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Car sharing adoption intention in urban areas: What are the key sociodemographic drivers?

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ABSTRACT

In recent years, car sharing has become an international transportation trend and has shown the potential to change the way people use cars. Sociodemographic variables are the key drivers of mobility patterns and travel modes and may determine the diffusion of car sharing services in the urban population. The present paper considers the impact of sociodemographic variables on car sharing behavior and explores individual choice between car clubs and peer-to-peer car sharing services. We carry out an international survey and analyze a representative sample of 2733 car owners in four major metropolitan areas: London, Madrid, Paris, and Tokyo. The empirical analysis identifies key drivers of car sharing behavior and choice. The findings yield practical insights for business practitioners and transportation planners.

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1. Introduction

In recent years, car sharing has become a key transportation trend, especially in metropolitan areas where car sharing services have been growing at an impressive rate. For example, the number of car sharing users in the world has increased from 0.35 million in 2006 to 4.94 million in 2014 (Frost and Sullivan, 2014). De Luca and Di Pace (2015) underlined the importance of this new transportation trend, which allows access to cars through sharing systems. Many researchers and practitioners have stressed the great potential of these new services in terms of business opportunities and as a sustainable solution for transportation needs (Steininger et al., 1996; Cervero et al., 2007; Shaheen and Cohen, 2007a, 2007b, 2008; Firnkorn and Muller, 2011, 2012). According to Navigant Research[1] (2016), global car sharing services revenue will grow from $1.1billion in 2015 to $6.5billion in 2024.

Most car sharing services have been developed in high-density metropolitan areas, allowing users to accomplish several transportation goals and avoid congestion, parking and pollution problems (De Luca and Di Pace, 2015). These services also permit users to benefit from a car's flexibility without supporting all of its costs (Huwer, 2004). However, despite the increased number of users, car sharing services are currently battling to achieve profitability (De Luca and Di Pace, 2015, p.60). As profitability is derived from the fixed cost of service, the estimated revenues of these companies are directly inferred from user behavior. Profitability requires not only a large number of subscribers, but also subscribers willing to frequently use the service to pay off the fixed charges.

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[1] http://www.navigantresearch.com/research/carsharing-programs.

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Currently, not much is known about the adoption intention and choice of car sharing services by individual users (e.g., De Luca and Di Pace, 2015). More specifically, market segmentation based on sociodemographic variables such as age, education or household size may be used to detect the profiles that are the most likely to use car sharing services (Millard-Ball et al., 2005). This is especially relevant as many sociodemographic variables affect mobility patterns and travel modes. It has been suggested that demographic factors are now the main determinants of travel demand (Metz, 2012). Consequently, knowing the key demographic, behavioral and geographic drivers may help to increase the diffusion of car sharing services (Millard-Ball et al., 2005). The current research is intended to address this gap in the literature by empirically investigating the sociodemographic drivers of car sharing (henceforth CS).

To that end, we consider the adoption intention of CS services including both car club (henceforth CC) and peer-to-peer services (carpooling and ridesharing services). Peer-to-peer services (henceforth P2P) mean sharing privately owned vehicles for a particular trip (Ballus-Armet et al., 2014). P2P chauffeur/taxi services on demand like those provided by Uber or Lyft, are not included in the P2P services and thus are not considered here. The rise of P2P systems followed the diffusion of smartphone technology and social networking websites. For example, the French car ride sharing platform BlaBlaCar zoomed ahead with a $200 m investment in September 2015 valuing it at €1.4bn (Financial Times, 2015). This start-up connects 20 million participants across 19 countries in three continents (BlaBlaCar, 2015). Kim (2015, p.251) suggests a prosperous future for carsharing according to indicators such as the total membership and the number of vehicles in carsharing fleets (see also Shaheen, 2012).

Several desirable effects of CS have been noted in the transportation literature, including reduced car ownership rates in urban areas, reduced vehicle mileage and lower greenhouse gas emission levels (Shaheen et al., 2008). Furthermore, parking limitations and congestion in high density areas play an important role in choosing a CS solution (Correia and Viegas, 2011).

These effects strengthen the phenomenon of 'peak car use' observed in the world's developed cities by the Brookings Institution in 2009 (Newman and Kenworthy, 2011). This peak car use phenomenon suggests that we may now be witnessing the demise of automobile dependence in cities. According to the emerging new car sharing platforms, this 'peak car use' considerably reinforces the potential of car sharing services in urban and high density areas.

This paper focuses on the sociodemographic drivers of CS behavior. We survey residents of four large metropolitan areas in four different countries to obtain a large international urban sample. The emphasis on the urban population is warranted because most CS services target urban customers (Bert et al., 2016, p.7).

The present study is intended to augment the existing literature on CS services. Firstly, our multinational study considers European and Asian markets, while existing studies on car sharing systems focus exclusively on North America. Secondly, we study individual preferences for CS systems and in doing so we expand the scope to all car owners as their use of CS services could have a substantial economic, social, and environmental impact. It should be noted that prior studies focus exclusively on existing CS users. We include both car club and P2P systems and explain individual choice behavior using microeconometric analysis in a sample of 2733 individuals from London, Madrid, Paris and Tokyo.

The paper is organized as follows. Section 2 summarizes the relevant literature. The methodological framework, the survey and some descriptive data are presented in Section 3. Section 4 reports the estimation results. These are discussed in Section 5. The last section concludes the paper and identifies opportunities for future research.

2. Literature review

Existing studies have been mainly concerned with the feasibility of CS services in North America and their potential impact on overall car ownership and vehicle usage (De Luca and Di Pace, 2015). As noted above, researchers have also investigated the behavior of members of CS services. The research literature has failed to consider preferences for CS in the general driver population and identify factors that make nonusers more prone to adopt CC or P2P services (Schaefers, 2013).

In previous research, existing CS users appeared to be younger and more educated (Burkhardt and Millard-Ball, 2006; Efthymiou et al., 2013). Shaheen and Schwartz (2004) found that CS users were often students and belonged to low income households. Le Vine et al. (2014) summarized the socio-economic profiles of CS users as urban, well-educated, moderate/upper income, younger adults that live alone or in small households without children.

Few recent studies have addressed the demographic factors explaining the propensity to join a CS system. Efthymiou et al. (2013) showed that intention to join a CS scheme was associated with household income and household size. Using a sample of licensed drivers in the Lisbon metropolitan area, Correia and Viegas (2011) confirmed that younger people with a lower income were more willing to carpool (Tischer and Dobson, 1979; Gensch, 1981; Teal, 1987). Zheng et al. (2009) showed that willingness to participate in a university community CS system was associated with the respondent's status at the university (i.e., student, professor or administrative staff).

Very few studies in the research literature have so far examined P2P services. Unlike CC services, P2P services match privately owned vehicles to other users on demand. As mentioned above, P2P success is largely attributed to internet applications; however, P2P platforms need to build trust (Ballus-Armet et al., 2014). The recent rise of P2P is partly due to solutions provided by online P2P platforms. For example, they have built online assessment systems or created an online community. Ballus-Armet et al. (2014) underlined the low awareness of those new services in the San Francisco and Oakland areas and stressed the need for further research on the demographics of P2P users.

In conclusion, there has been very little empirical work on sociodemographic factors related to adoption intention of both traditional CC and P2P systems. The sociodemographic drivers of CS services can assist public policymakers and expedite the diffusion of these new services in the population.

3. Material and methods

As noted above, the aim of the current paper is to identify sociodemographic determinants of CS adoption intention and choice behavior. We consider both traditional CC services and P2P systems. Our methodology distinguishes between CC services and P2P systems as they refer to different operations. Traditional CC services are provided by firms. CC services use an annual fee payment and a pay per use system. Without any annual fee, the P2P system results in a distinctive way of accessing the cars. Moreover, the service can be accessed without any annual engagement as the P2P system offers the service without the annual fee constraint. Consequently, the P2P system can be perceived as distinctive traditional CC services. These important operational differences cannot be ignored and the empirical analysis should discriminate between CC and P2P systems.

As mentioned in the literature review, high density urban areas are the target markets for CS services. In this paper, we survey residents of four large metropolitan areas in four different countries to obtain a large international urban sample (see Table 1). Only the car owners were targeted, as their use of CS services could have a substantial economic, social, and environmental impact.

In each capital city we carried out a representative online survey based on regional data from the national population census. The sampling methodology of quotas allows us to obtain a sample of car owners representative to the general public according to age group, gender, working status (employed, unemployed, student, retired) and localization (city center vs. suburbs). Sampling quotas administration and data collection are according to the TNS Sofres research institute, which carried out the survey and collected the data. The survey was launched in September 2015 and completed in two weeks.

The structure and content of the questionnaire were as follows. Firstly, after a short introduction and a welcome to the study, participants were asked to answer screening questions about their age, city and zip code, car ownership and driving license. Next, they answered several questions related to car use and CS adoption intention. The questionnaire was administrated in French for Paris, Spanish for Madrid, Japanese for Tokyo and English for London. We obtained 2733 respondents in the four final subsamples corresponding to the four cities. Table 2 summarizes the four subsamples.

The questionnaire introduced a short description of CS services (see Appendix A). The respondents were then asked if they would use any CS service in the next six months and what type of CS services they would choose (CC or/and P2P). Table 3 summarizes the descriptive statistics corresponding to those questions.

As expected, the majority of people in these four urban areas do not intend to use CS services. Additionally, consumer preferences for CC and/or P2P differ among cities. Respondents in Tokyo and London are more interested in CC than in P2P services. The opposite pattern is observed for Paris and Madrid. In all capital cities, more than 25 percent of those interested in car sharing services would use both CC and P2P systems.

Following the transportation mode choice literature, we adopt the choice modeling paradigm (e.g., Ben Akiva and Lerman, 1985; Train, 1986). In this paper, we use a standard probit model and a bivariate probit model (Greene, 2008). For the standard probit model the probability of Y = 1 can be expressed as:

$$\text{Prob}(\text{Y} = 1|\text{x}) = \int_{-\infty}^{\text{x}'\beta} \Phi(t)\text{dt} \tag{1}$$

where Φ is the standard Gaussian distribution function.

The equation expresses the choice probability between two alternatives (Y = 1 *vs.* Y = 0); x is a vector of independent variables.

The bivariate probit model allows us to simultaneously estimate two equations representing a simultaneous decision:

$$\begin{cases} y_1^* = x_1'\beta_1 + \varepsilon_1, \quad y_1 = 1 \quad if \quad y_1^* > 0,0 \quad otherwise, \\ \qquad\qquad\qquad\qquad and \\ y_2^* = x_2'\beta_2 + \varepsilon_2, \quad y_2 = 1 \quad if \quad y_2^{ast} > 0,0 \quad otherwise \end{cases} \tag{2}$$

In the bivariate model, the individual simultaneously makes two binary choices ($Y_1 = 1$ *vs.* $Y_1 = 0$) and ($Y_2 = 1$ *vs.* $Y_2 = 0$). As in the probit specification, x is the vector of independent variables (Greene, 2008).

In the present context, we first implement a standard probit model to identify the sociodemographic drivers of CS regardless of the preferred system (i.e., CC and P2P). Secondly, we apply a bivariate probit model to jointly analyze the choice of CC and P2P. The bivariate probit model allows for the joint determination of CC and PP response variables and allows the errors terms to be correlated as the two decisions are interdependent.

Table 1
Summary statistics for the four cities. *Source:* Pan, D. 2013. Key transport statistics of world cities. Journeys, 105–112. (except for Paris)

Characteristics	London[a] (UK)	Madrid[b] (Spain)	Paris[c] (France)	Tokyo[d] (Japan)
Number of inhabitants	9.7M (Greater London)	6.3M (Madrid area)	10.5M (Paris area)	13.3M (Tokyo area)
Total city area (km^2)	1572	1739	2845	2189
Population density (person/km^2)	5281 (mca)	3622	3696	6066
Road density (km per km^2)	9.42	4.87	4.56 (mca)	19.07 (mca)
Private cars per 100 persons	40.9	30.5	43.0	18.1 (mca)
Urban tool[e]	Yes	No	No	No

Note: mca = main city area.
[a] *Sources:* Transport for London Annual Report and Statement of Accounts 2012/13; Travel in London Report 5; Greater London Authority, GLA Intelligence Update (07, 2013); 2012 Round Interim Group Population Projections.
[b] *Sources:* EMT Madrid Annual Report 2011; Madrid Economy 2012; Metro de Madrid Annual Report 2011.
[c] *Sources:* INSEE (2011) Statistiques du recensement pour l'agglomération parisienne; STIF (2011) Statistiques des transports de l'agglomération Parisienne; Direction régionale et interdépartementale de l'équipement et de l'aménagement en Ile de France (2013) Motorisation et usage de la voiture en Ile de France. *Rapport pour 'Enquête Globale Transport'*, 28ff.
[d] *Sources:* Bureau of Transportation Annual Report 2012; Tokyo Metro Co. Ltd Securities Report 2011/12; Tokyo Metropolitan Government, Statistics of Tokyo.
[e] The line "Urban tool" indicates if the city has introduced or not an automatic tool. If that is the case, this means that each car driver has to pay a tax to drive in the city. London city named its system "congestion charging" that is a form of road pricing, to manage demand for vehicle use in a central zone.

Table 2
Descriptive statistics.

	Paris (France)	London (UK)	Madrid (Spain)	Tokyo (Japan)
Gender				
Male	408 (54.9)	369 (53.4)	389 (53.6)	360 (62.7)
Female	334 (45.1)	322 (46.6)	337 (46.4)	214 (37.3)
Age				
18–29	152 (20.5)	161 (23.3)	112 (15.4)	49 (8.5)
30–44	242 (32.6)	221 (32.0)	253 (34.9)	167 (29.1)
45–55	145 (19.5)	171 (24.8)	147 (20.3)	132 (23.0)
>55	203 (27.4)	138 (20.0)	214 (29.5)	226 (39.4)
Localization				
City center	189 (25.5)	361 (52.2)	287 (39.5)	159 (27.7)
Suburbs	553 (74.5)	330 (47.8)	439 (60.4)	415 (72.3)
Employment status				
Employed	558 (75.2)	522 (75.5)	496 (68.3)	405 (70.6)
Unemployed	41 (5.5)	54 (7.8)	115 (15.8)	93 (16.2)
Student	24 (3.2)	29 (4.2)	30 (4.1)	11 (1.9)
Retired	119 (16.0)	86 (12.5)	85 (11.7)	65 (11.3)
Overall sample	742 (100.0)	691 (100.0)	726 (100.0)	574 (100.0)

Table 3
Descriptive statistics for car sharing systems adoption.

	Paris (France)	London (UK)	Madrid (Spain)	Tokyo (Japan)
CS use				
No	463 (62.4)	489 (70.8)	492 (67.8)	430 (74.9)
Yes	279 (37.6)	202 (29.2)	234 (32.2)	144 (25.1)
CS choice				
Car clubs	68 (24.4)	110 (54.4)	71(30.3)	69 (47.9)
P2P	137 (49.1)	38 (18.8)	101 (43.2)	20 (13.9)
Both systems	74 (26.5)	54 (26.7)	62 (26.5)	55 (38.2)

4. Results

As alluded to earlier, the binary choice of intending to use a CS option is the dependent variable of the standard probit model. The dependent variable is a binary yes/no indicator (yes means that the individual is willing to use CC, P2P, or both; no means that the individual is not willing to use any CS system).

The bivariate probit model explains two dependent variables jointly. More specifically, the binary choice of using or not using CC is the dependent variable in the first equation of the bivariate probit model. Similarly, the binary choice of using or not using P2P is the dependent variable in the second equation of the bivariate probit model.

In both standard and bivariate probit models, a set of sociodemographic variables is used as the independent covariates, and as described in Table 4.

4.1. Results for the standard probit model

Table 5 shows the estimation results for the standard probit model. The model is fitted using LIMDEP 10 software using our sample of 2733 observations. Three city-specific dummy variables are included in the model (Paris being the reference category).

The results show that most independent variables as well as the overall model are statistically significant. Inspection of Table 5 reveals that CS adoption intention is driven by measurable and actionable individual characteristics. More specifically, CS adoption intention is negatively correlated with being the main driver of the household, suggesting that main drivers have greater need for uninterrupted access to their own private car. Older people are less likely to use CS services, probably because they have been using their own cars for many years and they do not want to change their habits. Nevertheless, several other factors are found to positively affect CS adoption intention. Respondents living in city centers, people with graduate degrees, and frequency of use are more likely to affect choice of CS services positively. Gender is also positively related with CS adoption intention. More specifically, men are more likely to use the service than women. This could be attributed to men having fewer safety concerns. Having a relatively recent car is positively related to CS as new car owners might wish to keep their vehicles safe and mileages low.

Finally, the results show that British, Spanish and Japanese drivers are all less likely to use CS services compared to French drivers.

4.2. Results for the bivariate model

Table 6 reports the parameter estimates of the bivariate probit model (Greene, 2008). We have already pointed out that the first equation represents the CC choice (yes/no), and the second equation represents the P2P choice (yes/no). The stochastic dependency between the two options is revealed by the significant disturbance correlation, suggesting that the two choice decisions are interrelated and the bivariate model is the correct specification (see Table 6). The bivariate probit model permits the joint estimation of the two equations. We use the LIMDEP 10 full-information maximum likelihood (FIML) estimator with clustering (robust covariance matrix with correction for clustering) to account for cross-city heterogeneity. Thus, standard errors are corrected for the presence of four clusters (cities) in the present sample.

As regards the first equation (CC choice), the results suggest that people living in city centers, male, and with a graduate level of education are more likely to choose a CC option. Frequency of car use and full-time employment also raise probability of CC selection, as such drivers are likely to travel more and need to rent out cars more often. Moreover, recent car ownership is again positively related to CC choice. The results also reveal that older people and single respondents are less likely to use CC. Being the main driver is also negatively related to CC choice. Finally, Japanese respondents are more likely to choose CC services than are French respondents.

We now turn to consider the P2P choice. The results show that living in the city center, being male, and being single increase the probability of using P2P option. These individual characteristics are indicative of fewer safety concerns and far more flexibility in arranging car trips through P2P platforms. These drivers are better able to deal with potential issues in P2P coordination (e.g., meeting point, punctuality, travel time predictions, etc.). In addition, older people are less likely to choose P2P. Finally, British, Spanish and Japanese respondents are less likely to choose P2P services than French drivers. This difference between Paris and the other three capitals can be attributed to the better reputation of P2P services in Paris where the well-established French P2P platforms BlaBlaCar, Drivy and OuiCar are quite popular.

The results also reveal which factors are not significant determinants of P2P use. For instance, being the main driver, being a worker, and being highly educated individual do not influence the intention of joining a P2P system. Beyond specific profiles (young and single urban respondents), P2P systems appear to be compatible with a wider range of potential consumers which opens opportunities for P2P platforms. These non-significant results can be reliant on the easiness and flexibility of P2P offerings. The absence of annual fees, the attractive prices and the saving opportunities for both passenger and driver make P2P attractive to broader demographics.

5. Discussion

The results show that sociodemographic variables play an important role in individual choice behavior regarding CS services. Living in the city center, being male and, being highly educated significantly increase the probability of CS adoption (cf. Burkhardt and Millard-Ball, 2006). Car club services are more available in city centers than in the suburbs because of the difference in population density. For instance, the Autolib' electric vehicle (EV) service was first introduced in the center of Paris and offers a denser network of stations in the center of the metropolis. This difference in car pool stations density between city center and suburbs is also observed in Tokyo (Nagata, 2014).

We also found that CS choice is partly driven by younger age, suggesting a generation effect that is in line with the peak car phenomenon (Goodwin, 2012). The younger generation is probably more prone to share cars because their attitude

Table 4
Independent variables.

Variable	Description
DRIVER	1 if the respondent is the main driver of the owned car; 0 otherwise
FREQ	Respondent's frequency car use
MILES	Total annual kilometers driven
WORKERS	Number of workers in the household
GENDER	1 if the respondent is a male; 0 if a female
JOB	1 if the respondent is working; 0 otherwise
CENTER	1 if the respondent lives in the city center; 0 if the respondent lives in the city suburbs
EDU	1 if the respondent has obtained a post graduate degree; 0 otherwise
AGEYEARS	Respondent's age in years
SINGLE	1 if the respondent is single; 0 otherwise
RECAR2010	1 if the respondent drives a relatively recent car (registered after 2009); 0 otherwise
NCARS	Number of cars in the household
UK	1 if the respondent lives in London (UK); 0 otherwise
SPAIN	1 if the respondent lives in Madrid (Spain); 0 otherwise
JAPAN	1 if the respondent lives in Tokyo (Japan); 0 otherwise

Table 5
Probit model estimation results.

Variable	Coefficient	St. Error	z	Prob.|z| > Z	Lower bound (95%)	Upper bound (95%)
DRIVER	−0.156***	0.057	−2.70	0.007	−0.270	−0.043
FREQ	0.060**	0.289	2.08	0.037	0.004	0.117
MILES	0.001	0.002	0.80	0.422	−0.002	0.005
WORKERS	−0.038	0.043	−0.87	0.382	−0.122	0.047
GENDER	0.201***	0.047	4.28	0.000	0.109	0.293
JOB	0.118	0.084	1.41	0.158	−0.046	0.282
CENTER	0.475***	0.096	4.93	0.000	0.286	0.663
EDU	0.222***	0.075	2.95	0.003	0.075	0.370
AGEYEARS	−0.021***	0.004	−4.68	0.000	−0.030	−0.012
SINGLE	−0.024	0.057	−0.42	0.675	−0.137	0.089
RECAR2010	0.157*	0.093	1.68	0.093	−0.026	0.340
CONSTANT	0.028	0.196	0.14	0.888	−0.357	0.412
UK	−0.479***	0.063	−7.92	0.000	−0.601	−0.356
SPAIN	−0.181***	0.208	−8.71	0.000	−0.222	−0.141
JAPAN	−0.302***	0.014	−22.08	0.000	−0.329	−0.275
Log likelihood function	−1,546.38					
Restricted log likelihood	−1,701.30					
Chi-squared (14 d.f.)	309.838					
Significance level	0.000					
Hosmer-Lemeshow Chi^2	8.435					
McFadden Pseudo R^2	0.091					
Sample size	2733					

*** Significance at 1% level.
** Significance at 5% level.
* Significance at 10% level.

toward the automobile is different from that of the older generations. As sociologists have suggested, this can be interpreted as a new form of car culture (Miller, 2001).

These changes in consumer behavior represent considerable challenges for the car industry. Carmakers and car rental firms have formed partnerships to deliver CS services e.g., BMW and Sixt's DriveNow and Europcar as well as Daimler's Car2go (Le Vine et al., 2014). The willingness of younger consumers to share cars is moving the frontiers of the automotive sector to a broader mobility service sector. The appeal of CS services to younger generations is an opportunity for traditional carmakers to encourage brand loyalty via CS services (Le Vine et al., 2014, p.9). Younger drivers may buy their own private cars in the future and their brand choice may be influenced by their previous CS experience.

Another interesting insight is that frequency of car use is a positive driver of CS adoption. Heavy users are more likely to join CS services to satisfy their transportation needs. For example, 42 percent of CC new members joined the service because they had the possibility of making trips they could not make using other modes of transportation (CarPlus, 2015). CS can save time and money on specific trips (e.g., short distances in urban areas, peak times), can serve specific transport needs (those which cannot be satisfied by private car or by public transportation) or is useful when the parking space is expected to be very limited (Louvet and Godillon, 2013; Schaefers, 2013).

The foregoing analysis also demonstrates that CC and P2P choices are correlated, interdependent decisions. In particular, the stochastic dependency between CC and P2P in the bivariate probit model yields an important insight for policy. It shows

Table 6
Bivariate probit model estimation results.

Variable	Coefficient	St. Error	z	Prob. |z| > Z	Lower bound (95%)	Upper bound (95%)
Equation for CC						
DRIVER	−0.112**	0.049	−2.28	0.023	−0.209	−0.016
FREQ	0.064*	0.033	1.93	0.054	−0.001	0.130
MILES	0.001	0.002	0.37	0.714	−0.003	0.005
WORKERS	−0.079	0.061	−1.31	0.192	−0.198	0.040
GENDER	0.133**	0.063	2.11	0.035	0.009	0.257
JOB	0.173**	0.081	2.13	0.032	0.014	0.332
CENTER	0.392***	0.122	3.22	0.001	0.154	0.631
EDU	0.297***	0.101	2.95	0.003	0.010	0.495
AGEYEARS	−0.014**	0.006	−2.44	0.015	−0.025	−0.003
SINGLE	−0.136**	0.055	−2.49	0.012	−0.243	−0.029
RECAR2010	0.257***	0.099	2.61	0.009	0.064	0.450
CONSTANT	−0.887***	0.145	−6.12	0.000	−1.171	−0.603
UK	0.069	0.112	−0.61	0.540	−0.289	0.151
SPAIN	−0.043	0.035	−1.25	0.213	−0.111	0.025
JAPAN	0.110***	0.022	4.96	0.000	0.066	0.152
Equation for P2P						
DRIVER	−0.099	0.077	−1.28	0.200	−0.251	0.053
FREQ	−0.009	0.026	−0.33	0.744	−0.060	0.042
MILES	0.003	0.002	1.45	0.146	−0.001	0.006
WORKERS	0.010	0.027	0.38	0.707	−0.042	0.062
SEX	0.088*	0.052	1.69	0.091	−0.014	0.191
JOB	0.049	0.099	0.50	0.620	−0.146	0.244
CENTER	0.313***	0.043	7.29	0.000	0.229	0.0397
EDU	0.057	0.076	0.75	0.452	−0.092	0.206
AGEYEARS	−0.016***	0.002	−6.47	0.000	−0.021	−0.011
SINGLE	0.090**	0.045	1.98	0.047	0.001	0.177
RECAR2010	0.016	0.066	0.24	0.811	−0.114	0.145
CONSTANT	−0.056	0.184	−0.31	0.760	−0.419	0.306
UK	−0.678***	0.026	−26.38	0.000	−0.728	−0.627
SPAIN	−0.214***	0.011	−19.00	0.000	−0.236	−0.192
JAPAN	−0.519***	0.038	−13.77	0.000	−0.593	−0.445
Disturbance correlation (Rho)	*0.531***	*0.074*	*7.19*	*0.000*	*0.386*	*0.676*
Log likelihood	−2455.69					
AIC/N	1.820					
Obs.	2733					

*** Significance at 1% level.
** Significance at 5% level.
* Significance at 10% level.

that both CC and P2P choices are driven by common latent preferences and people who are more prone to use CC are also more likely to use P2P (and vice versa). We have already pointed out that CC services need to increase the number of users to reach financial profitability. To do so, they may target existing P2P users and fine tune their marketing efforts using the driver profiles detected here.

We have also demonstrated the socio-demographic effects on CC and P2P choices. Interestingly, some variables have the same impact on the two options but others do not, suggesting the different target segments of the two CS services types.

We have also pointed out that our results reveal a potential market that is far less segmented in the case of P2P services. This suggests that P2P services are potentially more promising than traditional CC services as P2P appeals to a broader demographic. This finding may be particularly relevant for public authorities developing pro-car sharing policies (Kim, 2015). Such policies should yield a better impact in Paris than in the other three capitals as P2P adoption intention is stronger in this city. Nevertheless, competition between P2P and CC could negatively affect CC profitability, as CC systems have to pay off their owned car fleets.

Finally, the results underline the opposite effect of household types on CC/P2P adoption intention. Arranging car trips through P2P platforms may be more complicated for a family because of greater constraints than those faced by a single user.

6. Conclusions

A recent study carried out by Whelan (2007) in the UK predicted that by 2031 there will be a 25 percent reduction in the number of households without access to a car. In the Spanish context, Matas and Raymond (2008) forecasted an increase in the level of motorization derived from an increase in the employed population.

Despite decreases in population in Germany, Ritter and Vance (2013) predicted continued increases in the number of cars (about 0.2 percent per annum) until 2030. These findings can be observed in other countries in Europe and worldwide.

In this context, there is a crucial role for public transport policy aimed at diminishing car ownership and encouraging young generations to use sharing systems, especially for their ecological and health benefits.

Schaefers (2013, p.76) concluded that future studies should investigate the perception of CS by non-users. The present study addresses this gap through a multinational survey of car owners who may or may not choose CS services. It is intended to extend prior studies, which invariably consider existing customers of CS services. Our results shed new light on the sociodemographic drivers of CS use and CC/P2P choices. A limitation of this research is the lack of data on actual driver behavior and previous experience with CS, which may provide further insights into the way people choose and use CS services. Another useful extension would be to consider the explicit role of cost-benefit factors in consumer choice of CS services, using actual market data. We hope that the preceding analysis will provide the stimulus for further work on this emerging area of transportation research.

Appendix A. Questionnaire

You are going to respond to a questionnaire concerning the car sharing alternatives. We will introduce you briefly to what those alternatives are before beginning the questionnaire. In this survey, we consider the sharing options you may be interested in. We presume that for all the alternatives you can afford a car without necessary owning it.

(1) Car clubs: You have access to several cars belonging to a company and have to pay an annual fee in addition to a fee each time you use a car. (e.g. Zipcar, SocialCar).
(2) Peer-to-peer car sharing/renting: You have access to several cars belonging to participating individuals. You are charged a fee to rent out a vehicle when its owner is not using it. You pay only for the time you need to use it. The participants can also share a ride but they have to pay the driver (e.g. Carpooling, BlaBlaCar)

# Order	Questions / Items	Response formats
1	What is your gender?	1 = Male 2 = Female
2	How old are you?	Age in years.
3	What is your job status?	1 = Employee 2 = Unemployed 3 = Student 4 = retired
4	Do you live in or around "Great London, Surrey, Hertfordshire, Berkshire, Essex, or Kent" (for London), "Comunidad de Madrid" (for Madrid), "Région Ile-de-France" for Paris, "Tokyo Metropolis, or Chiba Prefecture, or Saitama prefecture, or Kanagawa Prefecture (for Tokyo)? Please think about our main home	1 = Yes 2 = No
5	Please select your postal code from the list below	Postal code
6	How many cars are available in your household?	1 = one car 2 = two cars 3 = three cars or more 4 = No cars in the household
7	How often do you drive this car?	1 = All days (including weekends) 2 = All days (midweek) 3 = From one to three times a week 4 = From one to three times a month 5 = Less than once a month
8	You are	1 = The main driver of this car 2 = The secondary driver of this car
9	What is the year of first registration of this car?	Year
10	On average, how many kilometers do you drive this car in a year?	Number of kilometers
11	Would you like to choose a sharing option in the next six months?	1 = Yes 2 = No

(*continued on next page*)

Questionnaire (*continued*)

# Order	Questions / Items	Response formats
12	If yes, which car sharing system would you be more likely to choose?	1 = I would choose the "car club" sharing option 2 = I would choose the "peer-to-peer" sharing option 3 = I would choose both
13	What is your household type?	1 = Single 2 = Couple without children 3 = An adult plus one or several children 4 = A couple with one or several children
14	How many household members are working individuals?	1 = One worker 2 = Two workers 3 = Three workers or more 4 = No workers
15	What is the highest degree or level of school you have completed?	1 = Completed some high school 2 = High school graduate 3 = Trade/technical/vocational training 4 = College or University degree 5 = Post-graduate degree

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