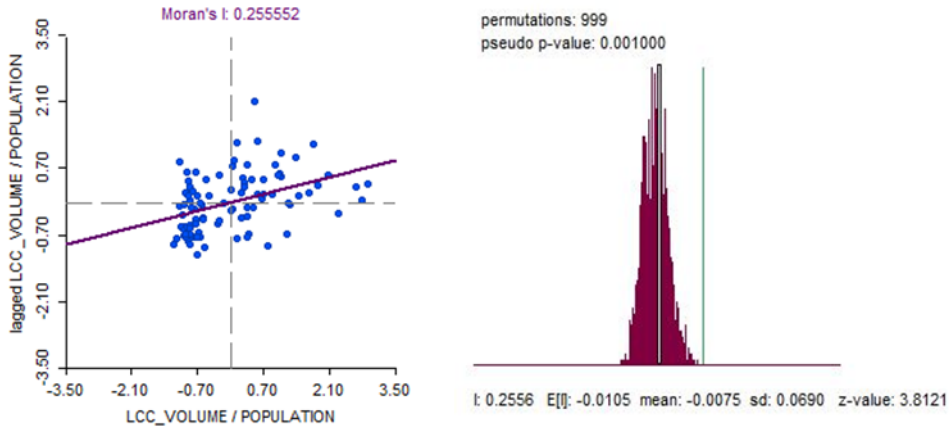

Figure 6: Population weighted global Moran's I statistic on the spatial distribution of aggregated cluster value of LCs per departments and its permutation test. Source: Own editing.

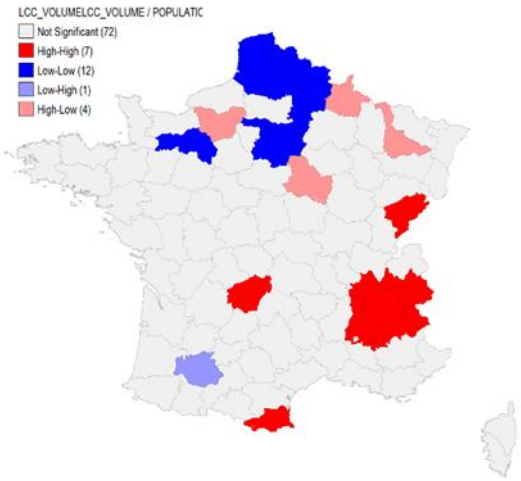

Figure 7: Population weighted local Moran's I statistic on the spatial distribution of aggregated cluster value of local currencies per departments. Source: Own editing.

We performed another test, although less sophisticated than the previous one, to underpin the argument of the spatial concentration. Table 3 shows the number of French departments according to their geographical position within the country as well as according to the existence of any local currency schemes within them. (Herewith, we took off the two departments of Corsica and the city of Paris.) As we see, only the northeastern part of France consists of departments mainly without local currency. Analyzing statistically the association between the geographical location of the departments and the existence of local currencies, we can see in Table 4 that there are some sorts of dependencies between these variables at significance level $p<0.05$. These results confirm the above presented spatial autocorrelation test results.

Table 3: Number of French departments according to their geographical position and the existence of local currency schemes. Source: Own editing.

Location	Are there circulating LCs?		**Total**
	Yes	No	
Northeast	8	15	23
Northwest	20	7	27
Southeast	15	8	23
Southwest	15	5	20
Total	58	35	93

Table 4: Association between the location of the French departments and the existence of local currencies. Source: Own editing based on Table 3.

	Value	Significance
Pearson Chi-square	10,472[a]	,015
Phi	,336	,015
Cramer's V	,336	,015
Number valid cases	93	

The results of the statistical analysis may be enlightened by the broader territorial socioeconomic conditions of the country. In the years 2010, a debate spread over in French academics and beyond on the territorial dynamics within the country (see notably Davezies, 2012 and the controversial Guilluy, 2014). The role of the rising metropolises was put central stage. As the important urban areas attract skills and capital from abroad and generate most of the nation's GDP, the effects of these metropolises on the other territories, called "peripheral" by Guilluy (2014), was particularly debated: are metropolises attractive centers that capture growth and wealth at the expense of their peripheries, leading to their impoverishment and desertification, or do they serve as an engine for the growth of the latter? And, consequently, what are the effects of the public policies that support the attractiveness of metropolises on the peripheral France?

The fate of middle towns in this context of rising metropolises and declining traditional industries, notably in the northern and eastern parts of the country, was also discussed[xi]. Middle towns were generally considered weakening by the surge of metropolitan areas. In order to assess their situation, the CGET[xii] built an index of fragility of middle towns based on their demographic dynamics, economic dynamics and poverty rates on the period 2008-2013 (Boutet, 2017). It showed a more complex situation than the too general viewpoint that would consider middle towns as declining. According to the CGET, declining middle towns are indeed mostly found in northern, northeastern and central parts of France, while many others are considered in a favorable situation in northwestern, western, southwestern, southern and southeastern parts of the country. Interestingly, the central and northeastern middle towns of France, which are overall the most fragile, are situated in departments with smaller number of LC schemes and limited volume of circulation. It seems that the departments that experience higher aggregate cluster value considerably overlap the departments in which the situation of the middle towns is less fragile than in others. One can conclude that, in general, LCs are less developed in vulnerable areas with impoverished populations.

So far, we illustrated and proved statistically the existence of a territorial concentration of LCs, providing some limited qualitative explanation. In order to get a more detailed and sophisticated representation, we need to consider broader aspects by applying further quantitative methodologies in form of correlation analysis than justifies our attempt to model the spatial spread of local currencies at departmental level in the next section.

4. SPATIAL HETEROGENEITY AND CONCENTRATION OF LOCAL CURRENCIES

Analyzing the socioeconomic factors which might influence the aggregated cluster value of the functioning local currencies, our first finding is that we cannot model this with any official statistical data in departmental breakdown. The reasons are mixed and multiple. One of them pertains to the problem of scale-dependency. Whereas 17 of the 75 LCs are supposed to be built for an area that corresponds with the territory of a department or higher, the claimed territory of the 58 others is much smaller than the departments wherein they are implemented. The actual extent of their circulation is even smaller than their claimed territory. The only case in Cluster 5, the Eusko, managed to reach 1.8 % of the population of its claimed territory of circulation (Pinos, 2019), and this one provides 45 % of the overall population of the whole department of Pyrénées-Atlantiques. Besides, the aggregated cluster value of LCs at the departmental level hides the inner differences and heterogeneity within the departments. Finally, the whole metropolitan territory of France itself is spatially heterogeneous. In this part, we are going to deal with the spatial heterogeneity of the country, dividing it to four parts: northeast, northwest, southwest and southeast. We show that, despite the lack of regression model among the multitude of all departments, correlations between departmental aggregated cluster value of local currencies and some explanatory variables may be found when considering quarters of the country.

At first, we wanted to explain the aggregated cluster value of local currencies, as dependent variable, with the following explanatory variables available on the website of INSEE:

- population in 2018
- social spending per capita in 2015
- unemployment rate at the end of 2016
- part of unemployed young population with low education in 2014
- poverty rate in 2014
- part of population geographically remoted from basic healthcare service centers in 2016
- inequality rate in 2017
- rate of social economy employees in 2015
- household waste recycling rate in 2013
- rate of population concerned by a local Agenda 21 program in 2014
- banks and saving cooperatives in 2017
- number of small shops in 2017
- employment centers per 100 000 inhabitants in 2017

The above-listed variables, apart from the population, can all be considered as proxies by which we could make some limited indirect deductions about the socioeconomic and environmental policy conditions that influence the aggregated cluster value of the functioning local currency schemes. However, as written above, our attempt to model the interrelations failed in respect to the whole country, partly due to its spatial heterogeneity. On the other hand, in case of some variables, we can model some sort of relation within certain quarters. We accept the existence of relationship between the observed variables wherever the explanatory power of the model is at least 40% and the result within the given quarter is significantly different from the rest of the country according to the Chow test at significance $p<0.05$.

As we showed previously, there are three major concentrations in the northwest, southwest and southeast. In the northeastern part of the country, there are only few local currencies with low volume, therefore we dispense with this quarter and focus only on the other three quarters.

Northwest:

In case of the northwestern part of France, it proved advisable to pull out the departments of Île-de-France from the correlation analyses because they behave as outliers in most of the cases. The reason is mainly that Paris and its region have a barely comparable weight, in respect of many socioeconomic dimensions, than the rest of the country, while the aggregated cluster value of the local currencies is low there. So, after pulling out the departments of Île-de-France, 20 elements remained in the multitude. Among these elements (departments), the aggregated cluster value of local currencies correlates in a positive way with the population, the number of financial institutions (banks and cooperatives) and small shops, the recycling rate, and it correlates in a negative way with the part of population geographically remoted from basic healthcare service centers (Figure 8). The Chow test shows significant difference in case of these variables between the quarter and the rest of the country (at significance $p<0.05$).

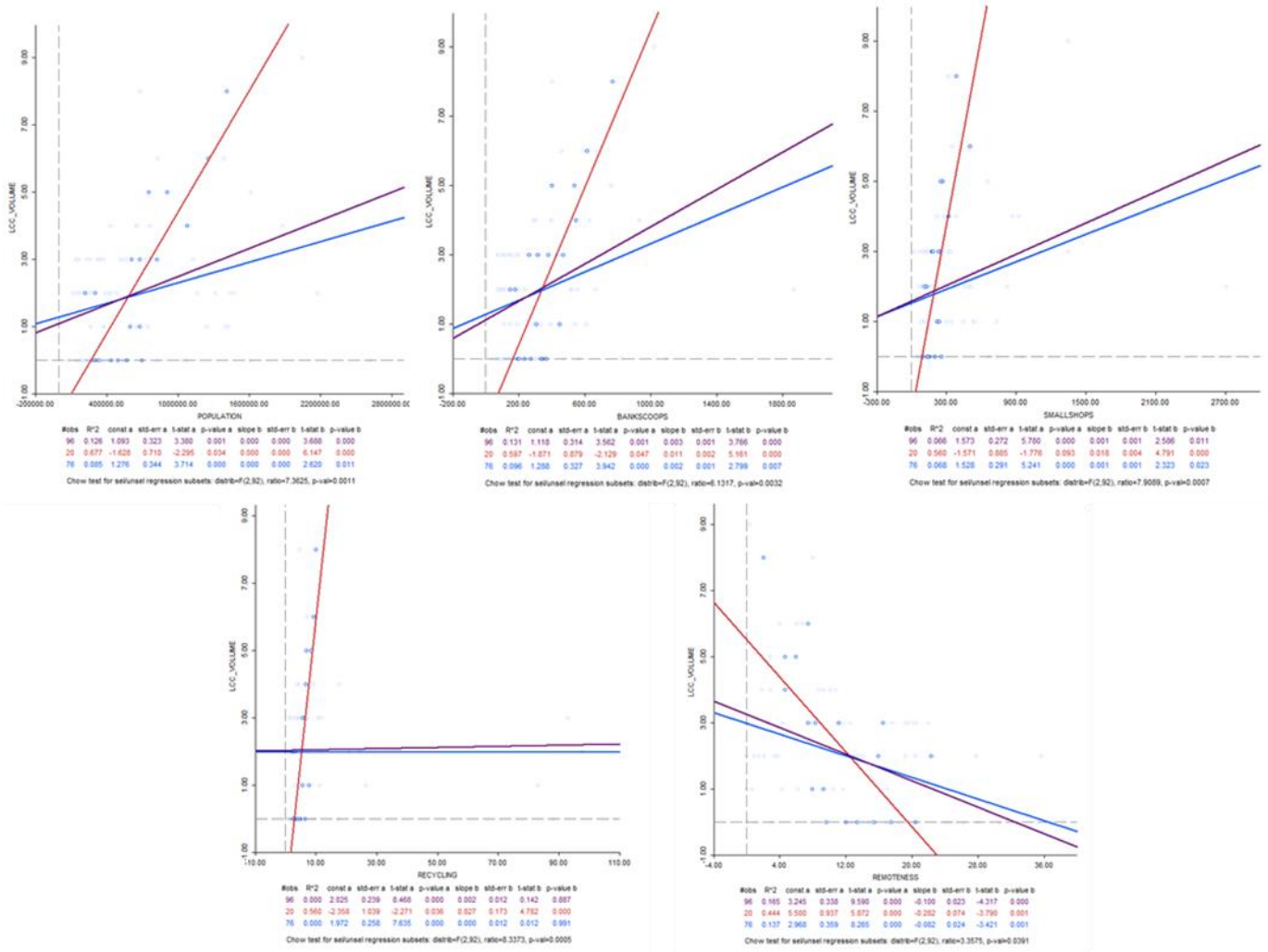

Figure 8: Relationship between the aggregated cluster value of local currencies, as dependent variable, and the population, the number of financial institutions (banks and cooperatives) and small shops, the recycling rate, and the rate of geographically remoted population as independent variables (Notes: in purple: correlation in the whole country; in red: correlation in the northwest; in blue: correlation in the rest of the country). Source: Own editing.

Southwest:

Among the 20 departments of the southwestern quarter, only the inequality rate shows correlation with the aggregated cluster value of the local currencies (which is approximately 40%) and, accordingly, the relation of these variables is significantly different inside from outside the quarter (Figure 9).

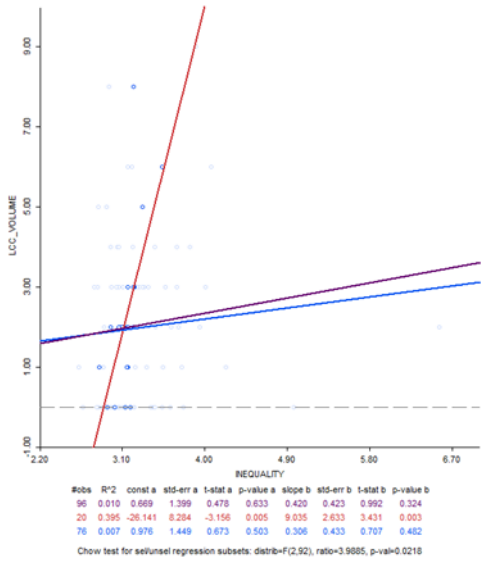

Figure 9: Relationship between the aggregated cluster value of local currencies, as dependent variable, and inequality rate as independent variable (Notes: in purple: correlation in the whole country; in red: correlation in the southwest; in blue: correlation in the rest of the country). Source: Own editing.

Southeast:

After setting aside the two departments of the island of Corsica, 23 elements remained in the sub-multitude of the southeast. As Figure 10 shows, the population and the number of financial institutions prove to be in stochastic relationship with the aggregated cluster value of the local currencies in this quarter.

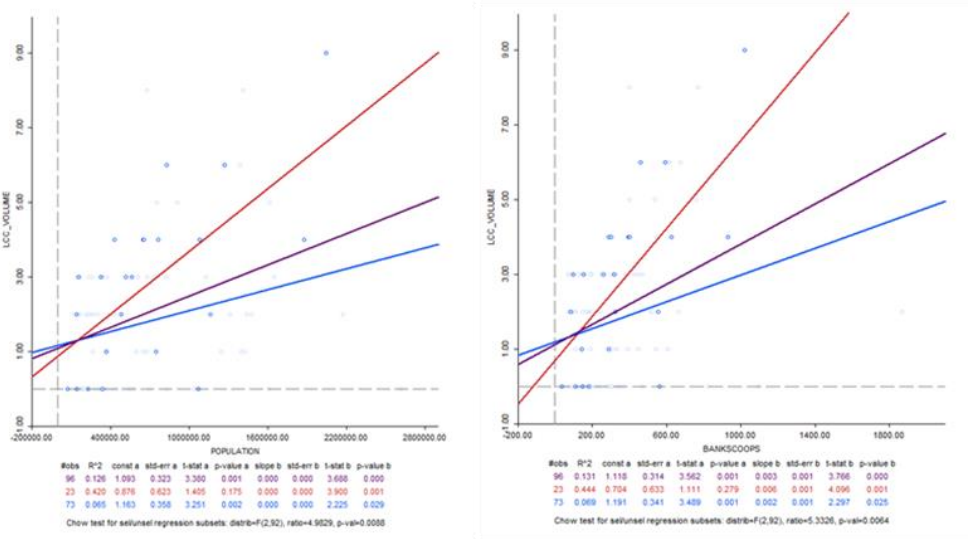

Figure 10: Relationship between the aggregated cluster value of local currencies, as dependent variable, and the population and number of financial institutions as dependent variables (Notes: in purple: correlation in the whole country; in red: correlation in the southeast; in blue: correlation in the rest of the country). Source: own editing.

At the regional level and for a lower number of LCs, Simon (2018) concluded that the number of LCs was positively affected by the population size and the percentage of organic agriculture fields, while it was negatively affected by the income per capita. Our method differs notably with that of Simon (2018): the analysis uses departmental breakdown and it relies on the criteria of aggregate cluster value of LCs in each department. Our findings tend to confirm the positive role of pro-environment indexes as well as that of the overall population (having excluded the departments of the Île-de-France region) and adds a few other explanations, which are diverse in different quarters of the country.

Based on the correlation analyzed above, we can state indeed that different factors are interrelated with the spatial concentration of local currency schemes within different quarters of France. In the northwest, four variables (population, number of financial institutions, number of small shops and recycling rate) are in a positive relation and one variable (rate of population geographically remoted from basic healthcare service) is in a negative one with the aggregated cluster value of LCs per department. This may mean that the use of LCs is notably related to a concern over the environment, to vibrant local economies, in the context of a higher access to conventional financial infrastructure/services, while they are less common in sparsely populated areas. In the southwest, one proxy for the social conditions (inequality rate) implies that mainly social considerations are relevant within this quarter of the country, though it seems impossible to give a straight interpretation to this relationship. In the southeast, geographic and economic conditions are found to be relevant; the bigger the population, and the more there are financial institutions, the higher aggregated cluster value of circulating LCs may be observed.

The spatial heterogeneity of France has been analyzed so far in regard to the aggregated cluster value of LCs per department. We also took into consideration the sum of existing schemes and projects in the making at departmental level, as another dependent variable instead of the aggregate value of circulating local currencies. Yet this can be spatially modeled in a limited way only. As Appendix 2 shows, in this new configuration the chosen dependent variable is spatially auto-correlated in form of spatial lag. This means that the aggregate number of LCs (existing ones and future projects) in the neighboring departments explains to a certain extent the aggregate number of LCs in any given department. While national networks do exist, as the above-mentioned Mouvement SOL and Réseau MLCC, which may support the spreading of LCs all over the French territory, closer social networks between activists may play a major role in the implementation of LC projects in neighboring areas.

We can also see that the aggregated cluster value of the existing LCs, the population and the part of population geographically remoted from basic healthcare services, as independent variables, can only weakly explain the estimated number of future schemes in regard to the whole country. Based on this result, we can forecast that the spatial concentration of the newly implemented local currencies in France will continue in the upcoming years along the lines and trends of the existing schemes. In other words, wherever the number of small LCs (i.e. with a low size index) is relatively high, more launches of new schemes could be observed in the near future, while in those areas where fewer but higher volume LCs operate, the already functioning schemes will most probably grow further instead of the inauguration of new ones. This analysis implies that in the northeast, where both the aggregate number and cluster value of LCs are modest, fewer new projects should be expected to be launched in the near future too.

5. CONCLUSION

The recent wave of local currencies, which spread in a dozen countries in the past decades, proved to be particularly fertile in France since the outbreak of the latest 2008 financial crisis. At the end of 2018, within a decade, 74 schemes were circulating, 11 had been shut down, and there were still dozens of projects under way (of which it is however impossible to assess how many would be launched). The existing local currency systems are diverse not only in terms of their size and volume but also of their spatial distribution. In section 3, we illustrated statistically the spatial autocorrelation of their aggregated cluster value calculated at departmental (NUTS-3 regional) level that is in accordance with the broader socioeconomic context of the territorial conditions within the country.

The spatial autocorrelation motivated our further analysis in section 4. Remaining in departmental breakdown, we tried to model those socioeconomic characteristics that influence the aggregated cluster value of the functioning local currencies, by using regression analysis with different data as proxy variables. We had to conclude that this attempt to modeling failed due to different reasons. However, by dividing the country into four parts spatially and excluding the central region of Île-de-France (which mostly corresponds with the urban area of Paris), we found some correlation between the aggregated cluster value and certain independent variables within three quarters, namely in the northwest, southwest and southeast. The stochastic relationship between the dependent and independent variables differ in these parts, which underpins the observation of a spatial heterogeneity.

The fact that various relations are found within different quarters of France implies that the inner territorial diversity of the country might be concerned separately as well. Three main more specific conclusions can be summarized here: 1) spatial proximities positively affects the evolution of local currencies in terms of number of schemes or volume, 2) the number and the size of LCs is not associated to poverty and crisis at the national level, since they are

generally more developed in areas with stronger socio-economic conditions; however, a higher inequality rate in the southwest is associated to a higher cluster value of LCs, 3) their development is associated to environmental concerns by the population in some parts of France.

Getting more sophisticated picture about the context and background would require further analyses, either statistical and/or econometric ones, with a finer-grained breakdown than the departmental one, and combined with a socio-economic analysis of the various cases of LCs. The main point of this paper is that further research on local currencies must take into account not only the observed variety of their characteristics, but the spatial heterogeneity based on their location as well. Given the limitations of the departmental breakdown to get a fine-grained spatial analysis of LCs, the next step should be to go down to a lower level such as employment areas or catchment areas, that is, a closer level to the territories wherein local currency schemes are actually implemented.

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Further sources

Institut national de la statistique et des études économiques (INSEE)

https://www.insee.fr/en/accueil

Mouvement SOL

http://www.sol-reseau.org/

Réseau des monnaies locales complémentaires citoyennes

http://monnaie-locale-complementaire-citoyenne.net/

Appendix 1: The original database

Thanks to Marc Abel, webmaster of the MLCC network website, we could use the basic data which the general map of French local currencies' ongoing experiences, past experiences and projects is built on (names of projects, web-links, GPS data; data retrieved May 18th, 2018).

We checked the data and completed the database regarding the circulating currencies during the year 2018 (thus excluding the local currencies that had been stopped and the projects that had not led to a launch as of end 2018). We added a series of data (money supply, number of providers, number of individual users) gathered through the websites of the schemes, reports from general assemblies and management committees, press releases, articles

from journalists, reports, academic studies and personal observations. As we had many cases with missing information on one or more of the three requested data, we completed the missing information by estimations based on averages calculated for each cluster of local currencies. We estimated that using averages by clusters reduced a fair part of the errors that the use of overall averages would have produced, provided that the sharp differences between local currencies leads to medians much lower than averages. Gathering the 75 cases through 5 clusters helped to solve the problem of the necessary approximation of the data.

Appendix 2: Standard and spatial lag model estimation for the sum of existing schemes and projects underway at departmental level

Independent variables: aggregated cluster value in 2018, population in 2018, part of population geographically remoted from basic healthcare service centers in 2016, and the spatial lag of the dependent variable.

```
SUMMARY OF OUTPUT: ORDINARY LEAST SQUARES
-----------------------------------------
Data set            :map_time_exploration2.dbf
Weights matrix      :File: map_time_exploration2_.gal
Dependent Variable  :   EXIS_PROJ                Number of Observations:          96
Mean dependent var  :      1.5938                Number of Variables   :           4
S.D. dependent var  :      1.3733                Degrees of Freedom    :          92
R-squared           :      0.3725
Adjusted R-squared  :      0.3520
Sum squared residual:     112.420                F-statistic           :     18.2048
Sigma-square        :       1.222                Prob(F-statistic)     :   2.348e-09
S.E. of regression  :       1.105                Log likelihood        :    -143.797
Sigma-square ML     :       1.171                Akaike info criterion :     295.594
S.E of regression ML:      1.0821                Schwarz criterion     :     305.851

------------------------------------------------------------------------------------
            Variable     Coefficient       Std.Error     t-Statistic     Probability
------------------------------------------------------------------------------------
            CONSTANT       1.1072313       0.5078783       2.1801116       0.0318013
          LCC_VOLUME       0.2705860       0.0608124       4.4495192       0.0000241
          POPULATION       0.0000004       0.0000003       1.2392019       0.2184228
          REMOTENESS      -0.0297457       0.0222144      -1.3390267       0.1838611
------------------------------------------------------------------------------------

REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER            9.820

TEST ON NORMALITY OF ERRORS
TEST                             DF        VALUE           PROB
Jarque-Bera                       2         268.485          0.0000

DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS
TEST                             DF        VALUE           PROB
Breusch-Pagan test                3          12.811          0.0051
Koenker-Bassett test              3           2.828          0.4189

DIAGNOSTICS FOR SPATIAL DEPENDENCE
TEST                           MI/DF       VALUE           PROB
Lagrange Multiplier (lag)         1          11.398          0.0007
Robust LM (lag)                   1          13.880          0.0002
Lagrange Multiplier (error)       1           3.134          0.0767
Robust LM (error)                 1           5.616          0.0178
Lagrange Multiplier (SARMA)       2          17.013          0.0002

================================= END OF REPORT =====================================
```

```
SUMMARY OF OUTPUT: SPATIAL TWO STAGE LEAST SQUARES
----------------------------------------------------
Data set            :map_time_exploration2.dbf
Weights matrix      :File: map_time_exploration2_.gal
Dependent Variable  :   EXIS_PROJ               Number of Observations:          96
Mean dependent var  :      1.5938               Number of Variables   :           5
S.D. dependent var  :      1.3733               Degrees of Freedom    :          91
Pseudo R-squared    :      0.4406
Spatial Pseudo R-squared:  0.4425

------------------------------------------------------------------------------------
            Variable     Coefficient       Std.Error     z-Statistic     Probability
------------------------------------------------------------------------------------
            CONSTANT      -0.2969652       0.5778587      -0.5139062       0.6073176
          LCC_VOLUME       0.1642338       0.0619998       2.6489420       0.0080744
          POPULATION       0.0000005       0.0000003       1.6671724       0.0954801
          REMOTENESS      -0.0052603       0.0215017      -0.2446452       0.8067311
         W_EXIS_PROJ       0.7971672       0.1880300       4.2395746       0.0000224
------------------------------------------------------------------------------------
Instrumented: W_EXIS_PROJ
Instruments: W_LCC_VOLUME, W_POPULATION, W_REMOTENESS

DIAGNOSTICS FOR SPATIAL DEPENDENCE
TEST                           MI/DF       VALUE           PROB
Anselin-Kelejian Test              1          9.214          0.0024
```

ENDNOTES

i - Only local currencies, as defined above, are considered here. Figures would be very different if all kinds of complementary currencies were taken into account.

Ii - Mouvement SOL. See http://www.sol-reseau.org/

Iii - It notably started to organize yearly encounters between LC promoters and local governments representatives.

iv - Réseau MLCC. See http://monnaie-locale-complementaire-citoyenne.net/

v - See the "Manifeste pour les monnaies locales complémentaires (MLC) et citoyennes (MLC)", http://monnaie-locale-complementaire-citoyenne.net/adhesion-mlcc/

vi - See http://monnaie-locale-complementaire-citoyenne.net/france/

vii - It seems for example that the club of LCs of Cluster 5 would be mostly limited to the Eusko and the German Chiemgauer. Data misses so far to build a general international comparison of LCs' sizes. International comparisons would require correcting data with purchasing power parities.

viii - The départements (departments, or counties) are an administrative subdivision of the French territory, characterized by an elected assembly and a government and by deconcentrated State services as well. The metropolitan (i.e., European) area of France is made of 96 departments.

ix - INSEE: Institut national de la statistique et des études économiques – the central statistical office in France

x - Simon (2018) developed a model of the number of LCs based on the French regions, which are administrative and political subdivisions of the French territory whose space corresponds with a grouping of a certain number of departments. Since 2016, Metropolitan France is divided into 13 regions (they were 22 up to 2015). As local currencies' claimed territories are usually much smaller than region (with the only exception of the Rollon), we considered this level too high for a relevant analysis.

xi - In France, middle towns generally refer to urban areas whose population ranges between 20,000 and 100,000 inhabitants.

xii - Commissariat général à l'égalité des territoires (General commission on territorial equality).