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# Which transport modes do people use for travelling to CoWorking Spaces (CWSs)?

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Summary (180 words)

There are many different ways of practicing coworking, and many different forms of CoWorking Spaces (CWSs). In this paper, we define CWSs in economic and spatial terms, and we provide some explanations on the transport mode used to travel to. Is the transport mode used to get to CWSs the same as that which is usually used for travel for work purposes? Does the spatial location of the CWS (in large city - medium-sized town - rural community) have an impact on the transport mode choice? The key issue is determining whether these new working spaces favor a shift in travel behavior toward practices less centered on the car. We use a survey of coworkers conducted in 2019 in the Auvergne-Rhône-Alpes Region (AURA), from which data is processed using a binomial logit model. The estimation results show that the mode choice for traveling to CWSs does not allow us to identify a characteristic that is fundamentally different from mode choice for work purpose. However, the availability of a parking place in CWSs is identified as a possible public policy level.

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**Keywords:** transport modes, mode choice, coworking, binomial logit model

## 1. Introduction

Before the COVID-19 pandemic, CoWorking Spaces (CWSs) were experiencing a period of constant growth, particularly in North America, where they first appeared in 2005 (Gandini 2015), and more recently in France with 360 CWSs in 2015 and 1,700 in 2019, meaning an almost fivefold increase in three years (Mission Société Numérique 2020). CWSs seem to be meeting a demand generated by a new organization of work, where sharing a workspace is not a problem and is even sought after and valued.

There are as many different ways of coworking as there are CWSs, from cafés or business centers to community or private spaces. These various approaches to the CWSs phenomenon include a spatial definition, according to which CWSs offer workers the chance to work near their residence. CWSs thus seem to reduce the negative impacts of work-related travel (traffic, pollution, the balance between work and family life, productivity, etc.). In France, CWSs establishment has been accompanied by a very proactive discourse on the part of the authorities, who encourage and even financially support their expansion. This support is justified primarily by the supposed, but not proven, positive effects of coworking in terms of sustainable mobility (Lejoux et al. 2019).

From an urban economics perspective, the work of Beckerich et al. (2019), Reuschke et al. (2021), and Mariotti et al. (2021) have shown that CWSs, with the collaboration they encourage between members, the facilities they offer, and the proximity to home they enable, serve as a true positive externality as defined in the seminal works of agglomeration economics (Krugman 1991; Fujita 1999; Henderson 2003), and that they influence transport and location choice. But although the question of location choice has been the subject of various studies, that of transport choice has hardly received any attention. There is some mention of proximity to transport infrastructure and the reduced distance/time spent traveling from home in studies that treat accessibility as an element of location choice (Mokhtarian and Bagley 2000; Reuschke et al., 2021, and Mariotti et al., 2021). But even these works refer to travel and mobility in passing rather than analyzing them in detail. That is why our intention in this article is to offer a more precise response to the question of transport mode choice for traveling to CWSs. Is the transport mode used to travel to the CWS the same as that normally used when traveling for work reasons? Does the geographic location of the CWS (large city, medium-sized town, rural community) affect transport mode choice? We might expect that there would be differences depending on whether the CWS is located in the center of a large city, where transport links are better than in the suburbs, in a medium-sized town, or in rural areas, where cars remain the dominant transport mode in the absence of alternative modes and where access to employment seems generally more difficult (France Stratégie 2018). Our aim is to improve understandings of mode choice for traveling to CWSs.

A better understanding of mode choice for traveling to CWSs is important in order to determine whether these new workspaces encourage travel behavior that is less focused on cars, whose negative effects on the environment are now well-known, particularly in the case of urban traffic (IEA 2012: Sousa Santos et al., 2020).

In this article, we attempt to answer the following question: Which transport mode(s) do people choose for traveling to CWSs? We use data collected during a survey of CWS users in the Auvergne-Rhône-Alpes Region (AURA) from December 2018 to February 2019. In order to provide the first overview of how the region's CWS users travel to their workspaces, the data collected are initially treated as descriptive statistics. We then present a more precise econometric analysis using a logit binomial model. The data were collected as part of the ANR COWORKWORLDS project, which aimed

to investigate the hypothesis that the sustainability of mobility practices among CWS users depends on the social (professional, family) and spatial (regional, residential) configurations in which they are embedded.

We first present a literature review, partly to find out whether CWS users have any specific socioeconomic characteristics, and partly to identify the standard economic foundation for understanding CWSs (section 1). Then we explain the data used and our method of analysis (section 2) before presenting and discussing our results (section 3).

## 2. Literature review on CWSs

The literature review on CWSs can be organized around the definition of CWSs and the socioeconomic characteristics of CWS users on one hand, and the theoretical field and standard economic concepts associated with the development of CWSs on the other hand.

### 2 – 1 CWSs: definition and users' characteristics

Third places, fab labs, telecommuting centers, shared locations, collaboration hubs, innovation labs, coworking hotels, incubators, coworking spaces: a whole array of new terms has appeared in recent years. Given the diversity of ways of referring to CWSs, our first task is to define what a CWS is for the purposes of this paper (see also Mariotti et al., 2021). We draw particularly on research carried out by Lejoux et al. (2019).

In studies by transport economists or engineers, mobility is understood as a journey between two points that can be quantified using different variables (purpose, distance, time, transport mode, etc.). The respective significance and weight of these variables in a model can be used to measure the individual determinants of transport demand. Following this logic, Mokhtarian and Bagley (2000) see preference for a given workplace location as a function of the perceived utility of that location under a number of constraints (travel time, for example). From this point of view, CWS users' mobility habits can be understood *via* the variables correlated with their daily (primarily work-related) journeys.

For spatial and urban planning researchers, mobility is principally a spatial phenomenon. It is a way to grasp the interactions between locations in geographical space at various spatial and temporal scales (daily mobility, residential mobility, travel, migration) (Gallez and Kaufmann 2009). They are thus interested not just in the daily journeys of CWS users, but also in their business-related travel or their choices in terms of residential mobility or even migration. Sociologists and anthropologists add a social dimension to this spatial one. Their aim is to relate position changes in geographic space with position changes in social space (Bassand and Brulhardt 1983).

After this definition, we want to ascertain whether previous studies have revealed (or not) any specific socioeconomic characteristics of CWS users and why. Then, we determine whether the situation in France seems particular or not.

First, we should point out that very few empirical papers have tried to identify the socioeconomic characteristics of CWS users. Basically, in reference to literature, these users seem to have following characteristics: they have a particular employment status, that of "freelance" or independent workers,<sup>1</sup> particularly in the creative and innovative industries; they may also be attached to new

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<sup>1</sup> According to the French Social Security Code, self-employed people or non-employees are distinguished from employees by the absence of an employment contract and by the fact that they are not in a permanent legal

forms of business organization such as start-ups. CWS users tend to be single men, young or middle-aged, with above-average education and living in urban centers. These traits do not seem to be specific to France and are usually associated with CWS users (Gandini 2015; Waters-Lynch and Duff, 2019; Avdikos and Kalogerisis, 2017).

Research by Merkel (2019) established a link between growth in the number of CWS users and increasing precarity of employment and work in England. In France, the explanation seems slightly different because the growth in the number of CWS users is ultimately due to the creation of the “auto-entrepreneur” tax regime in 2009. In 2016, there were 3.1 million self-employed people, including 860,000 active micro-entrepreneurs. They were mostly occupied in the tertiary sector (INSEE, 2020). Their income was low compared to that of “classic” self-employed people, in particular those in regulated professions (Le Boëtté, 2019).

## 2 – 2 Analytical frameworks

As we mentioned above, the creation of CWSs in France is a recent phenomenon. We must, therefore, determine whether this new development has given rise to a new theoretical field, or whether it can be incorporated into an existing field. The second option seems to be the correct one. The development of CWSs seems to fall partly into the sharing economy theory and mainly into the field of urban economic theory, which is also used in the standard analysis of mode choice.

### *The sharing economy*

The awarding of the Nobel Prize in Economics to Elinor Ostrom in 2009 drew attention to the sharing economy well beyond the confines of academia. One of her major results was to show that even when economic agents seek out their own individual interest, repeated interactions with a relatively high probability can produce cooperative results that are beneficial to all (Ostrom 1990; Ostrom et al., 1994). The idea is that CWSs, as an example of this sharing economy, encourage collaboration among members, but also sustainability, accessibility, community, and openness (Jamal 2018; Durante and Turvani 2018; Merkel 2019; Avdikos et al. 2021).

Despite the contributions of this approach, in this article we will focus solely on the theoretical framework of urban economics. Indeed, urban economics seems to be the standard theory for analyzing mobility in terms of the transport mode used for traveling to CWSs, which is the subject of this study (Button 1993; Quinet and Vickerman 2004; Small and Verhoef 2007).

### *Urban economics and externalities*

Even though few studies of CWSs draw on urban economics, positioning CWSs within this field of research seems more appropriate, particularly because of the opportunity to mobilize some of its concepts and analytical tools (Beckerich et al., 2019; Reuschke et al., 2021; Mariotti et al., 2021). The collaboration between CWS users, the facilities they have access to, and the proximity of the space all act as true positive externalities. Introduced by the work of Alfred Marshall (1920), externalities, particularly positive externalities, are at the heart of urban economics. Urban production externalities, or agglomeration effects, are defined as “external effects among producers in areas with a high density of economic activity. Such external effects are the main explanation for why productivity is usually

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relationship of subordination with a client (INSEE, 2020). They therefore carry out their business activity on their own account and are independent, particularly in terms of managing their organizations.

highest in those areas of a country where economic activity is densest” (Ciccone, 2008).<sup>2</sup> They play a role in individual preferences and influence people’s choice of location and transport mode.

Although the question of location choice for CWSs has been the subject of several studies, for example an analysis of the agglomeration economies of the micro-clusters generated by CWSs (Wijngaarden et al., 2020) or the determinants of CWS location in Italy (Mariotti et al., 2021), the question of transport in relation to CWSs has not received as much attention. At most, the proximity of transport infrastructure and the reduction of distance and time from users’ homes are mentioned in relation to the improved accessibility offered by CWSs and are thus treated as one of the determinants of CWS location choice. There is, however, as yet no precise analysis of journeys or mode choice. It is to fill this gap that we want to improve understanding of transport mode choice for traveling to CWSs. This aim will be achieved through a spatial analysis of mode choice in order to ascertain whether it is a discriminative factor in the behavior of CWS users.

### *Mode choice*

The economic analysis of mode choice was largely delineated by the seminal work of McFadden (1973) and Ben-Akiva and Lerman (1985). This analysis, based on the standard economic theory of utility, uses a disaggregated model of demand. Utility consists of a deterministic component, based on observable and measurable variables related to transport users’ choices, and a random component associated with observation errors and unidentifiable variables. Trip price, which is related to the value of the user’s time, and trip time are identified as the principal explanatory variables of transport mode choice (Wardman, 2004). These two variables are closely connected to the trip purpose.

Following these seminal studies, other explanatory variables have been identified, although some seems to have less impact. Our aim is not to draw up an exhaustive list, but rather to present an overview of the main categories with some examples. These additional variables include so-called spatiotemporal variables, user-specific variables, and, more recently, psychological variables. Spatio-temporal variables and socio-demographics such as urban density (Souche, 2010), the quality of the available transport in terms of low traffic levels (Khandker, Day, and Miller 2009), the availability of parking places (O’Fallon, Sullivan, and Hensher, 2004; Ye et al., 2007), and high frequency and accessibility of public transport together with the availability of soft modes (Camagni, Gibelli, and Rigamonti 2002; Cirillo and Axhausen 2006) are all identified as having an influence on mode choice. Among user-specific variables, literature identifies the following as particularly significant: age, gender, income, constraints experienced by the user, the possession of a driving license. The older people are, the less likely they are to use a car, while those aged thirty to fifty have the highest car-use rates (Cirillo and Axhausen, 2006). Moreover, the higher a person’s income, the more likely he or she is to use a car; the inverse applies to public transport (Mogridge 1967; Dargay and Hanly 2002). As Cirillo and Axhausen (2006) show, having children increases the likelihood of choosing to travel by car. Finally, psychological variables can also explain mode choice. Initially limited to a few pioneering works (Dittmar 1992; Ory and Mokhtarian 2009), psychological variables are now receiving much more attention. As well as the pleasure of driving as a determining factor in choosing a car (Dittmar 1992), the desire for social interaction may also lead to enjoyment of travel by public transport (Páez and Wahlen 2010). In contrast, the stress associated with being caught in traffic when using a car makes

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<sup>2</sup> The quote continues: “The best understood urban production externalities are technological externalities due to knowledge spillovers and non-transportable input sharing, both of which are already discussed by Marshall (1920).” (Ciccone, 2008).

people less likely to choose to travel by car (Legrain, Eluru, and El-Geneidy 2015), as do strong environmental concerns (Abrahamse et al., 2009; Van, Choocharukul, and Fujii 2014; Loo et al., 2015).

Following this literature review, in the present paper on transport mode choice of CWSs users, we use an economic and spatial definition of CWSs. It consists of the following three elements: a CWS is, first and foremost, an intermediary space between the home and the workplace; second, it is a place dedicated to work; finally, it involves an element of collaboration between members. For analyzing CWSs, we also take standard urban economics and standard mode choice analysis as reference theoretical framework. Now, we describe our methodology.

### 3. Methodology

#### 3 – 1 Data

For identifying CWSs in the AURA Region, we start by collecting data coming from different sources in order to elaborate a first database<sup>3</sup>. This database provides an analysis of the spatial repartition of the CWSs in the AURA Region into four regional profiles which approximatively corresponds to the French National Urban Areas of INSEE in 2010 (Brutel and Levy, 2011). As a consequence, we identify four spatial areas: City center (urban area with more than 400.000 of inhabitants), cities suburbs (suburbs of urban area with more than 400,000 of inhabitants), Medium-sized town (cities belong to urban area between 50,000 and 399,000 inhabitants), Small rural town (cities belong to urban area less than 50,000 inhabitants). Note that concerning transport modal share, AURA Region is quite similar to others Regions in France (AURA, 2017).

Based on this preliminary step, we collect data coming from a survey carried out from December 2018 to February 2019 in the AURA Region in France. The sample consisted of 377 questionnaires completed in CWSs.

To avoid a sample selection bias due to possible over-number of questionnaires in some spatial area (e.g. in city center) and to get a representative sample for each space, we use a quota method for collecting data. Quotas were set as follows: we first determined a list of number of CWSs in the region as of October 2018. This first list provided two valuable pieces of information: the number of CWSs in each geographic area and the number of places available in each CWS, which can differ widely from one CWS to another. Based on this information, we determined the percentage of CWSs and the percentage of places available in each of the four geographic zones defined as representative spatial area: large city centers, the suburbs of large cities, medium-sized towns, and small towns and the countryside. Then, we hypothesize the number of CWSs and the number of available CWS places behave in an equivalent way. On this basis, we weight both parameters equally in order to determine the share of CWSs in each spatial area, expressed as a percentage. Given our objective of collecting 400 questionnaires, we used this percentage to determine the number of questionnaires to be carried out in each of the four zones. Expressed in a slightly more formalized manner, we applied the following reasoning:

Let  $N$  be the number of CWSs identified.  $N$  is a function of the number of CWSs identified in each of the four geographic zones  $i$ : urban, suburban, medium-sized town, small town and countryside. This gives:

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<sup>3</sup> From websites (néo-nomade, coworking-France, etc.), ECWs, local ECWs networks (Coworking Grand Lyon, Cédille, La Tram 07, Co-alpin, etc.), a government report on coworking (Levy-Waitz, 2018), etc.

$$N = f(n_i)$$

As  $n_i = n_1 + n_2 + n_3 + n_4$  (1)

We have  $N = f(n_1, n_2, n_3, n_4)$

Where  $n_1$  is the number of CWSs in urban areas,  $n_2$  is the number of CWSs in suburban areas,  $n_3$  is the number of CWSs in medium-sized towns, and  $n_4$  is the number of CWSs in small towns and the countryside.

We determine the percentage of CWSs in each geographic zone as follows:  $\frac{n_i}{N}$

Let P be the number of available CWS places identified. P is a function of the number of CWS places identified in each of the four geographic zones i: urban, suburban, medium-sized town, small town and countryside. This gives:

$$P = f(p_i)$$

As  $p_i = p_1 + p_2 + p_3 + p_4$  (2)

We have  $P = f(p_1, p_2, p_3, p_4)$

Where  $p_1$  is the number of CWS places in urban areas,  $p_2$  is the number of CWS places in suburban areas,  $p_3$  is the number of CWS places in medium-sized towns, and  $p_4$  is the number of CWS places in small towns and the countryside.

We determine the percentage of available CWS places in each geographic zone as follows:  $\frac{p_i}{P}$

This gives us the share of CWSs, expressed as T, in each geographic zone as follows:

$$T = \frac{1}{2}N + \frac{1}{2}P$$
 (3)

We applied equation (3) to a statistical target of 400 questionnaires, giving the following division of questionnaires needing to be completed.

Finally, we obtained a sample of data with the following characteristics (**Table 1**)<sup>4</sup>:

|                                    | Number of CWSs (%) | CWS places (%) | Questionnaires to be completed (%) T |
|------------------------------------|--------------------|----------------|--------------------------------------|
| City center                        | 33                 | 41             | 37                                   |
| Suburb                             | 22                 | 28             | 25                                   |
| Medium-sized town                  | 23                 | 22             | 22.5                                 |
| Small town and countryside (rural) | 22                 | 9              | 15.5                                 |

<sup>4</sup> The number of completed questionnaires (377) is under the targeted one (400). Added to a difficulty to collect data in suburb, it explains a difference between number of estimated data and realized data for city center and suburb. However, the total amount of data collected for metropolitan area (city center + suburb) gets the estimated one (around 60%).

| <b>Socio-demographic data</b>  | <b>Items</b>                      | <b>%</b>     |
|--|-----------------------------------|--------------|
| Gender   | Man                               | <b>53.8</b>  |
|  | Woman                             | 46.2         |
| How old are you?   | 18 to 25 years                    | 6.6          |
|  | 26 to 35 years                    | <b>43.8</b>  |
|  | 36 to 55 years                    | <b>47.2</b>  |
|  | 56 to 65 years                    | 2.4          |
|  | Over 65 years                     | 0.0          |
| What is your employment status?  | Full time                         | <b>81.4</b>  |
|  | Part time, more than 50%          | 14.9         |
|  | Part time, less than 50%          | 3.2          |
|  | Not available                     | 0.5          |
| How many people (including you) live in your place of residence?                             | One                               | <b>19.9</b>  |
|  | Two                               | <b>27.6</b>  |
|  | Three                             | <b>20.4</b>  |
|  | Four                              | <b>23.3</b>  |
|  | Five                              | 6.4          |
|  | Six or more                       | 1.6          |
|  | Not available                     | 0.8          |
| What is the highest level of education you have obtained?                                    | None                              | 0.5          |
|  | Certificate of pro. competence    | 2.1          |
|  | High school                       | 3.2          |
|  | Graduate                          | <b>28.6</b>  |
|  | Postgraduate                      | <b>65.2</b>  |
|  | Not available                     | 0.3          |
| Are you?   | Business (less than 10 employees) | <b>22.02</b> |
|  | Business (less than 50 employees) | 10.6         |
|  | Business (more than 50 employees) | 8            |
|  | Self-employed                     | <b>52</b>    |
|  | Government official or equivalent | 0.53         |
|  | Charitable association, NGO       | 6.6          |
|  | Not available                     | 0.3          |
| Please could you tell us which net monthly income band your household falls into before tax? | Less than 2000 euros              | 21.0         |
|  | 2000-4000 euros                   | 36.9         |
|  | 4000-6000 euros                   | 24.9         |
|  | 6000-8000 euros                   | <b>9.5</b>   |
|  | More than 8000 euros              | <b>4.8</b>   |
|  | Not available                     | 2.9          |

**Table 1:** Socioeconomic characteristics of the sample

### 3 – 2 Estimation method

To interpret these data, we first used a descriptive statistical analysis to obtain an initial univariate analysis of the characteristics of CWS users' mode choice, in the absence of any such analysis either for France or in the literature covering several regions. We then used a more sophisticated binomial logit model to explain transport mode choice for traveling to CWSs in more detail. Data were processed using the free software R and the *mlogit* package (Croissant, 2015).

We will now provide some supplementary information about this binomial model. In the model, mode choice for travel to CWSs is the variable to be explained. The variable to be explained is a discrete variable that can take one of two forms. Discrete choice models explain the mode choice of economic agents as a consequence of their preferences among a set of alternatives (Train 2003; for an overview of discrete choice models in the field of transport see, for example, Kamargianni, Ben-Akiva, and Polydoropoulou, 2014 and Kamargianni *et al.*, 2015). A binomial model is used when the variable to be explained is a categorical variable with two possible values, as in this case. In this paper, transport mode choice has been converted into a binary variable representing two transport modes: cars and all other transport modes. The value of the variable is 0 for the "car" mode and 1 for the "other transport modes". The explanatory variables are the responses collected in the survey. To run the model, we need to specify the distribution followed by the difference between the error terms of the two utility functions. The logistic distribution allows us to use the logit model.

### 4 – Results and discussion

#### 4 – 1 General overview

We first present a general overview of CWS users' characteristics for showing how different (or not) they are to Regional population. Then, we focus on a more disaggregated spatial analysis in order to consider with more details CWS users' differences.

##### General characteristics of CWS users'

In accordance to literature, CWS users appear to be a man (53.4%), young (43.8% for 26-35 years old) or middle-aged (47.3% for 36-55 years old), full-time worker (81.4%), independent worker (52%), with a very high level of diploma (65.2% are post graduate) and a high level of income (only 21% get less than 2,000 euros *per* month against 50% in the Region see INSEE, 2014) (see **Table 2**).

Analysis of the general transport results shows that, as a whole, CWS users tend to have a driving license (95.8%) and one (14.3%) or more (76.4%) cars. Only a few of them use public transport (9.3%) or have a public transport pass (18.3%), even though most of them (72.4%) live less than 500 m from a public transport station! Moreover, 36.8% travel to their CWS by cycling (18.8%) or walking (18%) the entire route, compared to 29.7% who use a car. Among those who travel by car, one third have a parking place, which is free in a third of cases (**Table 2**).

All these results suggest that the mobility behavior of CWS users differs from the mobility behavior of the average AURA Region inhabitant (see AURA, 2017). CWS users get a higher rate of motorization (95.8% of the CWS users belong a car against 89% for the Region) and of multi-motorization (76.4% of the CWS users belong to more than one car against 45% for the Region). Their rate of annual public transport ticket is similar to the rest of the inhabitants (18.3% against 19%). However, they travel less by car (29.7% against 61 % for the average of Region inhabitants) or by walking (18.8% against 27% for the average of Region inhabitants) and more by cycle for their commute (18% against 2%).

| <b>Transport data</b>  | <b>Items</b>             | <b>Number</b> | <b>%</b>    |
|--|--------------------------|---------------|-------------|
| Location of CWS  | City center              | 173           | 45.8        |
|  | Suburb                   | 60            | 15.9        |
|  | Medium-sized town        | 85            | 22.5        |
|  | Small rural town         | 59            | 15.6        |
| Type of space  | Independent CWS          | 221           | <b>58.6</b> |
|  | Chain CWS                | 156           | 41.4        |
| (Q3) Do you have a driving license?  | Yes                      | 361           | <b>95.8</b> |
|  | No                       | 16            | 4.2         |
| (Q4) Do you have a valid public transport pass (bus, train, etc.)?   | Yes                      | 69            | 18.3        |
|  | No                       | 308           | <b>81.7</b> |
| (Q5) How many vehicles does your household own (including vehicles provided by an employer, leased, motorized two-wheeled vehicles, etc.)? | One                      | 54            | <b>14.3</b> |
|  | Two                      | 168           | <b>44.6</b> |
|  | Three                    | 120           | <b>31.8</b> |
|  | Four                     | 35            | 9.3         |
| (Q6) Do you have a bicycle in your household?  | Yes                      | 291           | <b>77.2</b> |
|  | No                       | 86            | 22.8        |
| (Q10) How far is your home from the closest public transport station (bus, metro, tram, train) (in meters)?                                | Less than 100m           | 140           | <b>37.1</b> |
|  | Less than 500m           | 133           | <b>35.3</b> |
|  | Less than 1000m          | 36            | 9.5         |
|  | More than 1000m          | 67            | 17.8        |
|  | NA                       | 1             | 0.3         |
| (Q15) What transport mode do you principally use when traveling to your coworking space?   | Car                      | 112           | <b>29.7</b> |
|  | Train                    | 7             | 1.9         |
|  | Bicycle                  | 71            | <b>18.8</b> |
|  | PT                       | 35            | 9.3         |
|  | Walking the entire route | 68            | <b>18.0</b> |
|  | Car pooling              | 0             | 0.0         |
|  | Car and train            | 1             | 0.3         |
|  | Train and PT             | 0             | 0.0         |
|  | Train or PT              | 2             | 0.5         |
|  | Scooter                  | 6             | 1.6         |
|  | Motorized two-wheeler    | 4             | 1.1         |
|  | Other                    | 11            | 2.9         |
|  | At least two modes       | 60            | <b>15.9</b> |
| (Q16) If you often travel by car, do you have a parking place near your coworking space (private or public carpark, parking in the road)?  | Yes                      | 134           | <b>35.5</b> |
|  | No                       | 99            | 26.3        |
|  | Not relevant             | 137           | <b>36.3</b> |
|  | NA                       | 7             | 1.9         |
| (Q17) Is this parking place free?  | Yes                      | 118           | <b>31.3</b> |
|  | No                       | 99            | 26.3        |
|  | Not relevant             | 149           | <b>39.5</b> |
|  | NA                       | 11            | 2.9         |

**Table 2:** Transport data for the entire sample

## Spatial CWS user's analysis

Beyond this CWS users' overview, a more disaggregated spatial analysis points out some important differences.

Note we regroup some items for mode choice (see question Q15 in **Table 2**), for eliminating a slightly unclear category "at least two modes" (answers are included in function of the first transport mode declared). We get **Table 3** with data coming from our survey in AURA Region.

Survey data shows significant spatial difference in CWS users' behavior. In city centers, only 5.2% of CWS users use a car, while 89.2% use soft modes (cycling, public transport, walking the whole way). In contrast, car remains the main transport mode used (50% or more) for traveling to CWSs in the three other spatial areas (suburbs, medium-sized towns, rural). In the suburbs, car mobility reaches 70% while bicycles and public transport only account for 10%. Alongside cars, which are used by 56.5% in medium-sized towns and 67.8% in rural areas, other modes are also used but much less. In those two spatial areas combined, bicycles are used by almost 14%, while almost 20% walk the entire way (to their CWS).

These spatial differences appear to be consistent with Regional mobility heterogeneity. However, our result points out a more specific mobility situation for medium-sized town and suburbs. In 2016, if car represents 61 % of the AURA inhabitants' travel, differences are important regarding residential location, the scale is in fact between 28 % and 73 %. Car mobility is the highest for rural area and medium-sized town (2,8 car travel *per day*), and the least for city center (1 car travel *per day*). Walking is the second transport mode (27%) and the first for the two biggest AURA cities (Lyon and Grenoble). Public transport (8%) and bicycle (2%) are fare behind but with the same contrasting situation depending of the city size: public transport modal share gets around 20% in Lyon and Grenoble against around 10% in medium-sized town and less than 5% in rural area; for bicycle is around 10% (15% in Grenoble and only 6% in Lyon), around 5% in medium-sized town and less than 2% in rural area (AURA, 2017).

In the middle of the 2010, outside the biggest city center of Lyon and Grenoble, car mobility domination can be explained by the low quality of the public transport alternative in terms of capacity, speed and frequency (absence of subway or tramways and a very weak high service level bus network outside Lyon and Grenoble) and a weakness of safe and developed bicycle itineraries.

|                                 | Survey on Auvergne-Rhône-Alpes Region (AURA) (%) |             |                    |             |             |
|---------------------------------|--|-------------|--------------------|-------------|-------------|
|                                 | Center   | Suburbs     | Medium-sized towns | Rural       | Total       |
| Car                             | 5.2  | <b>70.0</b> | <b>56.5</b>        | <b>67.8</b> | 36.9        |
| Public transport                | <b>27.2</b>                                      | 13.3        | 5.9                | <b>0.0</b>  | 15.9        |
| Bicycle                         | <b>26.0</b>                                      | 11.7        | 14.1               | 10.2        | <b>24.7</b> |
| Walking entire way              | <b>36.4</b>                                      | 1.7         | 21.2               | 18.6        | 18.6        |
| Two wheels, scooters, and other | 5.2  | 3.3         | 2.4                | 3.4         | 4.0         |

**Table 3:** Transport mode and spatial location

After a presentation of general characteristics of CWSs users', we focus more specifically on transportation mode choice for travelling to CWSs.

## 4 – 2 Mode choice model results

As we have already said, we will use a logit binomial econometric analysis to understand mode choice in more detail. We want to identify significant variables which explain mode choice for travelling to CWSs. Added to the fact that taking into account several transport modes is finally quite recent in the literature (Heinen and Chatterjee, 2015; Patil et al., 2017), the sample is too small for taking more than two modes and to be able to break it down and carry out a mode choice analysis for each of the four geographic areas. Given the initial results we have just discussed, doing so would probably have allowed us to identify more subtle differences in mode choice in different areas.

As for the models results, the full model that includes all the variables in the database is presented in **Table 4**. The likelihood statistic shows that the model is significant at 5%, but the Wald test shows that the full model suffers from multicollinearity ( $F = 0.9004$ ;  $Df = 39$ ;  $p\text{-value} = 0.6432$ ), which is mainly because it contains all the variables.

Interpreting binomial logit coefficient appears slightly different from standard regression coefficient (from Ordinary Least Squares for example) because in particular one of the binary variables is taken as a reference one. Hence, the estimated coefficients are relative to the reference level of the predictor. As a consequence, in the present work, a positive coefficient sign indicates a positive effect of an explicative variable on the alternative mode choice (other transport mode) compare to the reference one (car)<sup>5</sup>.

Hence, variables that act against a choice in favor of other transport modes than car are: being located in the suburbs or a medium-sized town, not having a public transport pass, living more than a kilometer from a public transport station, and not owning a bicycle. This indicates that these four variables are significant for explaining why CWS users have less preference for other transport modes than cars. This result is largely in line with expectations because, as we previously explain, cars remain the most used transport mode outside city centers, especially when access to efficient alternative modes is limited.<sup>6</sup> In contrast, not having a parking place at the CWS and being aged between 36 years old and 55 years old are positively correlated to other transport mode choice than car. Result concerning the relationship between the lack of parking place and the reduction of car modal choice is well-established. On that basis, a lack of parking places seems to be a possible tool for decision-makers who want to ensure the spread of CWSs is linked to a reduction in car use. The positive correlation between age and a modal choice not in favor of car is more unattended. In the AURA Region, between 25 years and 64 years old, car mobility is the most popular (AURA, 2017). This result asks worthy of further investigation, in particular for establishing if it is linked to an increase of the environmental preoccupation in population or to other factor (like price oil variation).

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<sup>5</sup> For more detailed econometrics elements see Train (2009, chapter 3, p.5).

<sup>6</sup> Which may help to explain the “gilet jaunes” movement (Souche-Le Corvec 2019).

| Explanatory variables        | Variables items                    | Coefficients | Estimate   | Std. Error | z value<br>Pr(> z ) |
|------------------------------|------------------------------------|--------------|------------|------------|---------------------|
| Location of CWS              | Large city center                  | <i>Fixed</i> |            |            |                     |
|                              | Large city suburb                  | -3.7745      | 1.5954     | -2.366     | 0.017987 *          |
|                              | Medium-sized town                  | -4.9784      | 1.3199     | -3.772     | 0.000162 ***        |
|                              | Small rural town                   | -2.7455      | 1.4770     | -1.859     | 0.063057.           |
| Distance to public transport | Less than 100m                     | <i>Fixed</i> |            |            |                     |
|                              | Less than 500m                     | 0.6749       | 0.9172     | 0.736      | 0.461820            |
|                              | Less than 1 000m                   | 1.5603       | 1.2536     | 1.245      | 0.213253            |
|                              | More than 1 000m                   | -3.6156      | 1.3808     | -2.618     | 0.008832 **         |
| Age                          | 18 to 36 years                     | <i>Fixed</i> |            |            |                     |
|                              | 36 to 55 years                     | 2.1018       | 0.8719     | 2.411      | 0.015929 *          |
|                              | Over 55 years                      | -0.5443      | 2.1549     | -0.253     | 0.800576            |
| Gender                       | Women                              | <i>Fixed</i> |            |            |                     |
|                              | Man                                | -0.4415      | 0.7506     | -0.588     | 0.556373            |
| Driving License              | Yes                                | <i>Fixed</i> |            |            |                     |
|                              | No                                 | 20.1960      | 8238.0380  | 0.002      | 0.998044            |
| Valid public transport pass  | Yes                                | <i>Fixed</i> |            |            |                     |
|                              | No                                 | -3.5578      | 1.2452     | -2.857     | 0.004273 **         |
| Education                    | Other                              | <i>Fixed</i> |            |            |                     |
|                              | Graduate                           | -2.0253      | 1.2318     | -1.644     | 0.100135            |
|                              | Postgraduate                       | -0.1670      | 1.0501     | -0.159     | 0.873630            |
| Employment status            | Full time                          | <i>Fixed</i> |            |            |                     |
|                              | Part time, more than 50%           | -0.8268      | 0.9905     | -0.835     | 0.403837            |
|                              | Part time, less than 50%           | 0.9486       | 1.7837     | 0.532      | 0.594837            |
| Household size               | One person                         | <i>Fixed</i> |            |            |                     |
|                              | Two persons                        | -1.0664      | 1.1084     | -0.962     | 0.335995            |
|                              | Three persons                      | -0.7756      | 1.1582     | -0.670     | 0.503077            |
|                              | Four persons                       | -1.0253      | 1.1264     | -0.910     | 0.362695            |
|                              | Five persons                       | -1.6186      | 1.6255     | -0.996     | 0.319375            |
|                              | Six persons                        | -13.7504     | 2540.7411  | -0.005     | 0.995682            |
|                              | Eight or more persons              | -28.6981     | 48196.1424 | -0.001     | 0.999525            |
| CWS frequency                | Not every day                      | <i>Fixed</i> |            |            |                     |
|                              | Every day                          | 0.5008       | 0.6995     | 0.716      | 0.474024            |
| CWS time                     | Less than 12 months                | <i>Fixed</i> |            |            |                     |
|                              | More than 12 months                | -0.1530      | 0.7080     | -0.216     | 0.828902            |
| CWS parking space            | Yes                                | <i>Fixed</i> |            |            |                     |
|                              | No                                 | 2.9532       | 0.9033     | 3.269      | 0.001078 **         |
|                              | Not relevant                       | 29.4441      | 3577.7095  | 0.008      | 0.993434            |
| Free CWS parking space       | Yes                                | <i>Fixed</i> |            |            |                     |
|                              | No                                 | 1.8439       | 0.9975     | 1.849      | 0.064528 .          |
|                              | Not relevant                       | 1.2081       | 2.7845     | 0.434      | 0.664381            |
| CWS workplace                | Yes                                | <i>Fixed</i> |            |            |                     |
|                              | No                                 | -0.6105      | 0.8439     | -0.723     | 0.469408            |
| Socio-professional category  | Business (less than 10 employees)  | <i>Fixed</i> |            |            |                     |
|                              | Business (less than 50 employees ) | -2.4724      | 1.2786     | -1.934     | 0.053155.           |

|                  |                                   |                                  |            |        |            |
|------------------|-----------------------------------|----------------------------------|------------|--------|------------|
|                  | Business (more than 50 employees) | -2.1564                          | 1.2954     | -1.665 | 0.095994.  |
|                  | Self-employed                     | -1.4375                          | 0.8955     | -1.605 | 0.108422   |
|                  | Government official or equivalent | 19.4938                          | 48196.1449 | 0.000  | 0.999677   |
|                  | Charitable association, NGO       | -1.5959                          | 1.5993     | -0.998 | 0.318347   |
| Car number       | One car                           | <i>Fixed</i>                     |            |        |            |
|                  | Two cars                          | -15.2294                         | 4738.8789  | -0.003 | 0.997436   |
|                  | Three cars                        | -16.3408                         | 4738.8789  | -0.003 | 0.997249   |
|                  | More than three cars              | -16.0103                         | 4738.8790  | -0.003 | 0.997304   |
| Bike             | Yes                               | <i>Fixed</i>                     |            |        |            |
|                  | No                                | -1.9557                          | 0.9879     | -1.980 | 0.047756 * |
| Household income | Less than Smic1                   | <i>Fixed</i>                     |            |        |            |
|                  | Smic to 3000 euros                | 0.8304                           | 1.0851     | 0.765  | 0.444128   |
|                  | More than 3000 euros              | 0.8733                           | 1.1957     | 0.730  | 0.465166   |
| Intercept (car)  |                                   | 22.6082                          | 4738.8794  | 0.005  | 0.996193   |
|                  | AIC                               | 172.93                           |            |        |            |
|                  | Log-Likelihood                    | -46.46529 (df=40)                |            |        |            |
|                  | Fisher test                       | 0.9004                           |            |        |            |
|                  | Residual deviance                 | 92.931 on 303 degrees of freedom |            |        |            |

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1 (Dispersion parameter for binomial family taken to be 1) 1Smic is around 1 500 euro/month

**Table 4:** Full mode choice model<sup>7</sup>

After presenting the general model containing all the variables, we test various models, and following convention selected the one that included the most significant variables, a good fit when deviance is low, and a good indicator of model quality (AIC) (Greene, 1993; Maddala, 2001). The properties of the selected model are satisfactory because the likelihood statistic shows that the model is significant at 5% and the Wald test shows that the model does not suffer from multicollinearity ( $F = 5.737$ ;  $Df = 10$ ;  $p$ -value:  $5.293e-08$ ).

Model only using significant variables is presented in **Table 5**. Results show where CWS is located, distance from a user's home to a public transport station, ownership of a public transport pass, number of bicycles, and the availability of a parking place are significant variables determining transport mode choice for traveling to CWSs. Specifically, and without surprise, CWS location outside city center, a public transport station located over than 1 km from home, not having a public transport pass, and not having a bicycle encourage choice for car on the contrary to not having a parking place in CWS. These results are largely in line with expectations because cars remain the most used transport mode outside city centers in AURA Region and because these variables correlation are standard. They underline public transport or soft transport modes accessibility is a key variable in their use (Camagni, Gibelli, and Rigamonti 2002; Cirillo and Axhausen, 2006). This also indicates fairly monomodal behavior among CWS users, who tend not to have public transport passes or bicycles as well as a car.

| Explanatory variables | Variables items | Coefficients | Estimate | Std. Error | z value<br>Pr(> z ) |
|-----------------------|-----------------|--------------|----------|------------|---------------------|
|-----------------------|-----------------|--------------|----------|------------|---------------------|

<sup>7</sup> We should point out that certain insignificant variables like "licenceNo" or "nmbppershouseEight" are characterized by a high coefficient due to the low number of responses in that category: for example, compared to the reference household size, very few households have more than eight people.

|                              |                   |              |                               |        |              |
|------------------------------|-------------------|--------------|-------------------------------|--------|--------------|
| Location of CWS              | Large city center | <i>Fixed</i> |                               |        |              |
|                              | Large city suburb | -3.2338      | 0.7475                        | -4.326 | 1.52e-05 *** |
|                              | Medium-sized town | -3.5262      | 0.7326                        | -4.813 | 1.49e-06 *** |
|                              | Small rural town  | -2.7553      | 0.7526                        | -3.661 | 0.000251 *** |
| Distance to public transport | Less than 100m    | <i>Fixed</i> |                               |        |              |
|                              | Less than 500m    | 0.2028       | 0.5327                        | 0.381  | 0.703415     |
|                              | Less than 1 000m  | 0.3258       | 0.6687                        | 0.487  | 0.626130     |
|                              | More than 1 000m  | -2.2679      | 0.6546                        | -3.464 | 0.000531 *** |
| Valid public transport pass  | Yes               | <i>Fixed</i> |                               |        |              |
|                              | No                | -2.5073      | 0.7187                        | -3.489 | 0.000485 *** |
| Household bicycle            | Yes               | <i>fixed</i> |                               |        |              |
|                              | No                | -1.8916      | 0.6107                        | -3.097 | 0.001953 **  |
| CWS parking place            | Yes               | <i>Fixed</i> |                               |        |              |
|                              | No                | 2.4534       | 0.4675                        | 5.247  | 1.54e-07 *** |
|                              | not Relevant      | 20.2672      | 1305.9667                     | 0.016  | 0.987618     |
| Intercept (car)              |                   | 8.15390      | 1.12551                       | 7.245  | 4.34e-13 *** |
|                              | AIC               | 185.64       |                               |        |              |
|                              | Log-Likelihood    | -81.81859    | df=11                         |        |              |
|                              | Fisher test       | 5.737        | df=10; p-value: 5.293e-08 *** |        |              |
|                              | Residual deviance | 163.64       |                               |        |              |

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

**Table 5:** Mode choice model for CWSs

After this result presentation, we discuss them.

#### 4.3 Discussion

##### CWS users: a specific and favored category

In accordance to literature, in AURA Region CWS users appears to be a specific category. This category is composed by man, young or middle-aged, full-time worker, independent worker, with a very high level of diploma and a high level of income. These traits do not seem to be specific to France and are usually associated with CWS users (Gandini 2015). In addition to this compliance, we point out CWS users gets a higher rate of motorization and of multi-motorization than in average for AURA inhabitants. Associated to their higher level of diploma and of income, CWS users of AURA Region appears to belong to a rather favored category. This result underlines the necessity to integrate fairness problematic in CWS debate. CWS can participate to a better territorial balance, and a spatial equity, in allowing positive externalities for workers not only in the city center but also and mainly outside the city center. However, as CWS users belong to a favored category, CWSs interrogate also social equity (for a definition of equity dimensions in transport see for example Raux and Souche, 2004). Public decision makers who would like to encourage CWSs, should anticipate the balance between territorial and social equities.

##### A strong spatial effect on modal choice and the need of oriented policy

Survey data shows significant spatial difference in CWS users' behavior which are consistent with Regional mobility heterogeneity. They point out more specific results, in particular, for suburbs and medium-sized town usually less studied and where car is still mainly used.

In city centers, soft modes get 90% of the modal share, cars are almost disappeared. In contrast, car remains the main transport mode used for traveling to CWSs in suburbs, medium-sized towns, rural

areas. In the suburbs, car mobility reaches 70% while bicycles and public transport only account for 10%. In medium-sized towns, bicycles are used by almost 14%, more than public transport. In rural areas, public transport is absent, dominant modal alternatives to car are walking and bicycling.

Focusing with more details on modal choice between car and other transport modes, we confirm car mode choice to CWS is correlated to CWS location outside city center. Without surprise, we also show car mobility choice is correlated to a public transport station over 1 km from home, to not having a public transport pass, and to not having a bicycle. Result point out CWS in city center are different from the others, underlying public policy should be adapted to CWS location. They also show car users of CWS seem to have no modal alternative to car (absence of bicycle, low accessibility to PT) while their rate of annual public transport ticket is similar to the rest of the inhabitants. Added to this result, we find an unattended correlation between some age categories (young and middle-aged age) and to be against car modal choice while in the same time, car mobility is the most popular for this age category. This result can probably reveal that this category currently use car because modal alternatives are not satisfying, but can change.

Last, all these results point out first urban transport policies success where CWS users can adopt a smart mobility. Second, they underline the need of oriented mobility policy outside city center in particular in improving public transport, bicycle or in helping car users to switch to electric car. Financing public transport investments outside city center but also supporting bicycle switch appear to be crucial for AURA Region but probably costly because population density is lower. Third, future research could be useful for a better understanding of public transport availability and on the intention to use modal alternative to car.

## **5. Conclusion**

The aim of this paper was to contribute to knowledge of transport modes used for traveling to CWSs. This information has until now not been available in the literature.

In accordance to literature, we find CWS users appears to be a specific category. We add this is also a favored category which introduces in the debate the equity balance between territorial and social objectives. With a more innovative result consistent with the Regional mobility heterogeneity, we show significant spatial difference in CWS users' behavior. In particular, we point out the need to pay attention to spatial areas outside city-centers which are less studied and where car is still mainly used in particular because the modal alternative is not enough attractive.

The idea is not to say nothing has been done in these areas but to show that policy must be focus on with adapted and faster measures in particular because the young and middle-aged categories appear to be in favor of changing their car mobility behavior. Moreover, keeping in mind the yellow vest movement in France which provides mostly from workers living in rural areas, our results show alternatives modal solutions in rural area are different from suburbs or medium-sized town regarding public transport and bicycle or electric vehicles. Focusing on these areas, the next stage would be to carry out a more detailed analysis of journeys carried out by CWS users (distance, trip time, time of day, frequency, travel constraints, etc.). One option would be to use GPS data from their journeys in order to collect data about all movements.

Our result on spatial difference in CWS users' behavior also interrogates CWS suppliers. In France, some of the CWS can be seen as "public goods" as local public policy encourages and finances them in particular in rural area on the opposite to CWS in city centers where public funds are scarcer. For

both, CWS location is a crucial point but linked to competitiveness for CWS in city center and to transport accessibility in others areas.

As Luo and Chang (2020) show coworking spaces in China appears to be different regarding in particular the public policy support. In China, the local state encourages competitiveness between CWSs while national state promotes the production of CWS “as a spatial fix for the national economic transitional crisis<sup>8</sup>”. As a consequence, in a future work, a comparison between CWS in different world regions could bring useful information for improving CWS knowledge.

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<sup>8</sup> “(...) such crises need solutions through a spatial fix (i.e. the insatiable spatial expansion of the market, expropriation of new labor, and new urban space production) (Harvey, 1981)” Luo and Chang (2020, p.100).

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