FROM THE MAIN DETERMINANTS OF SELF-DECLARED MINIMUM INCOME TO THE MEASURE OF SUB-NATIONAL PURCHASING POWER PARITY

BY CLÉMENT CARBONNIER*

Université Paris 8 Vincennes - Saint-Denis, LED

Exploiting a French living condition survey from 2008 to 2015, this paper documents the main determinants of self-declared minimum income necessary to achieve decent living. Declared minimum income is strongly related to actual income. Isolating this relationship, it is possible to highlight the other determinants: family composition, housing tenure, socioprofessional status, region, and degree of urbanization. A sub-national measure of purchasing power parity is then developed. From a macroeconomic point of view, it leads to lower Gini index and higher rate of poverty in PPP terms than in nominal terms. However, these changes are heterogeneous, with increased poverty concentration around Paris, Mediterranean coast, and in the North. It is worth noting that the North, the poorest region in nominal terms, presents relatively low price of housing but a relatively high cost of living.

JEL Codes: I31, I32, R23

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1. INTRODUCTION

The present paper seeks to assess the main determinants of self-declared minimum income—understood as minimal resources necessary to achieve decent living—and to use, among these determinants, those related to geography to build a measure of sub-national purchasing power parity.

The comparison of purchasing power across different communities has challenged economic theory since a long time. It has been extensively discussed from an international point of view (Taylor and Taylor, 2004; Burstein and Gopinath, 2014). One of the main issues is to consider the divergence in the qualitative consumption between countries. Such divergence may come from geographical or climate differences: the need for snow removing or house heating is larger in Canada than in Spain. It may also come from different public provision of goods and services: the need for private expenditure related to health is lower under the Sweden universal health care system than in the US. Cultural differences may also generate

differences in consumption baskets. Usual international comparisons try to consider the basket definition through a double asymmetrical comparison of prices (OECD and Eurostat, 2012): first is computed the relative price between country A and country B for the reference basket in country A, then is computed the relative price for the reference basket in country B, with the PPP index being computed from the geometric average of the two measures.

Such basket composition issues may also arise when comparing different territories of the same country. More than local cultural differences, disparities in terms of geographic or urban characteristics, as much as in terms of local public goods, create differences in needs. Therefore, it is not possible to compare purchasing power by only comparing local prices for a reference basket of commodities, because the reference basket varies across regions. In that matter, the use of local consumption price indexes (CPI) may induce biases because they usually compare similar baskets in different locations. Furthermore, Handbury and Weinstein (2015) point out that not only price but also diversity matter for utility derived from consumption. They compute a price index for food accounting for availability, diversity, and substitution possibilities. They find that utility derived from food consumption is cheaper in larger cities. However, their measure—as main local CPIs—excludes housing consumption, although it constitutes a great share of households' budgets. Suedekum (2006) includes a housing good in the seminal economic geography model of Krugman (1991) and shows that although prices are lower in the core (metropolitan areas) than in the periphery (rural areas) in usual new economic geography models, taking housing into account inverses the result and induces higher prices in the core. Moretti (2013) builds on the large rise of housing prices in largest cities and the urban segregation according to diploma to argue that the growth of wage inequality in the US has been lower in real terms than in nominal terms. In the opposite, Albouy *et al*. (2016), analyzing the correlation between housing rental growth and the income of the tenants, conclude that the worse-off in terms of income have been the more deeply affected by the housing cost increases.

The present paper aims at assessing the infra-national purchasing power parity, without making assumption on the local reference basket of commodities. The estimation method relies on self-declared minimum income, comparing them with the actual households' income. This intersection method has been developed by Goedhart *et al*. (1977) for estimating the poverty line. Indeed, the measurement of poverty necessitates determining the level of resources necessary to achieve basic needs. However, this level is difficult to assess because it is not constituted of objective necessaries independent from period and societies, as would be the minimal calories needed to keep alive. The basket of necessaries rather depends on social norms differing from countries and periods. In that matter, early authors have pointed out the relative dimension of necessaries, such did Smith (1977 edition, 1776.):

> "*By necessaries I understand not only the commodities which are indispensably necessary for the support of life, but what ever the custom of the country renders it indecent for creditable people, even the lowest order, to be without*."

Marx ([1867](#)) has a similar view when he defines the subsistence wage:

"*His* [the labourer] *natural wants, such as food, clothing, fuel, and housing, vary according to the climatic and other physical conditions of his country. On the other hand, the number and extent of his so-called necessary wants, as also the modes of satisfying them, are themselves the product of historical development, and depend therefore to a great extent on the degree of civilisation of a country, more particularly on the conditions under which, and consequently on the habits and degree of comfort in which, the class of free labourers has been formed.*"

Furthermore, Sen ([1983](#)) includes the issue of poverty thresholds—and consequently the definition of what should be considered as necessaries—within the concept of capabilities. The necessaries are linked to the capabilities and not to the actual consumption, while capability differences may stand at an individual level but also at an inter-community level. Amartya Sen gives the example of a community where car owning affects the social choice in the matter of public transportation, then affecting the necessity of cars. Such example fits the purpose of the present article because local necessaries are strongly determined by local public goods.

Allen ([2017](#)) discusses the potential international biases of the World Bank Poverty Line (WBPL) and develops a country by country Basic Need Poverty Line (BNPL): a food reference budget is estimated by linear programming, and a non-food reference budget considers housing market differences and needs linked to the weather. Comparing various regions in the world, Allen ([2020](#)) shows that BNPL is much higher in Asia than in Africa. Therefore, the WBPL, estimated on African countries, probably underestimates extreme poverty in Asia.

As a consequence of the relative definition of necessaries, official poverty thresholds are often determined in relative terms. Nevertheless, purely relative measures also present weaknesses, as shown by the historical example of the Dutch Hunger winter of 1944–1945. During this period, famine hurts such a large share of the population that relative poverty thresholds would have been very low and so would have been the relative poverty measures (Stein *et al.*, [1975](#)). A broad literature has been developed to build measures of poverty or to discuss their weaknesses.[1] For example, Garner and Short ([2010](#)) produce poverty thresholds as a percentage of median expenditures for a specified basic bundle of goods and services by a reference household (thresholds for other households were produced using an equivalence scale). They report that combining these thresholds with resources results in higher poverty rates than those resulting from applying the official poverty measure for the US for 1996–2005.

Among the different approaches, Goedhart *et al.* ([1977](#)) develop the intersection method based on the principle of extracting information from the subjective declarations of well-being documented by Van Praag ([1968](#)). The principle is to confront declared minimum income with actual income. The authors observe that the relationship is log-linear, allowing to define the intersection as the actual

[1]For a broader discussion of debate over poverty measures, see Ravallion ([2016](#))'s discussion over achievements and challenges remaining.

necessary income. This assessment is defended by the argument that only house-holds exactly at the minimum income can know it. This method has been used for various purposes: de Vos and Garner (1991) compare poverty measures in the US and the Netherlands, and Bishop *et al*. (2014) produce equivalence scales in the Eurozone. The present article relies on this method to assess territorial differentials in costs of living. Such a method may be biased if actual income is misreported (Kapteyn *et al*., 1988), but the present estimations are computed, thanks to income tax declarations, which contain much less underreporting than survey declarations (Piketty, 2020). Another source of bias may come from the way questions are asked (Garner and Short, 2003, 2004), but the question in the survey exploited here cor-responds to the formulation the least biased and the source of actual measure is adapted to the subjective question.

The database presently exploited is the SRCV survey for years 2008–2015. It corresponds to the French part of the European SILC-EU survey—plus additional variables—collected by INSEE, the French statistical administration. Noticeably, it provides precise income and tax data for a representative sample of households, merged with their region of inhabitancy and the size of the urban unit they live in. Data on family composition are also included, in addition to the socioprofessional status, the size of housing, and its housing tenure. A specific item of the survey provides the self-declared income necessary to make ends meet.

The principle of the assessment consists in disentangling the main determinants of this self-declared minimum income and to isolate the impact of the localization of the households. That for, it is of prime importance to control for the impact of the actual income on the self-declared minimum income. This can be done thanks to a very robust statistical stylized fact. When comparing self-declared minimum equiv-alized income and actual equivalized income, a log-linear relationship appears—with the slope of 0.4—very stable across the French territory. This means that whatever the region of inhabitancy and the size of the urban unit, a household with a 10 percent greater equivalized income declares a 4 percent greater minimum equival-ized income. This phenomenon may be explained by the habituation of households to their actual equivalized income. Such habituation leads households having more than the local minimum income to consider some superfluous expenditure as neces-sary: they overestimate the local minimum income. Conversely, households having less than the local minimum income consider some necessary expenditure they can-not afford as superfluous: they underestimate the local minimum income.

Following this interpretation, the "*true*" local minimum equivalized income should lie at the intersection of the self-declared minimum and the actual equiv-alized incomes. An econometric method is developed to estimate this fixed point. This method is applied on French data to assess the infra-national purchasing power parity, with reference to Paris (PPPP).

Then I test the way this PPPP index affects the national measures of inequali-ties and poverty. From a macroeconomic point of view, considering infra-national PPP leads to a decrease in main inequality indexes but an increase in the rate of poverty measured at 60 percent of the median equivalized income. However, these changes are very heterogeneous across the territory, with increased concentration of poverty in metropolises and more broadly in the Parisian region, around the Mediterranean coast and in the *Nord-Pas de Calais*.

The rest of this article is organized as follows. The second section presents the SRCV survey, and descriptive statistics are detailed. The third section presents the empirical strategy used to estimate the local minimum equivalized incomes. The fourth section assesses these local minimum equivalized incomes for France and analyzes the consequences in terms of poverty and real income inequality measurement, then more precisely assesses the territorial inequalities in terms of standard of living. The last section concludes and discusses the scope of the results.

2. TERRITORIAL ECONOMIC DISPARITIES

2.1. *Database on Household Living Condition*

The survey "*enquête sur les revenus et les conditions de vie des ménages*" (SRCV) is exploited to assess the territorial economic disparities and the local cost of living. From this face-to-face survey collected yearly by INSEE (the French statistical agency), the French part of the European panel on living conditions (SILC-EU) under the Eurostat supervision and harmonization is extracted. Vintages from 2008 to 2015 are used in the present paper; 2015 is the last available vintage. Before 2008, actual income data were reported by the interviewed household although it is matched with administrative databases since. Consequently, there was a substantial under-reporting of income in SRCV surveys until 2007, which may be observed in the data through a strong income jump between 2007 and 2008.

After cleaning the database by dropping observations with a missing value for localization, each vintage contains around 8000 observations at the household level, with the exception of the 2015 vintage containing 10,153 observations. The aggregated dataset contains 65,793 observations and a rich set of variables, including both quantitative figures of income, taxes, expenditure for housing, etc. and qualitative characteristics of living conditions. The quantitative variables are extracted from tax databases (although some are declared as for example the overall debt amount or the size of housing) and the qualitative variables are declared and reflect the way households felt their own living conditions.

The Main Control Variables

Importantly, the database includes geographical information concerning the location of the surveyed household's home. France is divided into eight major regions.[2] In addition, the size of the inhabited urban unit is specified. Urban units

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[2]These are the eight NUTS1 regions of the NUTS classification (Nomenclature of territorial units for statistics), a hierarchical system developed by Eurostat for dividing up the EU territory for the purpose of: (*i*) collection, development, and harmonization of European regional statistics; (*ii*) socioeconomic analyses of the regions; and (*iii*) framing of EU regional policies. The three embedded levels are: NUTS 1, major socioeconomic regions; NUTS 2, basic regions for the application of regional policies; NUTS 3, small regions for specific diagnoses. Before the 2016 reform, there were 22 continental regions (corresponding to NUTS2) in the French administrative structure. The NUTS1 regions were grouping of these administrative regions: the Parisian region (*Ile de France*), the Center (*Picardie, Champagne-Ardennes, Bourgogne, Centre, Haute-Normandie, Basse-Normandie*), the North (*Nord-Pas de Calais*), the East (*Alsace, Lorraine, Franche-Comté*), the West (*Bretagne, Pays de Loire, Poitou-Charente*), the South-West (*Limousin, Aquitaine, Midi-Pyrénées*), the Center-East (*Auvergne, Rhône-Alpes*), and the Mediterranean coast (*Provence-Alpes-Cote d'Azur, Langudoc-Roussilon, Corse*).

are delimited by INSEE according to continuity of construction: are attached to the same urban unit all building distant from each other by less than 200 m.[3] The units with fewer than 2000 inhabitants are reported as rural. For the statistical assessment presented below, the urban units are categorized into three groups such that each contains approximatively the same number of inhabitants. The small urban units are those with fewer than 5000 inhabitants, the large ones are those with more than 200,000 inhabitants, and the medium ones between 5000 and 200,000 inhabitants. Crossing size of urban units with regions allows one to define 24 territories, whose geography is presented in Figure 1. The territorial distribution of observations (weighted and non-weighted) is reported in Table 1.

The center of the Parisian region constitutes a very large urban unit, accounting for a large share of the population and observations. In contrast, there are few inhabitants and observations for small and medium urban units of the Parisian region. This prevents getting robust estimates for these two territories. The North and Mediterranean coast also contain a low number of small urban unit households—but sufficient to get estimates—although the number of rural households is very large in the West and Center regions. For the medium and large urban units, all regions have similar—and large—number of observations.

The survey also includes data on the socioeconomic characteristics of the households. The main variables used for the present study are the housing tenure, the family composition, and the socioprofessional category. The housing tenure may be (*i*) owner, (*ii*) tenant at market price, (*iii*) benefiter of social housing, or (*iv*) housed for free. The distributions of housing tenure among regions and degrees of urbanization are reported in Table 2.

The share of owners is much larger in small urban units than in medium and large ones. The share of social housing tenants is greater in larger urban units. The difference between regions may be mainly explained by the composition in terms of size of urban units, with the exception of the Mediterranean coast: this region of the South-East of France presents a low share of households of small urban units but a very large share of owners.

Concerning the family composition, the categories are structured as follows: (*i*) single without a child, (*ii*) single with children, (*iii*) couple without a child, (*iv*) couple with children, and (*v*) large families. The category of large families contains couples with at least three children. The distribution of family compositions among regions and degrees of urbanization is reported in Table 3

The larger number of observations for the 2015 vintage appears on that table. The shares of each type of family composition remain very stable all along the period. Households are mainly without children—one-third singles and one-third couples—as the last third of families is composed of 61.0 percent of couples with one or two children, 16.4 percent of singles with children, and 22.6 percent of couples with three or more children.

The socioprofessional categories in the SRCV survey correspond to the French statistics classification which differs from the ISCO-08 classification of the International Labor Organisation (ILO). Category 1—*agriculteurs exploitants*—is

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[3]http://www.insee.fr/en/methodes/default.asp?page=definitions/unite-urbaine.htm.

TABLE 1
TERRITORIAL DISTRIBUTION OF OBSERVATIONS

		Nuts 1 Region							
	All	Paris	Center	North	East	West	Center East	South West	Mediterranean coast
Unweighted sample									
Households	65,793	9159	12,602	4869	6147	10,816	7978	7272	6950
Share of observations									
All	100.0	13.9	19.2	7.4	9.3	16.4	12.1	11.1	10.6
Large	36.0	12.0	3.2	4.2	2.3	2.4	3.2	3.8	4.8
Medium	29.4	1.1	6.3	1.9	3.1	5.3	4.2	3.6	3.9
Small	34.7	0.8	9.7	1.3	4.0	8.7	4.7	3.6	1.8
Weighted sample									
Households	156.6M	28.1M	27.5M	11.9M	14.5M	23.7M	17.9M	16.4M	16.6M
Share of observations									
All	100.0	13.9	19.2	7.4	9.3	16.4	12.1	11.1	10.6
Large	43.2	12.0	5.8	4.1	3.0	4.8	3.6	4.6	5.3
Medium	27.8	1.5	5.5	2.3	3.4	4.6	3.6	3.2	3.7
Small	28.9	0.4	7.9	1.0	2.9	7.0	4.9	3.2	1.6

Notes: The regions are the eight French continental NUTS 1. Small urban units contain fewer than 5000 inhabitants, medium ones between 5000 and 200,000, and large ones more than 200,000 inhabitants.
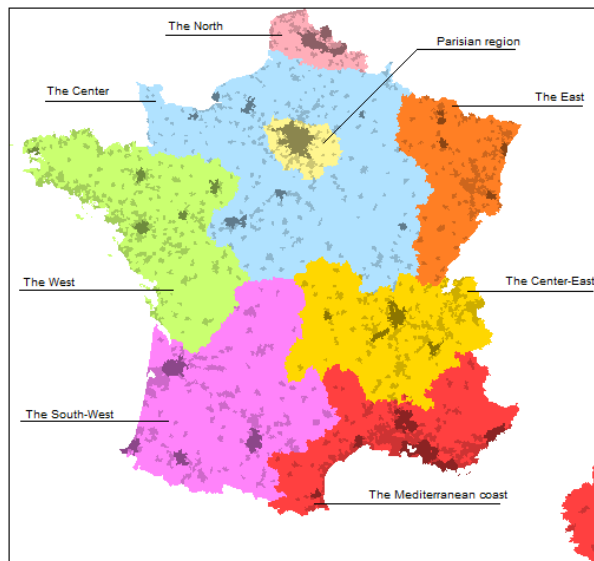*Source*: SRCV 2008–2015.

Figure 1. Map of the Studied Territorial Units.

Notes: The regions are the eight French continental NUTS 1: the Parisian region in khaki, the Center in blue, the North in pink, the East in brown, the West in green, the South-West in purple, the Center-East in gold, and the Mediterranean coast in red. Small urban units contain fewer than 5000 inhabitants (represented with the lightest colors), medium ones between 5000 and 200,000, and large ones more than 200,000 inhabitants (represented with the darkest colors).

Source: SRCV 2008–2015. [Colour figure can be viewed at wileyonlinelibrary.com]

composed of self-employed of the farming industry; it is called "farmers" in the rest of the article. Category 2—*artisants, commerçants et chefs d'entreprises*—is composed of self-employed or small business owners in other industries; it is called "self-employed." Category 3—*cadres et professions intellectuelles supérieures*—is composed of managers and professionals, mainly in skill level 4 of the ILO classification; it is called "high-skill." Category 4—*professions intermédiaires*—is composed of technicians and associate professionals, mainly in skill level 3 of the ILO classification; it is called "medium-skill." Category 5— *employés*—is composed of clerical support workers, services and sales workers, and elementary occupations, mainly in skill levels 1 and 2 of the ILO classification; it is called "low-skill." Category 6— *ouvriers*—is composed of plant and machine operators and assemblers; it is called "blue collar." Category 7 is composed of retirees and category 8 of non-retired inactive people. For each household is given the socioprofessional status of the self-declared household's head. The distribution of household's head socioprofessional status across the French territory is presented in Table 4.

About one-third of self-declared heads of the household are retired. The share of self-employed is low as well as the share of inactive, and more than half of the household's heads are salaried. The salaried are distributed in a similar share between high-, medium-, and low-skill and blue collar. However, this distribution is heterogeneous across the territories. Not surprisingly, farmers may be found only in urban units with fewer than 5000 inhabitants; from a regional point of view,

TABLE 2

HOUSING TENURE PER REGION AND SIZE OF URBAN UNIT

	Housing Tenure									
	All	Owner	Market Price	Social Housing	Free	All	Owner	Market Price	Social Housing	Free
	Unweighted Sample					Weighted Sample				
All	100.0	68.6	14.5	14.1	2.8	100.0	64.5	16.6	15.8	3.2
Size of the urban unit										
Large	36.0	20.6	6.8	7.4	1.1	40.6	21.7	8.4	9.0	1.4
Medium	29.4	19.6	4.8	4.2	0.8	29.3	18.6	5.3	4.5	0.9
Small	34.7	28.5	2.9	2.4	0.9	30.1	24.2	2.9	2.2	0.9
Region of inhabitancy										
Parisian region	13.9	7.8	2.2	3.3	0.5	18.0	9.4	3.4	4.4	0.8
Center	19.2	13.7	2.5	2.5	0.4	17.6	12.1	2.5	2.5	0.4
North	7.4	4.6	1.3	1.2	0.2	7.6	4.4	1.5	1.4	0.3
East	9.3	6.3	1.5	1.3	0.3	9.2	5.8	1.7	1.4	0.4
West	16.4	12.4	2.2	1.6	0.2	15.1	11.0	2.3	1.6	0.2
Center-East	12.1	8.8	1.6	1.3	0.4	11.5	7.9	1.8	1.4	0.4
South-West	11.1	7.7	1.6	1.5	0.3	10.5	7.0	1.7	1.5	0.3
Mediteranean	10.6	7.1	1.6	1.4	0.4	10.6	6.9	1.7	1.6	0.4

Notes: The regions are the eight French continental NUTS 1. Small urban units contain fewer than 5000 inhabitants, medium ones between 5000 and 200,000, and large ones more than 200,000 inhabitants.

Source: SRCV 2008–2015.

TABLE 3

FAMILY COMPOSITION PER REGION AND SIZE OF URBAN UNIT

Years	All	2008	2009	2010	2011	2012	2013	2014	2015
Unweighted sample									
All	100.0	11.4	11.6	12.1	12.4	13.0	11.9	12.2	15.4
Single no child	30.2	3.3	3.4	3.6	3.7	3.9	3.6	3.7	4.8
Couple no child	34.7	3.8	3.9	4.2	4.3	4.6	4.3	4.4	5.2
Single parent	5.4	0.6	0.6	0.6	0.7	0.7	0.6	0.7	0.9
Couple 1–2 child(ren)	21.1	2.6	2.5	2.6	2.6	2.7	2.4	2.4	3.2
Large family	8.6	1.1	1.0	1.1	1.1	1.1	1.0	1.0	1.2
Weighted sample									
All	100.0	11.8	12.0	11.9	12.1	12.1	11.7	11.9	16.3
Single no child	36.5	4.2	4.2	4.4	4.4	4.5	4.4	4.4	6.0
Couple no child	32.5	3.8	4.1	3.9	4.0	4.0	3.8	3.9	5.1
Single parent	5.1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.9
Couple 1–2 child(ren)	18.9	2.4	2.3	2.1	2.3	2.3	2.1	2.2	3.3
Large family	7.0	0.9	0.9	0.9	0.8	0.8	0.8	0.8	1.0

Source: SRCV surveys, 2008–2015.

TABLE 4
SOCIOPROFESSIONAL CATEGORIES PER REGION AND SIZE OF URBAN UNIT

Socioprofessional Category	All	Farmers	Self Employed	High Skill	Medium Skill	Low Skill	Blue Collar	Retired	Inactive
Unweighted sample									
All	100.0	1.2	3.2	11.9	15.1	12.1	14.4	35.0	7.1
Size of the urban unit									
Large	36.0	0.0	1.1	6.3	5.7	5.0	4.0	11.1	2.7
Medium	29.4	0.1	0.8	2.9	4.3	3.6	4.1	11.2	2.3
Small	34.7	1.0	1.3	2.7	5.1	3.6	6.3	12.7	2.1
Region of inhabitancy									
Parisian region	13.9	0.0	0.4	3.2	2.3	2.2	1.3	3.8	0.8
Center	19.2	0.3	0.5	1.7	2.9	2.1	3.3	7.2	1.2
North	7.4	0.0	0.1	0.8	1.1	0.9	1.4	2.5	0.6
East	9.3	0.1	0.3	0.8	1.5	1.1	1.7	3.2	0.7
West	16.4	0.3	0.6	1.6	2.3	1.8	2.8	6.0	1.1
South-West	12.1	0.3	0.4	1.4	1.7	1.5	1.4	4.4	1.0
Center-East	11.0	0.1	0.5	1.4	1.9	1.2	1.5	3.8	0.7
Mediteranean	10.6	0.1	0.5	1.1	1.5	1.3	1.1	4.2	1.0
Weighted sample									
All	100.0	1.1	4.0	10.7	14.8	12.3	13.7	36.9	6.5
Size of the urban unit									
Large	40.6	0.0	1.6	6.4	6.4	5.8	4.5	13.1	2.9
Medium	29.2	0.1	1.0	2.3	4.1	3.5	3.9	12.1	2.1
Small	30.2	1.0	1.5	1.9	4.3	2.9	5.3	11.7	1.6
Region of inhabitancy									
Parisian region	18.0	0.0	0.5	3.7	3.0	2.9	1.6	5.1	1.1
Center	17.6	0.3	0.6	1.3	2.5	1.9	3.0	7.0	1.0
North	7.6	0.0	0.2	0.6	1.1	0.9	1.4	2.8	0.6
East	9.2	0.1	0.3	0.7	1.4	1.1	1.6	3.4	0.6
West	15.1	0.2	0.7	1.2	2.0	1.7	2.4	5.9	0.9
South-West	11.4	0.3	0.4	1.2	1.6	1.4	1.3	4.5	0.8
Center-East	10.5	0.1	0.5	1.1	1.8	1.1	1.3	3.9	0.5
Mediteranean	10.6	0.1	0.7	0.9	1.5	1.3	1.0	4.3	0.9

Notes: The socioprofessional status is those of the self-declared head of the household. The regions are the eight French continental NUTS 1. Small urban units contain fewer than 5000 inhabitants, medium ones between 5000 and 200,000, and large ones more than 200,000 inhabitants.

Source: SRCV 2008–2015.

they are overrepresented in the Center region (with an overrepresentation of small urban units) but not in the West (the other region with a very large number of small urban units). Instead, there are a large number of farmers in the South-West, a region with a low share of small urban units but with small urban units more dedicated to farming. The other self-employed are distributed across the territory, with a slight overrepresentation in the small urban units. Retired and inactive are also distributed quite fairly, except for an overrepresentation of inactive in the North and around the Mediterranean coast.

For the employees, the medium-skill may be found in the same proportion in all regions and sizes of urban units, although there is clearly more high-skill in the large urban units, particularly in Paris. For the low-skill and blue collar, there is little territorial difference despite weak relationships with the size of the urban unit: there is a little more low-skill in large urban units than in medium ones and little more in medium than in small ones; the order is reversed for blue collar. Low-skill is overrepresented in Paris; blue collar is overrepresented in the Center and North regions but underrepresented in Paris and around the Mediterranean coast.

Income and Tax Variables

Concerning disposable income, different proxies may be calculated. A variable called *disposable income* is directly given, which is latter on called *taxable income* because it is reconstituted by INSEE from tax data (even if a share is actually exempted from taxation). It consists in all income declared to the tax administration, including capital gains and social benefits, minus direct taxes (including social contributions and local taxes but excluding consumption taxes).

From this variable is calculated the *disposable income* by adding the implicit net rental income to the taxable income. The principle of accounting for the implicit net rental income has long been defended in the economic literature, for national accounting (Eisner, 1988)—which is now done by statistical agencies of most developed countries—as much as for measuring income distribution (Yates, 1994). Indeed, home-owning is strongly linked to the inequalities of standard of living (Carbonnier, 2015, 2017, 2019). The basic idea is that the disposable income of a household is the sum of its consumption and the change in its net wealth: thus, consumption of its own housing is an in-kind property income, to which should be subtracted the financial costs, but financial costs only. In the SRCV survey, implicit rents are calculated from hedonic regressions on an external source: the housing survey.[4] Living in one's own housing may also generate costs, such as interests for loans contracted to achieve the permanent residence purchase. Therefore, these costs are deducted from the implicit rent. However, the rest of the mortgage repayment is not deducted as it generates an actual increase in the household's net wealth. For the same reason, the difference between the private market rental value and the actual rent is added to the taxable income of benefiters of social housing for calculating their disposable income. Similarly, the rental value of housing is included in the disposable income of households housed for free.

[4]http://www.insee.fr/en/methodes/default.asp?page=definitions/enquete-logement.htm.
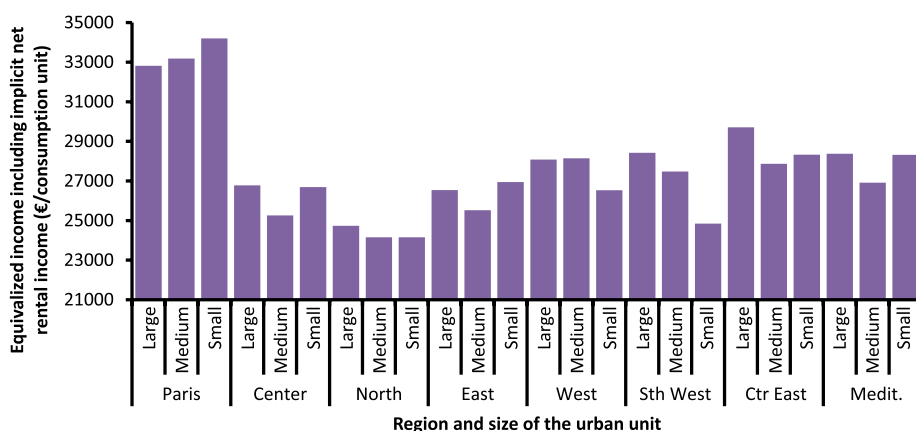
Figure 2. Territorial Disparities in Equivalized Income Including Implicit Rental Value.
Notes: The regions are the eight French continental NUTS 1. Small urban units contain fewer than 5000 inhabitants, medium ones between 5000 and 200,000, and large ones more than 200,000 inhabitants.
Source: SRCV 2008–2015. [Colour figure can be viewed at wileyonlinelibrary.com]

From this disposable income, it is possible to calculate the equivalized income of the household by dividing it by the number of consumption units.[5] This allows comparing mean equivalized income across the French territory. Figure 9 in Appendix A shows the distributions of equivalized income (the equivalized income is attributed to each individual to compute the distributions) in each territory in comparison to the national distribution, for the monetary equivalized income and the equivalized income including implicit net rental income. Despite the impact at the macro level,[6] very little change appears in the territorial distribution of equivalized income. The only visible modification concerns the large urban units of the Mediterranean coast: although they present a distribution of monetary equivalized income very close to the national one, distribution of equivalized income including imputed rents differs substantially from the national one: in this region, there is a lower share of households from the four bottom deciles of the national distribution and a larger share of households from the deciles eight and nine. Indeed, the share of owners is particularly high around the Mediterranean coast (see Table 2) and the rental value of housing is also high in this region (see Figure 3).

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[5]Because data are collected by the French national statistics institute (INSEE), it is appropriate to use their equivalence scale, which is the same as the OECD-modified equivalence scale recommended for use by Eurostat (http://www.insee.fr/en/methodes/default.asp?page=definitions/unite-consomma-tion.htm). This scale counts one unit for the first adult, 0.5 unit for each additional member of the households aged over 14, and 0.3 unit for each additional member of the household aged under 14.
[6]Because the value of housing increases at a slower rate than the monetary income, including implicit net rental value diminishes a little the macro measures of inequalities: a Gini of equivalized income of 28.2 instead of 28.6 and a share of the top decile in the overall equivalized income of 23.0 instead of 23.8. These values correspond to those published annually by Insee.
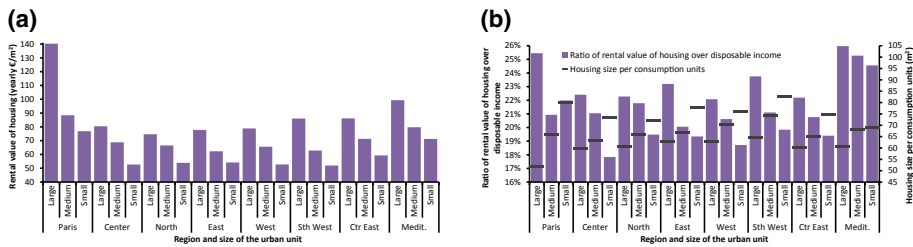
Figure 3. Disparities in Housing Across the French Territory. *a*. Rental value of housing and *b*. Ratio of rental value over disposable income.
Notes: The regions are the eight French continental NUTS 1. Small urban units contain fewer than 5000 inhabitants, medium ones between 5000 and 200,000, and large ones more than 200,000 inhabitants. Housing size in square meters is divided by the modified-OECD scale of the households.
Source: SRCV 2008–2015. [Colour figure can be viewed at wileyonlinelibrary.com]

2.2. *Overview of Geographic Economic Disparities*

In a comparative overview of the territorial distribution of equivalized income across the French territory, Figure 2 shows that the Parisian region is clearly the most affluent; to a lesser extent, the northern region appears to be the poorest. Among the remaining six regions, regional differences are small compared to differences between the categories of territorial units.

Nevertheless, the ordering of urban units within regions is contrasted. The medium urban units present the lower equivalized income in the Center, East, and Mediterranean coast although the small urban units are less affluent in the West and the South-West regions. In the Center-East region, the large urban units spread out as richer than all other territories except the Parisian region.

Housing is an important part of households' budgets. For each territory of study, Figure 3 shows the value of housing (rental value per square meter), the actual consumption in terms of housing size (square meters per consumption unit), and the importance of housing in the budget (ratio of rental value over disposable income).

By construction, the ratio of rental value over disposable income (Figure 3*b*) depends on the rental value of housing per square meter (Figure 3*a*), the size of housing (Figure 3*b*), and the household disposable income (Figure 2). The same pattern appears in all regions, with a rental value per square meter steeply increasing with the size of the urban unit although the size of housing decreases. Despite this lower consumption of space, the ratio of rental value over disposable income substantially increases with the size of the urban unit.

In interregional terms, Paris spread out as the territory with the highest value per square meter and the lowest size of housing. It is also the place of the largest ratio of rental value over disposable income, high above all regions but the Mediterranean coast. This South-East region of France presents the second highest value per square meter for all sizes of urban units, far below the Parisian region but above all others. The size of housing is comparable to other regions for large and medium urban units but slightly lower for small urban units. Therefore, the ratio of

rental value over disposable income is largely higher than in other regions; at the level of large urban unit, it is even higher than in all sizes of Parisian urban units.

These differences in terms of housing affordability—either rented or owned—explain a large share of territorial disparities in cost of living. Yet, Albouy *et al*. (2016) base their territorial comparison of cost of living exclusively on the cost of housing. Nevertheless, other differences matter. Pricing-to-market—at infra-national level—in case of imperfect competition may also generate differences in cost of living. According to monopolistic competition with endogenous elasticity of substitution,[7] the elasticity of substitution between varieties depends on the consumption level and consequently depends on income. Under the most credible assumption—relative love for variety increases with respect to the consumption level—the elasticity of substitution decreases with income (larger willingness to pay for variety) and prices are larger in richer areas.

In addition to cost differences—for housing or the rest of the basket of commodities—variations in cost of living come from the composition of the basket of necessaries: the bundle of needs varies from one region to another, and even more between a center city and the periphery. A first determinant of this basket lies in the environmental factors: the weather—generating different needs for heating—or the ruggedness of terrains. A second is public input: local governments may differently provide public goods or services to the population. This provision partially substitutes to private consumption and therefore reduces the size of the private basket of necessaries. One example is public transportation, allowing one to save private car costs, often of the responsibility of local governments. Disparities in the basket of necessaries may also come from differences in local social habits (Sen, 1983), themselves partially determined by specific needs due to geography or to differences in public input.

3. Empirical Strategy for Estimating the Local Cost of Living

The usual method for evaluating local cost of living consists in comparing the price of a given bundle between regions. Such a method cannot consider differences in consumption needs. The present paper relies on individual subjective data for estimating local minimum equivalized income. The SRCV survey contains an item about the minimum monthly income the household needs to "make ends meet." Before being used for cost of living estimation, the income used in combination with the minimum monthly income question to derive the basic needed budget should be corrected for income not considered by the household, particularly the implicit net rental income if any. The main estimate is implemented with including implicit net rental income in both declared minimum income and actual income. Alternative specifications are run (see Figure 12 in Appendix C), and the results are very similar with all specifications.

Furthermore, the declared minimum income is divided per the number of consumption units of the modified-OECD equivalence scale to obtain the "*declared*

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[7]See Zhelobodko *et al*. (2012) for the development on Dixit and Stiglitz (1977) monopolistic competition model through the concept of relative love for variety.

minimum equivalized income," which is compared to the actual equivalized income. The main estimate is implemented with declared minimum equivalized income and actual equivalized income. Alternative specifications are run with non-equivalized declared minimum income and actual household income (see Figure 12 in Appendix C), and the results are very similar with all specifications.

Most importantly, such subjective declaration is biased by the actual equivalized income of the declaring household through the consumption habits. This is linked to the Easterlin (1974) paradox, whose interpretations highlight income evaluation relative to others: social comparison; or to oneself in the past: habituation (see Clark *et al.*, 2008, for a review). Habituation mechanisms have been defended by several authors including Easterlin (2001), it is defined as "*a reduction in the affective intensity of favorable and unfavorable circumstances*" by Frederick and Loewenstein (1999) and is largely documented in the psychology literature (Kimball and Willis, 2006).

Social comparisons are related to the level of development of a society. It is not considered as a bias because the basket of necessaries is not an atemporal definition based on survival only but is determined by the resources necessary to be fully included within the society. The matter for the present estimation is that these social comparisons take place at the national level and not locally: this assumption is defended below with theoretical arguments and the description of the regional patterns of declarations of minimum income.

3.1. *Principle of the Intersection Method*

Based on this assumption that the social comparison occurred at the national level, it is necessary that the estimation method correct for the habituation bias. The application of the habituation concept to the case of subjective declaration of income necessary to make ends meet is the following: households underestimate their distance to the minimum income, which means that they overestimate the minimum income if they are above and underestimate it if they are under. Households richer than the minimum equivalized income consider some of their actual "luxury" consumption as "necessary" because they are used to it. Similarly, households poorer than the minimum equivalized income are used to live without some necessary consumptions and do not count them as necessary. Such assumption is confirmed when plotting the mean declared minimum equivalized income over the quantiles of actual equivalized income: Figure 4 presents a sample of regions and type of urban units, the whole set is presented in Figures 10 and 11 in Appendix B.

Indeed, the figure draws a very regular log-dependency between declared minimum and actual equivalized incomes. Within each territory, the dots are precisely aligned even at the extremities. Furthermore, the dependency is very similar in each territory: the slope of the log-linear relationship is very close to 0.4. This means that, *ceteris paribus*, a household 10 percent more affluent than another one declares an equivalized minimum income 4 percent higher than this less affluent household.

This justifies the use of the method developed by Goedhart *et al.* (1977), called the intersection method because the principle of the estimation is to consider the intersection between the declared minimum equivalized income and the actual equivalized income as the "true" minimum equivalized income. The authors defend
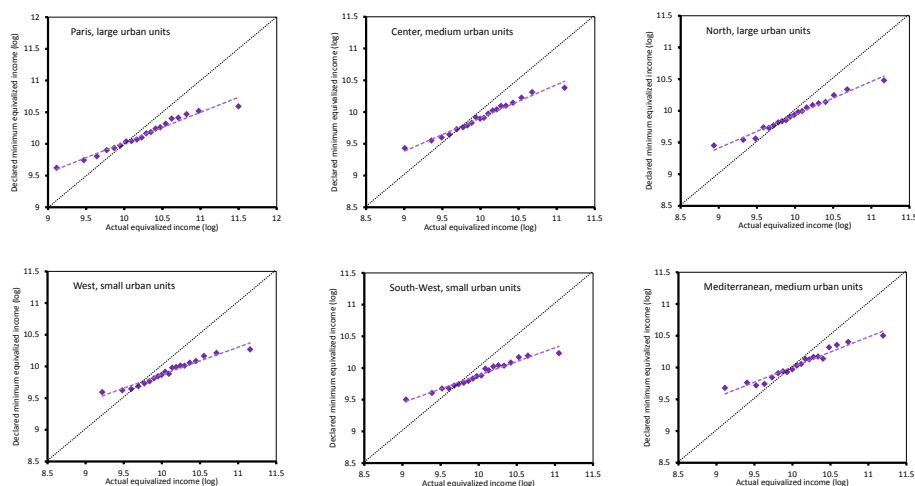
Figure 4. Declared Minimum Equivalized Income *Versus* Actual Equivalized Income.
Notes: Mean of the declared minimum equivalized income for making ends meet (equivalized with the modified-OECD scale, redressed for implicit net rental income, and converted in 2015 Euros) per quantiles (20 bins) of actual equivalized income (from tax returns, including implicit net rental income). Regarding the *x*-axis, the dots are situated at the level of the mean actual equivalized income of the quantile. The regions are the eight French continental NUTS 1. Small urban units contain fewer than 5000 inhabitants, medium ones between 5000 and 200,000, and large ones more than 200,000 inhabitants.
Source: SRCV 2008–2015. [Colour figure can be viewed at wileyonlinelibrary.com]

this by the fact that only households exactly at the minimum income can know it. The precise regularity of the relationship in each kind of territory, in addition to the identical slope, allows extending the interpretation: the households feel if they are above, under, or exactly at the minimum income level, but underestimate their distance to this threshold because of the habituation principle. It appears in the French data that this under-estimation of the distance to the minimum equivalized income is very stable throughout the territory and the distribution of actual equivalized income: the slopes of the curves in Figures 10 and 11 in Appendix B are 0.4, corresponding to an underestimated of the distance by a 60 percent coefficient (a direct test of this territorial stability is presented in the following section).

This method has been used for different purposes. de Vos and Garner (1991) compare poverty measures in the US and the Netherlands. The estimated thresholds are above the official poverty lines in both countries, with a larger difference in the US than in the Netherlands. Bishop *et al*. (2014) measure equivalent scales in the Eurozone: they estimate the basic income for different configurations of households and interpret the relative levels in function of the size of the household as the equivalence scale. Their results depart lightly from the modified-OECD equivalence scale, mainly used in institutional statistics. They find greater economies of scale in countries with more developed welfare states, and that marginal cost of children declines.

Gardes and Loisy (1998) exploit similar data for France and find that the correlation between declared minimum income and actual income is stronger at the middle of the income distribution. However, they used surveys in which actual

income is self-reported. Yet, self-reported actual income is downward biased, and such reporting biases may be different at the different level of the income distribution. The present analysis is not impacted by this potential bias: since 2008, the actual income in the SRCV survey is not self-reported but matched with tax files.

Implementation of the Method

The actual estimation is run following equation 1.

$$(1) \qquad \ln(DMEI_i) = \alpha + \beta \ln(AEI_i) + \sum_t \gamma_t * \mathbb{1}_{[i \in t]} + \sum_c \delta_c * C_i + \epsilon_i,$$

where $DMEI_i$ is the declared minimum equivalized income (plus implicit net rental income if any) of household i and AEI_i its actual equivalized income (also including implicit net rental income); t stands for the 24 French territories defined by the height NUTS1 regions and the three sizes of urban units. The noise term ϵ_i is assumed $i.i.d.$ The control variables C_i include the year of the survey, the socioprofessional category of the household, its composition,[8] the housing tenure—owner, tenant at market price, or tenant below the market price—and a centrality measure. Indeed, France is divided into 24 territories according to regions and sizes of urban units, which are therefore large territories. A share of within territory heterogeneity is captured by this centrality measure. Combes *et al.* (2019) highlight the existence of sharp within-city distance gradients for house and land prices. The centrality measure builds on these gradients. For each territory, the mean rental value per square meter of housing is measured, and then the centrality measure is computed as the ratio of the rental value per square meter of the household's house on the mean rental value in its territory. The main estimate is implemented with controlling for centrality, but alternative specifications are run (see Figure 13 in Appendix C) and the results are very similar with and without this measure.

Following this regression, the local minimum equivalized income $LMEI_t$ in territory t is computed according to equation (2).

$$(2) \qquad LMEI_t = \exp\left(\frac{\alpha + \gamma_t + \sum_c \delta_c * \overline{C}_t}{1 - \beta}\right) = f_t(\theta),$$

where $\overline{C}_t$ is the average of control C in territory t and θ is the vector of regression coefficients. For estimating the standard errors of the estimates, it is possible to derive the Taylor series of function $f(\theta_t)$ between the estimated point $\hat{\theta}_t = (\hat{\alpha}, \hat{\beta}, \hat{\gamma}_t, \hat{\delta}_c)$ and the "true" parameter $\theta_t = (\alpha, \beta, \gamma_t, \delta_c)$. It gives

$$f_t(\hat{\theta}_t) \approx f_t(\theta_t) + f'_t(\theta_t)^T (\hat{\theta}_t - \theta_t),$$

and the variance of the estimated basic equivalized income is computed following equation (3).

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[8]Composition is controlled here by dummy variables of households' type: single without a child, single parent, couple without a child, couple with one or two children, and couple with more than three children.

$$(3) \qquad \mathbb{V}[f_t(\widehat{\theta}_t)] \approx \mathbb{V}[f'_t(\theta_t)^T \widehat{\theta}_t] = f'_t(\theta_t)\mathbb{V}[\widehat{\theta}_t]^T f'_t(\theta),$$

where $\mathbb{V}[\widehat{\theta}_t]$ is the variance–covariance matrix of the regression.

3.2. *Validity of the Method to Assess Infra-National PPP*

To ensure the validity of the method to assess local minimum equivalized income, two assumptions should be verified: (*i*) the estimation is unbiased; and (*ii*) territorial variations indicate differences in the cost of living and not in expectations.

An Unbiased Estimation Method

Kapteyn *et al.* (1988) show that such a method may be biased if actual income is misreported. However, the present estimations are computed, thanks to income data extracted from tax files and not from survey declarations. Indeed, income data from tax files are much less underreported (see Piketty, 2020, for a discussion of the different sources on income). Actually, income data in SRCV surveys were collected by self-reporting during the survey until 2007 and are matched from tax files since 2008: an income hike of about 20 percent in French average income appears between 2007 and 2008. For the present analysis, only surveys after 2008 are used.

Furthermore, several notions of income may be used. As robustness tests, the estimations are run with six types of income measures. First, regressions are run directly on income (simply controlling for family composition) or on the equivalized income (using the modified-OECD equivalence scale). Second, the central assumption corrects the declaration of minimum income in the same way as actual income: by adding implicit net rental income (difference between rental value of housing and actual rent if any, minus mortgaged interests). However, the way implicit net rental income or mortgaged payments are included in the subjective answer is not clear, and that is why alternative regressions are run. The first two alternatives simply focus on monetary income: the (equivalized) income without imputed rents is regressed on the non-corrected declaration of minimum (equivalized) income. The third alternative considers monetary equivalized income and does not correct the declared minimum income, but adds a control for implicit net rental income. The fourth alternative assumes that households consider the whole mortgaged annuities (interests plus capital) as a housing cost when answering the minimum income question (and do not consider capital reimbursement as saving): the dependent variable in the regression is the declared minimum equivalized income plus implicit rents net of the whole mortgaged annuities (and the same correction is done for the actual equivalized income).

All six series of estimations lead to very similar results with indiscernible differences from a qualitative point of view (see Figure 12 in Appendix C and the online appendix for the coefficients of all regressions). This means that the level of implicit net rental income—and the way it is computed—does not drive the results, which reinforce their robustness. Actually, central estimations control for housing tenure (so implicit net rental income is not compared between owners and tenants) and for socioprofessional categories (retired owners having generally already

repaid their mortgaged loan). This minimizes the impact of computations implicit net rental income on the results.

Another source of bias may come from the way questions are asked. Garner and Short (2003, 2004) study the difference in results using the intersection method with subjective minimum income (MIQ) and minimum spending (MSQ). They concluded that "MIQ and MSQ reflect different needs, with the MIQ referring to a broader set of needs than the MSQ. The MIQ allows respondents to formulate more freely what is needed to make ends meet while the MSQ directs respondents to think of a certain set of commodities." The actual question in the French survey is[9]

> *Up to you, what is the monthly minimum income your household needs to only make ends meet, that is to afford basic spending? You should answer according to your own household situation and to what you consider as basic spending (necessary to make ends meet).*

This question is based on income and leaves the choice for the respondent to define what is needed to make ends meet: it corresponds to MIQ. Garner and Short (2003, 2004) also concluded that the source of actual income or spending should be adapted to the subjection question. In the case of MIQ, it should be actual income, which is the case in the present study.

Territorial Variations in Cost of Living *Versus* in Expectations

The other main assumption for the validity of the estimates is that the inter-territorial differences are due to differences in cost of living and not in local culture, expectation, nor income trajectory. For the case of France, this is highly probable because there is an important homogeneity across the country, at least its continental part to which the present study is restricted. Almost all broadcasting programs are national, as well as are most institutions—health system, social benefits, minimum wage, *etc*. Concerning income trajectories, regional differences may exist because of the heterogeneous impact of deindustrialization: for example, the North has experienced a massive deindustrialization although some other regions were never a center of industry. Such economic differences, which must have influenced the intergenerational income trajectories, may impact local subjective estimation of basic needs. Nevertheless, Table 4 shows that all socioprofessional categories— including blue collar—are substantially represented in all regions and sizes of urban units (except for farmers outside small urban units). Therefore, controls for socioprofessional categories in the regressions contribute to the correction of these differences in inter-regional industrial history.

Furthermore, several hints of this relative homogeneity may be presented. First, even if income inequality appears between French territories, households

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[9]The question in English is our own translation of the question asked in French: *À votre avis, quel est le revenu mensuel minimal dont votre ménage doit absolument disposer pour pouvoir simplement joindre les deux bouts, c'est-à-dire subvenir aux dépenses courantes ? Vous devez répondre en fonction de la situation actuelle de votre ménage et de ce que vous considérez comme dépenses courantes (indispensables pour joindre les deux bouts).*

from each part of the national income distribution may be found in each territory. Indeed, Figure 9 in Appendix A shows the distributions of equivalized income in each territory in comparison to the national distribution: whatever the region and size of the urban unit, the proportion of local inhabitants in each decile of the national distribution is close to 10 percent, usually within a 2 percent distance interval and often closer. The two most specific regions are the North—the poorest—and the Parisian region— the richest. Nevertheless, the share of poorest households in Paris is never below the half of the national distribution and the share of the richest households never above the double of the national share. For the North region, the maximum over-representation of poorest deciles is 15.8 percent in the bottom decile and the maximum underrepresentation of the richest deciles is 5.7 percent in the top decile.

Similarly, Table 4 shows that despite the small differences discussed above, all socioeconomic categories—with the exception of farmers—are present throughout the territory. Self-employed, middle- and low-skill employees, as well as retirees and inactive may be found in a similar proportion in all regions and size of urban units. More differences appear for high-skill employees and blue collar: the former are overrepresented in large urban units (where their proportion is 148 percent of the national proportion) and particularly in Paris (191 percent) and underrepresented in small urban units (59 percent) and in the Center region (68 percent); the latter are more equally distributed between size of urban units (a minimum of 80 percent of the national proportion in large ones and a maximum of 129 percent in small ones) but the disparities are larger across regions (a minimum of 66 percent of the national proportion in the Parisian region and a maximum of 131 percent in the North). Of course, this does not mean that there is no urban segregation in France, but only that segregation occurs at a smaller level within the urban units.

Another hint lies in the behavior of households regarding their answer to the declaration of the basic needs. Figure 4 and Figures 10 and 11 in Appendix B show a very similar relation between declared minimum equivalized income and actual equivalized incomes in all territories: a regular increase of 4 percent of the declared minimum equivalized income for each 10 percent increase in the actual equivalized income. Interregional differences are tested: Table 5 reports the difference between the β coefficients of the regression 1 for the whole sample and for the studied region and size of urban unit. The t statistics of the student test of the equality of the two estimates are also reported.

Among the 24 regions*size categories, 20 present a very small and insignificant difference with the national slope between declared minimum equivalized income and actual equivalized income. The four remaining are the rural territories of the Parisian region (for which is noted above a lack of observations) as well as the small urban units of the Western region and the large urban units of the Center and South-West regions. Nevertheless, the differences with the national dependency remain small. This means that the relationship between needs or expectations and the actual equivalized income is homogeneous across the territory. This also means that differences in income trajectories between territories do not drive the estimation. Indeed, deindustrialization would impact the declaration of necessary income because downgraded households may declare a higher minimum income than other households because of their past equivalized income. As

TABLE 5
DIFFERENCE BETWEEN LOCAL AND NATIONAL REGRESSION COEFFICIENTS OF DECLARED MINIMUM
EQUIVALIZED INCOME ON ACTUAL EQUIVALIZED INCOME

	Parisian Region			Center		
Size of urban unit	Large	Medium	Small	Large	Medium	Small
Difference	0.0082	0.0370	−0.0745*	0.0741*	0.026	−0.0188
Student's t	0.453	1.061	−2.118	3.395	1.299	−0.990
	North			East		
Size of urban unit	Large	Medium	Small	Large	Medium	Small
Difference with average	−0.0144	−0.0021	0.0453	0.0274	−0.0037	−0.0106
Student's t	−0.694	−0.078	1.548	1.171	−0.159	−0.487
	West			South-West		
Size of urban unit	Large	Medium	Small	Large	Medium	Small
Difference with average	−0.0142	0.0226	−0.0536*	0.0539*	−0.0123	−0.0406
Student's t	−0.586	1.116	−2.827	2.488	−0.5896	−1.958
	Center-East			Mediteranean		
Size of urban unit	Large	Medium	Small	Large	Medium	Small
Difference with average	0.0243	−0.0315	−0.0256	−0.0247	0.0171	−0.0095
Student's t	1.128	−1.425	−1.213	−1.243	0.781	−0.368

Reading: The coefficient of the regression of declared minimum equivalized income on the actual equivalized income is 0.0082 higher when estimated on the sample of households of the large urban unit of Paris rather than when estimated on the whole sample. The *t* statistics of the Student's test of equality of the two estimates is 0.453, meaning that the difference is nonsignificant.

Notes: Difference between the β coefficients of the regression 1 estimated on households of the studied region and size of urban unit and on the whole sample. Student's *t* is the statistics of the Student's test for equality of the two estimates. *: significant at the 5 percent level.

Source: SRCV 2008–2015.

downgraded households are *ex post* at the bottom of the distribution, this would decrease the correlation between declared necessary and actual income in the concerned regions.

4. RESULTS OF THE INTERSECTION METHOD

4.1. *Local Cost of Living Per Region and Size of Urban Units*

The central results of the intersection method for estimating local cost of living—relative to Paris—are presented in Figure 5. They are the estimations following equation (2)—with standard errors computed according to equation (3)—using the coefficients of regression 1. These central results are found using
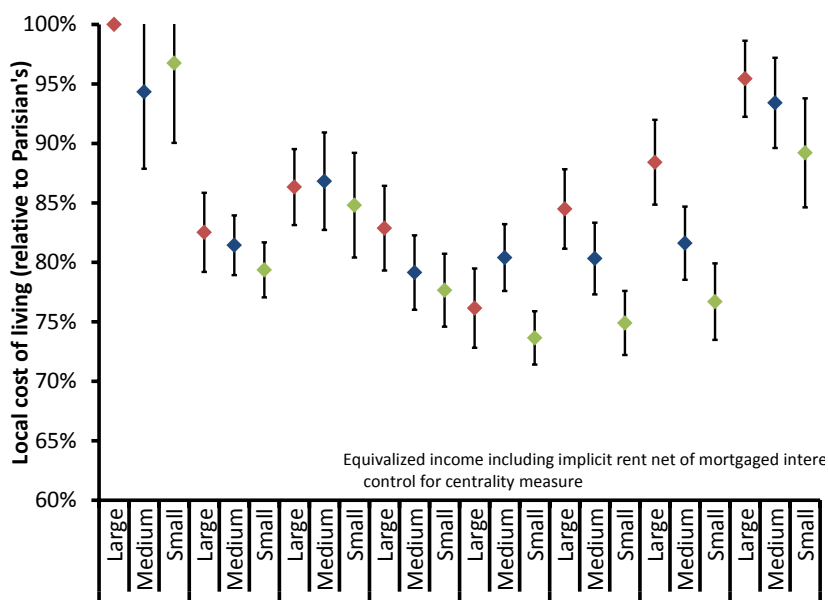
Figure 5. Local Cost of Living Per Region and Size of Urban Units, Central Specification.
Notes: Results from the estimations of minimum equivalized income—relative to Paris—following equation 2 with 95 percent confidence intervals based on the standard errors computed according to equation (3).
Source: SRCV 2008–2015. [Colour figure can be viewed at wileyonlinelibrary.com]

equivalized income including implicit net rental income, with controlling the regressions with the year of the survey, the household composition, the socioeconomic category of the households' head, the housing tenure, and a centrality measure. Robustness tests with different measure of income—with or without implicit net rental income, household income, or equivalized income using the modified-OECD equivalent scale—are presented in Figure 13 in Appendix C. Robustness tests without controlling for the centrality measure are presented in Figure 12 in the same Appendix.[10] All robustness tests present very similar results.

The cost of living appears maximal in the Parisian region, with a large gap above the others. In a lesser extent, cost of living is also greater in the Mediterranean region than in the rest of France. In addition, it should be noted that—apart from the Parisian region—the differences in the estimated cost of living are not only because of the mean nominal equivalized income of the regions (see Figure 2). This is an indication that the method succeeded in correcting the declarations of minimum income from their dependency to the actual income: the differences in cost of living measured here are not because of a simple Easterlin effect. Particularly, the North region—which is the poorest in France (see Figure 7 and Figure 9 in Appendix A)—presents a relatively high cost of living, although the lowest costs

[10]The coefficients of regressions and the computations of local costs of living relative to Paris, for the central specification and all robustness tests are presented in the online appendix.
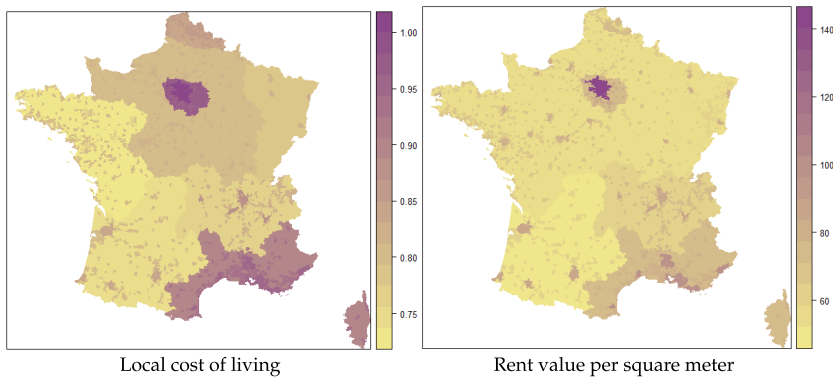
Local cost of living   Rent value per square meter

Figure 6. Local Cost of Living and Cost of Housing.

Notes: Local costs of living are the results from the estimations of minimum equivalized income—relative to Paris—following equation 2. The regions are the eight French continental NUTS 1; small urban units contain fewer than 5000 inhabitants, medium ones between 5000 and 200,000, and large ones more than 200,000 inhabitants.

Source: SRCV 2008–2015. [Colour figure can be viewed at wileyonlinelibrary.com]

of living are found in the East and West regions—which are composed of relatively affluent households.

Concerning the size of the urban units, France is divided into two parts. In the southern half— Center-East, South-West, and the Mediterranean coast—a steep gradient appears, with cost of living increasing with the size of the urban unit. However, the differences are much lower and even nonsignificant in the northern half—North, East, West, and Center. Here again, the results are not correlated with the local mean nominal equivalized income. Indeed, Figure 2 shows little difference in nominal equivalized income between urban units of different sizes in the same region (with the exception of South-West).

Furthermore, it is interesting to see that whereas housing costs are likely an important part of the explanation, other determinants of the local cost of living are at stake. Figure 6 put in parallel the local cost of living relative to Paris (left panel) and the mean rental value per square meter in the territory (right panel).

Yet, the two regions with the highest cost of living—Paris and the Mediterranean coast—are also the two regions with the highest rental value per square meter and the highest ratio of rental value on income (see Figure 3). Nevertheless, the differences between other regions seem driven by other causes: cost of living is relatively high in the North (and in a lesser extent in the Center) although housing costs are not higher than in other non-Parisian regions. Similarly, a steep housing cost gradient appears in all regions relative to the size of urban units but a cost of living gradient is strong only in the southern half of France. The North and Center regions present no significant difference, there is no difference between medium and small urban units in the East—despite substantial difference in housing costs—and the highest cost of living in the West region is found in medium and not in large urban units.

Three potential determinants may be considered in addition to housing cost: (*i*) pricing-to-market, (*ii*) local compositions of the basket of necessaries, and
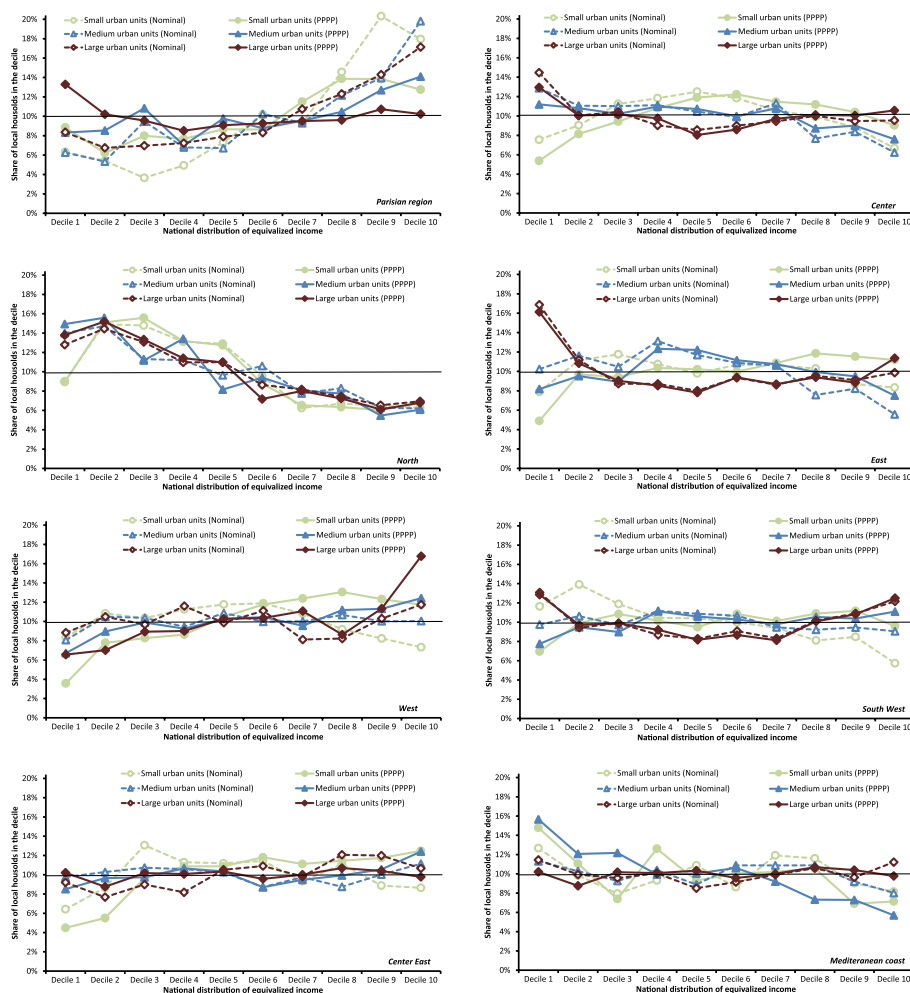
Figure 7. Distribution of Equivalized Incomes: Nominal *vs* PPPP.

Notes: The regions are the eight French continental NUTS 1. Small urban units contain fewer than 5000 inhabitants, medium ones between 5000 and 200,000, and large ones more than 200,000 inhabitants. *Reading*: For each territory, the curve shows the share of the inhabitants in each decile of the national distribution of equivalized income including implicit net rental income (nominal or corrected from the purchasing power parity): a territory with exactly the same distribution as the national distribution would present a flat curve at 10 percent. For example, there is an over-representation of top income households in the large urban units of the Parisian region: the last point of the red dotted curve indicates that 17.1 percent of the local population is in the top decile of the national distribution of nominal equivalized income, which represents 71 percent more households than in the national distribution.

Source: SRCV 2008–2015. [Colour figure can be viewed at wileyonlinelibrary.com]

(*iii*) local public input. Regarding the first, it would explain the present results if the demand elasticity of substitution between varieties was relatively lower in rural areas of the northern half of France and in the entire North region. For rural areas, it could be explained by a more difficult access to markets. For North region,

it could be linked to its relative poorness: poorest households are limited in their consumption choices and consume a smaller range of varieties of goods, focusing on the cheapest varieties; their elasticity of substitution from these cheapest varieties could be small, leading to higher prices.

However, the results do not come from occupational differences because all categories are present in all territories—even if with light heterogeneity (see Table 4)—and the estimations are run by controlling for the socioprofessional category. The coefficients of these controls show no difference in the cost of living between different types of salaried workers (high-, medium-, and low-skill and blue collar), but a lower cost of living for farmers (probably because of self-consumption) and retired.

An example of the second potential determinant may be the need for heating because of the weather, the French climate being cooler in the North of France than in the South. The third determinant deserves an extensive analysis of the local public service throughout the French territory, which is beyond the scope of the present paper.

4.2. *Impact of Local Cost of Living on Inequality Measures*

Previous results show that cost of living may differ substantially from one territory to another, leading to change in the distribution of the PPPP-adjusted equivalized income. The present subsection aims at presenting these changes. To do so, a first stage consists in computing for each observation i the PPPP-adjusted (equivalized) income by dividing the actual (equivalized) income by a territorial deflator DEF_t based on the coefficients of regression (1) according to formula (4), the reference being the large urban unit of the Parisian region:

$$(4) \qquad DEF_t = \exp\left(\frac{\gamma_t}{1-\beta}\right).$$

The largest deflator is 0.954 for the large urban units of the Mediterranean coast and the smallest one is 0.736 for the small urban units of the West region (all deflators as well as all regressions' coefficients— central specification and alternatives—are presented in the online appendix). Inequality indexes and deciles of the distribution are then compared between actual and PPPP-adjusted equivalized income. Each individual is attributed the equivalized income of its households and distributions, and inequality measures are computed at the individual level. First of all, the impact on macro measures of inequalities is tested. Correcting equivalized income for the PPPP decreases slightly the GINI coefficient (from 28.2 in nominal to 27.9 in PPPP) and the share of the top 10 percent (from 23.0 percent in nominal to 22.8 percent in PPPP).

A first remark should be that the present source—the SRCV survey—may underestimate inequality of nominal monetary income. The indexes of inequality of nominal equivalized income found here (e.g., the Gini noted above of 28.2 with implicit net rental income and 28.6 without implicit rents) correspond to those published annually by INSEE but are below other measures obtained with

different methods, for example, Garbinti *et al*. (2018); the authors explain this difference by the fact that a share of capital earnings measured in national accounts does not appear in fiscal data on income. In addition, the present source is based on a relatively small sample—11,000–15,000 observations a year—with potential lack of information for the very top of the distribution. Nevertheless, the point of the present exercise is not to measure precisely the income inequality but to show how considering local purchasing power parity may change quantitatively the magnitude of the inequality measures.

Because of limited information, it is only possible to have here a static measure of this difference. If the PPPP is stable over time, the evolution in the long run of the inequality measures is not modified (see, e.g., Bozio *et al*., 2019, for the long run evolution of post-tax income inequalities in France). However, it is possible that the huge housing cost increase during the 1990s and 2000s, having been heterogeneous on the territory, has modified the PPPP during the period. Similarly, the transfer of mission from national to local governments associated with restrictions on local government budgets may have impacted heterogeneously the territories.

The macro figures show little variation in inequality indices, but microvariations may be more substantial, with changes at micro-level that compensate each other at macro-level. To explore more precisely the impact of PPPP, Figure 7 presents, for each category of urban unit size in each region, the proportion of households in each decile of the national distributions of income (nominal and PPPP).

If the modifications of the curves are very small in the North, Center, and Center-East regions, the changes are more substantial in Paris, the East, West, and South-West regions, and the Mediterranean coast. Not surprisingly, Parisian households are much less affluent in PPPP terms than in nominal terms in national comparison. The nominal distribution—showing a lower proportion of households from the bottom 60 percent and a larger proportion from the top 30 percent—shifts to a PPPP distribution very similar to the national one—with even a larger share of households from the bottom decile. The expensive Mediterranean coast is impacted similarly, but only for the medium-size urban units: few changes are viewable for the small and large urban units of the Mediterranean coast. Although the distribution of nominal equivalized income in the medium-size urban units is similar to the national one, medium-size urban units of the Mediterranean coast show an overrepresentation of households from the bottom 40 percent and an underrepresentation of households from the top 30 percent of the national PPPP distribution of equivalized income.

For East, West, and South-West regions, the impact is the opposite. Although the middle-size urban units of the West are not strongly impacted when PPPP adjustment are applied to actual equivalized income, small and large urban units shift from a nominal distribution similar to the whole country to a clearly richer PPPP distribution. In the East and South-West regions, changes appear mainly for small urban units, from a nominal distribution less affluent than the national one to a PPPP-adjusted distribution similar to the national one.

4.3. *Impact of Local Cost of Living on Poverty Measures*

Several poverty measures have been discussed in the literature. The official poverty threshold is set in the EU at 60 percent of national median equivalized income. The poverty rate calculated in our sample with this definition (let us call it "*relative nominal*" definition) is slightly lower than the official poverty rate for the same period published by INSEE (13.0 percent instead of 13.8 percent). The difference is mainly because of implicit net rental income, which are not considered in the official poverty measure. Indeed, some households with very low monetary income are owners in France, which changes the poverty statistics if considering housing property: Carbonnier (2019) shows that in 2015, more than one-third of the bottom decile of the distribution of monetary income (excluding implicit rents) and more than half of the four following deciles (deciles 2–5, the rest of the bottom half of the distribution) own their home. The share of owners in the bottom decile drops substantially when including implicit net rental income—from one-third to one-sixth—but the share for the rest of the bottom half stays close to 50 percent.

To analyze the impact of local cost of living on poverty, an alternative measure of the poverty rate is computed (let us call it "*relative PPPP*" definition). The cost of living adjustment is the same as for the inequality analysis. Household income is equivalized using the OECD-modified equivalence scale, applied in the same way to actual and declared minimum income for the estimation of the cost of living indices based on the intersection method. The poverty threshold is set at 60 percent of the national median PPPP-adjusted equivalized income (€28,172 yearly instead of €23,743 yearly for the median nominal equivalized income). People are considered poor if their PPPP-adjusted equivalized household income is below this threshold.

This leads to a slightly higher poverty rate: 13.3 percent, that is, 0.3 points higher than with nominal equivalized income. Nevertheless, this small change is the result of opposing modifications: 1.6 points of households below 60 percent of the median nominal equivalized income are above 60 percent of the median PPPP-adjusted equivalized income; conversely, 1.9 points of households below 60 percent of the median PPPP-adjusted equivalized income are above 60 percent of the median nominal equivalized income. Figure 8 shows the distribution of these opposite modifications per region and size of urban units, and Table 6 in Appendix C presents the transition matrices.

The households above the nominal poverty line but under the PPPP poverty line may be found mainly in Paris, the North region, and around the Mediterranean coast. Conversely, households considered poor with the nominal measure but non-poor in PPPP terms are found in the West region and the medium and small urban units of the Center, East, South-West, and Center-East regions. The differences may be substantial as, respectively, 6.5 percent and 6.6 percent of households from large urban units of Paris and the Mediterranean coast are considered non-poor by the relative nominal definition but are below the relative PPPP poverty line. Reciprocally, the small urban units of the West and South-West regions containing, respectively, 5.0 percent and 6.3 percent of households considered poor by the relative nominal definition but benefiting from PPPP-adjusted equivalized income above the PPPP relative poverty line Therefore, considering the territorial
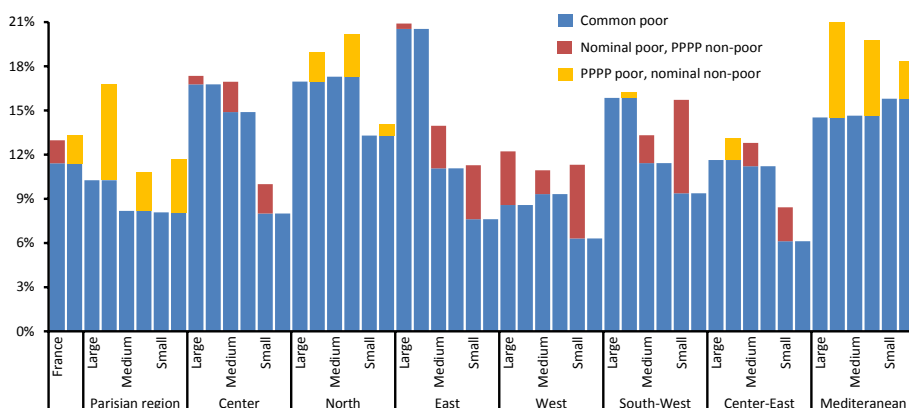
Figure 8. Territorial Distribution of Relative Poverty: Nominal *vs* PPPP adjusted.
Notes: The regions are the eight French continental NUTS 1. Small urban units contain fewer than 5000 inhabitants, medium ones between 5000 and 200,000, and large ones more than 200,000 inhabitants. Relative poverty threshold is defined at 60 percent of national median equivalized income.
Source: SRCV 2008–2015. [Colour figure can be viewed at wileyonlinelibrary.com]

differences in purchasing power changes substantially the geography of poverty. Two of the regions with the highest poverty rates in nominal terms present even higher poverty rates in PPPP terms—the North region and the Mediterranean coast—although the region with the lowest nominal poverty rate presents an even lower poverty rate in PPPP terms—the West region.

5. Conclusion

The present paper develops an empirical method to assess purchasing power parity within a country (PPPP). It is shown that the purchasing power of the Euro varies substantially across the French territory. The measure is not directly linked to local average income nor entirely explained by the cost of housing: the poorest region, for example, which is also the region where housing is the cheapest, presents a relatively high cost of living.

Usual inequality measures (Gini index and the share of the top 10 percent) slightly decrease when computed with PPPP-adjusted equivalized income rather than with nominal equivalized income. The change is also small for the measure of the poverty rate at the national level but substantial variations appear between territories: when considering PPPP-adjusted equivalized income instead of nominal equivalized income, the poverty rate increases by up to 6.6 percentage points in the large urban units of the Mediterranean coast and decreases by up to 6.3 percentage points in the small urban units of the South-West region.

More broadly, Paris, the North region, and the Mediterranean coast appear the most negatively affected by the PPPP adjustment, while the East and West regions are the most positively affected. This finding highlights the important specificity of territorial characteristics, in terms of local prices—and mainly the rental value of housing—but also in terms of local public services. In the time of

transformation of national and regional social policy in France, such territorial impacts deserve further analyses.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article at the publisher's web site:

Appendix A: Equivalized incomes: monetary *vs* including implicit net rental income

Figure 9: Distribution of equivalized incomes: monetary *vs* including imputed rent *Notes*: The regions are the eight French continental NUTS 1. Small urban units contains less than 5,000 inhabitants, medium ones between 5,000 and 200,000, large ones more than 200,000 inhabitants. Reading: For each territory, the curve shows the share of the inhabitants in each decile of the national distribution of equivalized income (monetary or including implicit net rental income): a territory with exactly the same distribution as the national distribution would present a flat curve at 10%. For an exemple, there is an over-representation of top income households in the large urban units of the Parisian region: the last point of the red curve indicates that 17.1% of the local population is in the top decile of the national distribution of nominal equivalized income including implicit net rental income, which represents 71% more households than in the national distribution. *Source*: SRCV 2008–2015.

Appendix B: Estimating the local cost of living

Figure 10: Declared minimum equivalized income versus actual equivalized

income (north half) *Notes*: Mean of declared minimum equivalized income for making ends meet (equivalized with the modified-OECD scale, redressed for implicit net rental income and converted in 2015 Euros) per quantiles (20 bins) of actual equivalized income (from tax returns, including implicit net rental income). Regarding the x-axis, the dots are situated at the level of the mean actual equivalized income of the quantile. The regions are the eight French continental NUTS 1. Small urban units contains less than 5,000 inhabitants, medium ones between 5,000 and 200,000, large ones more than 200,000 inhabitants. *Source*: SRCV 2008–2015

Figure 11: Declared minimum equivalized income versus actual equivalized income (south half) *Notes*: Mean of declared minimum equivalized income for making ends meet (equivalized with the modified-OECD scale, redressed for implicit net rental income and converted in 2015 Euros) per quantiles (20 bins) of actual equivalized income (from tax returns, including implicit net rental income). Regarding the x-axis, the dots are situated at the level of the mean actual equivalized income of the quantile. The regions are the eight French continental NUTS 1. Small urban units contains less than 5,000 inhabitants, medium ones between 5,000 and 200,000, large ones more than 200,000 inhabitants. *Source*: SRCV 2008–2015

Appendix C: Results of alternative specifications

Figure 12: Cost of living indices based on the intersection method using alternative measures of income *Note*: Results from the estimations of local minimum equivalized income following equation 2 with 95% confidence intervals based on the standard error computed according to equation 3. *Source*: SRCV 2008–2015

Figure 13: Cost of living indices based on the intersection method without controling by the centrality measure *Note*: Results from the estimations of local minimum equivalized income following equation 2 with 95% confidence intervals based on the standard error computed according to equation 3. *Source*: SRCV 2008–2015

Table 6: Transition matrices between poor & non-poor for relative poverty nominal versus PPPP