JOB ACCESSIBILITY, EMPLOYMENT AND JOB-EDUCATION MISMATCH IN THE METROPOLITAN AREA OF BARCELONA

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Abstract
This paper analyzes the effect of job accessibility by public and private transport on labour market outcomes in the metropolitan area of Barcelona. Beyond employment, we consider the effect of job accessibility on job-education mismatch, which represents a relevant aspect of job-quality. We adopt a recursive system of equations that explains the number of cars per adults in the household, employment and mismatch. Public transport accessibility appears as an exogenous variable in the three equations. Even if it might reflect endogenous residential sorting, additional falsification proofs suggest that residential sorting is unlikely to be the main driver of the results.

[PRELIMINARY VERSION, PLEASE DO NOT CITE]

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1) Introduction

In this paper we analyse the relevance of job accessibility for labour market outcomes in the metropolitan area of Barcelona, putting a special emphasis on the role played by job accessibility by public transport facilities. The general framework of our analysis is grounded on the Spatial Mismatch Hypothesis, which states that the distance to employment centres is harmful for labour market outcomes, especially among ethnic minorities and disadvantaged workers (Kain, 1968). Starting from this hypothesis, the existing research highlighted that what really matters in urban areas is not distance per-se, but rather the existence of good transport connections from residential location to employment agglomerations. Indeed, the empirical evidence suggests that insufficient job accessibility is harmful for labour market outcomes in decentralized cities and accounts for a substantial part of the labour market penalization experienced by most vulnerable workers (see Ihlanfeldt & Sjoquist 1998, Ihlanfeldt 2006, Zenou 2008 and Korsu & Wenglenski 2010, among others). The main theoretical explanation for the poorer labour market performance of spatially mismatched workers is urban labour market is that the lack of job accessibility reduces the incentives to conduct a more intensive search for a good job (Gobillon et al., 2007, Zenou 2006, 2009). These models show that low job accessibility increases the likelihood to remain unemployed and/or makes people more

willing to accept low quality jobs. More recently, the theoretical model developed by Zenou (2013) points out that social networks represent another potential mechanism through which "job disconnection" might affect labour market outcomes. In fact, spatially mismatched workers are prevented to accede to good network connections that are likely to foster employment and job quality. As a consequence, public policies aimed at increasing job accessibility by public and private transport would be beneficial for individuals' performance in urban labour markets.

Based on this general framework, our research focuses on the impact of job accessibility on employment and job quality of individuals residing in the metropolitan area of Barcelona. This metropolitan area is particularly relevant for our analysis, since experienced a significant decentralization of employment and residential locations during the last decades, as well as a substantial (but still insufficient) increase in public expenditure directed to improve spatial connectivity. More specifically, we extend the previous work by Matas et al. (2010) by considering not only the effect of job accessibility on the likelihood of being employed, but also its potential impact on an extremely relevant aspect of job quality, which consists in the degree of adjustment of individual's completed education to his/her attained occupation (i.e. job-education mismatch). The extensive literature on job-education mismatch (see Leuven & Oosterbeek 2011) highlights that (especially) having a job below the attained qualification level — that is, being overeducated, which is a specific aspect of vertical job-education mismatch — represents a situation of underemployment and generates a waste of human capital. Indeed, overeducation is associated with lower productivity, less remuneration (relatively to equally-educated but well-matched workers), increased risk of job quit and job dissatisfaction.

It has been also argued that job-education mismatch, especially in the form of overeducation, might be (among other things) the result of spatially constrained job search. Therefore, beyond unemployment, the incidence of overeducation should be higher among spatially constrained workers. Put in other words, increasing job accessibility should reduce the risk of being overeducated in urban labour markets. Following this line of reasoning, from the seminal work by Büchel & van Ham (2003), a growing number of papers concern with the role played by spatial flexibility in explaining employment probabilities and (taking into account self-selection into employment) the propensity to become overeducated, which represents a specific case of having a low quality job (see Hensen 2009 for the Netherlands, Jauhiainen 2001 for Finland, Huber

2012 for several EU countries, Iammarino & Martinelli 2012, Devillanova 2012 and Croce & Ghignoni 2013 for the Italian case, as well as Ramos & Sanromà 2013 for Spain). The general result from these papers is that fostering spatial flexibility (in terms of either migration, commuting or private transport accessibility to the workplace) is beneficial for employment and, in general, reduces the probability of suffering some kind of job-education mismatch. However, to the best of our knowledge, none of the existing papers explicitly consider the role played by job accessibility by public transport in explaining the risk of overeducation[1]. Indeed, we consider that improving private transport accessibility (i.e. car availability) is of course relevant, but generates additional congestion and pollution costs. Moreover, female labour market performance in urban labour markets could be especially sensitive to public transport accessibility rather than car availability.

Therefore, the main contribution to the literature made by paper consists in analyzing the effect of job accessibility by public transport connections to employment centres not only on the chances of being employed, but also on the incidence and the extent of job-education mismatch (in the form of overeducation). In doing that, on the one hand, we explicitly recognize the relevance of private transport accessibility (proxied by the number of available cars per adults in the household) and, on the other hand, we enable public transport accessibility to affect car endowment at the family level. More specifically, our econometric strategy relies on a recursive system of equations with correlated errors[2] that explains the number of cars per adults in the household, the likelihood of being employed and job-education mismatch. Moreover, we allow cars availability to appear in the employment and mismatch equations in an endogenous way, whereas the measure of public transport accessibility appears as an exogenous variable in the mismatch and employment equations, as well as in the one that explains car availability (as done by Matas et al., 2009). In this way we account for the fact that private and public transport represent substitutive forms of commuting from the residential location to the workplace (that might affect employment and job quality) and that disposing of better public transport connections might modify the propensity to have more car in the household (keeping other factors constant). An additional contribution of this paper is that we focus our

[1] On the contrary, the relationship between public transport accessibility and employment outcomes has been previously studied by Cervero et al. (2002), Holzer et al. (2003), Sanchez et al. (2004) and by Matas et al. (2010), among others.

[2] In this way, we try to control for unobserved individual heterogeneity that might simultaneously affect car availability, employment and mismatch, which appear to be relevant due to the significant estimated correlation coefficients between the residuals of the three equations. Since the employment equation identifies the subsample of individuals who are regularly employed, we also control for sample selection based on unobservable elements in the job-mismatch equation (that can be estimated only for employed individuals who are not a random subsample of the entire population).

analysis on a specific urban area[3], which would implicitly limit the importance of territorial unobserved heterogeneity, while other existing studies on the issue of overeducation usually draw on data at the national/country level (and rely on the use of control or territorial fixed effects to control for local labour market effects).

It seems worth to notice from the beginning that public transport accessibility to the workplace is considered to be an exogenous variable in our empirical analysis. However, since this variable is intrinsically based on residential location, it might be argued that the estimated effect of public transport accessibility on the three outcomes that we analyze throughout the paper could be biased by the presence of endogenous residential sorting (i.e. individuals who tend to perform better in the labour market because of favourable unobservable traits might be more likely to reside in neighbourhoods better covered by the public transport network). We actually recognize that residential sorting represents a relevant issue for our analysis (as suggested by Dujardin et al., 2009 and by Åslund et al., 2010, among others) but, unfortunately, we cannot directly deal with this issue because we do not dispose of exogenous predictors of residential location. However, as previously done in the literature, we present two falsification proofs that seek to verify whether restricting the sample to individuals for whom residential location can be reasonably assumed to be less affected by endogeneity provide or not similar results. The results from these robustness checks suggest that endogenous residential sorting does not seem to be the main driver of the overall results presented in what follows. The rest of the paper is organized as follows: in the next section we describe the data that are used in the empirical analysis and in section 3 we introduce the econometric strategy. Section 4 presents the results and some robustness checks (subsection 4.1) and finally section 5 concludes.

2) Data and Descriptive Statistics

This study draws on data from the 2001 Spanish Micro-census, which covers 5% of the Census of Population. The main advantages of this dataset are its large sample size and the level of spatial disaggregation of the information, which enables defining territorial variables using very small spatial units (census tract level). Therefore, the 2001 Micro-census is the only source of information that allows locating

[3] Notice that, as well explained in section 3, the measure of public transport accessibility that we use in this paper captures the spatial distribution of jobs (which reflects employment potential) relative to their accessibility in terms of public transport time. Connectivity to employment centers by public transport facilities is based on administrative data on official travel time matrices (available for the whole metropolitan area of Barcelona) rather than self-reported measure of commuting time by public transport.

job places at municipality level and, hence, constructing a precise measure of job accessibility. The database also provides information on several individual characteristics (among others: age, gender, citizenship, marital status, level of education, field of tertiary education, labour market status and occupation) and on a large number of household characteristics (household composition, number of children, number of working adults, number of cars, availability of second residence, housing tenure and housing size). Since our aim is to analyse the impact of job accessibility on labour market outcomes, we selected individuals aged between 16 and 64 who are not involved in education, are not retired or disable. We also excluded individuals who are either self-employed or employers, because defining job-education mismatch is somewhat subtle for these groups of workers, as well as individuals belonging to occupation with fewer than 20 observations (which is needed for constructing job-education mismatch, see below). Finally, we also excluded very few individuals living in households where there are multiple families, since the number of cars is defined at the household level while the number of adults (and family composition in general) is defined at the family level. We end up with a sample comprising 93,038 observations belonging to the Barcelona's metropolitan area (44,077 males and 48,961 females).

The study focuses on the metropolitan area of Barcelona, the second largest metropolitan area in Spain. In 2001, this metropolitan area had 3,263 square km and 4.4 million inhabitants distributed among 164 municipalities, which implies an average density of 1,380 inhabitants per km^2. The central city, with a relatively small area of around 100 km^2, concentrates somewhat more than one third of the whole population, with a population density of 15,150 inhabitants per km^2. Job density shows substantial differences between municipalities, with an average of 476 jobs per km^2 in the metropolitan area and 7,828 in the city of Barcelona. In recent decades, a process of employment and residential decentralization took place, since the central city has lost both population and jobs, relative to the entire metropolitan area. It is interesting to notice that the process of population suburbanisation has been lower for high income people, whereas employment decentralisation has been lower for jobs filled by population with post-compulsory education levels.

As previously commented, the labour market outcomes that we analyse in this paper are employment and job-education mismatch, where the latter is considered to be a meaningful measure of job quality (among the employed subsample). There are several alternative ways of defining job-education mismatch — i.e.

whether the individual is endowed of more/less qualification than what is actually required in his/her workplace — and the discussion about which method prevails over the others is still open (see Hartog, 2000, McGuinnes, 2006, Verhaest & Omey 2006, 2010 and Leuven & Oosterbeek 2011 for more details). Usually, as is the case of the present work, the final choice mostly depends on data availability. Since the Census database does not contain any direct information about qualification requirement in the workplace, we define job-education mismatch using the Method of Realized Matches, which relies on the difference between individual's years of schooling and average schooling in the corresponding occupation (two-digit national classification). Therefore, an individual is considered to be under/overeducated if he/she has less/more schooling than the average in his/her occupation, minus/plus one standard deviation point.

The main variables of interest in this study are those related to (potential) accessibility from the neighbourhood of residence to the workplace, which may influence the individual performance in the labour market in terms of employment and job quality. In order to measure disconnection between jobs and residential places, we distinguish between private and public transport accessibility to job opportunities. With respect to accessibility by private transport, we selected the number of cars per adult in the household. Matas et al. (2010) suggest that the relevant variable to approximate distance to jobs is not commuting time with private transport, but rather car availability in the household[4]. This result is in line with other studies and reflects that private transport is sometimes the only option to connect residential places and job opportunities (Raphael & Rice, 2002 and Ong & Miller, 2005). Regarding public transport, the measure of job accessibility that we used in this paper is the employment potential for each zone of residence[5]. Following Rogers (1997), a measure of market potential should take into account the spatial distribution of jobs and the distance or cost to reach them. The employment potential fulfils both requirements. According

[4] Notice that we do not explicitly consider which member of the household actually uses the car(s), since this would introduce further complications in the empirical analysis. However, under the assumption that each member of the household has the same probability of using the car(s), taking the number of cars per adults represents a parsimonious way of approximating potential car availability in the family.

[5] As suggested by Bunel and Tovar (2013), the use of alternative measures of job accessibility might lead to different results. Therefore, we checked for the sensitivity of our results obtained under different definitions of job accessibility by public transport, such as the one that considers occupied Jobs and active workers, different specifications of exponential decay functions with varying weights for public transport time, etc. and the results appeared quite robust with respect to the original ones. Therefore, we retained the results obtained using the simplest non-weighted measure of employment. Finally, it should be noted that the measure used in this paper does not account for potential frontier effects, which could arise from the artificial truncation of the pool of reachable jobs within administrative boundaries. However, Bunel and Tovar (2013) found that this was not a significant problem for the Paris region, since it is surrounded by a large area where there are very few jobs. Therefore, failing to register jobs outside the Paris region frontier is not likely to modify the accessibility measure. Although this is not the case of Barcelona, in our view the frontier issue should not be be a problem given that the geographical area considered matches the local job market for the city.

to the literature, the most suitable variable for capturing employment potential should be the number of vacancies but, unfortunately, we do not dispose of job vacancies. Therefore, the total number of jobs located in each zone has been taken as a proxy for vacancies. The implicit assumption is that zones with a higher number of jobs will also generate a higher number of vacancies (Rogers, 1997). More specifically, job accessibility by public transport has been defined as:

$$pta_k = \sum_j \frac{empl_j}{t_{kj}}$$

where $empl_j$ is the number of jobs located in zone j, t_{kj} is the travel time by public transport between k and j, k is the individual's zone of residence and j is the destination zone. Therefore, job accessibility for an individual resident in zone k depends on the sum of employment opportunities in each destination zone j, inversely weighted public transport travel time between k and j. Regarding residential areas, transport zones represents the geographic unit of analysis. These are a subdivision of municipalities used to calculate travel time matrices. Destination zones are defined at municipality level, as this is the smallest spatial unit for which the number of jobs is available. However, in order to improve the accuracy of the accessibility measure within the city of Barcelona, jobs are calculated at the district level. The index is computed using job locations from the 2001 Census of Population. Commuting times are based on real network data and are obtained from the official travel time matrices. For intrazonal trips, a commuting time was assigned according to the implicit radius corresponding to the surface of each municipality or district. Overall, this variable provides a measure of the extent to which the lack of public transport can diminish potential job opportunities.

Across the metropolitan area of Barcelona, the index ranges from 10 for the zone with the lowest accessibility to 61,427 for the zone with the highest, with an average of 32,087[6]. The spatial distribution of public transport job accessibility is depicted in Figure 1, which shows that job opportunities can be more easily reached by public transport in the Capital City, along coast at the south of Barcelona and in the west-side of its metropolitan area.

[FIGURE 1 ABOUT HERE]

[6] Notice that the measure of public transport accessibility has been divided by 10,000 for the purpose of descriptive statistics and the subsequent econometric analysis.

Since public and private transports are clearly substitute ways of reaching job opportunities, we expect that families residing in areas served by better public transport infrastructure are, on average, less dependent on private transport. In order to get a first impression about this relationship, in Figure 2 we represent the scatter plot of the (census tract average) number of cars per adults with respect to public transport job accessibility, which highlights a negative and significant relationship between these two variables.

[FIGURE 2 ABOUT HERE]

The same relationship can be also appreciated in Table 2, which indicated that the higher quintile of job accessibility, the lower proportion of families with more than one car per adult (and the higher incidence of having no car in the household). Moreover, the same table reports, separately for males and females, row differentials in unconditional employment probabilities by public and private transport accessibility respectively. In general, the share of employed individuals is significantly higher in the male subsample, since a significant proportion of women declare to be involved in housework tasks (30% against 0.62% among males), while the incidence of unemployment (i.e. not working but actively looking for a job) is similar for both genders. The increase of car availability (relative to the number of adults in the family) improves the chances of being employed for both genders, although the employment differential between males and females appear to be the same also for those who have at least one car per adult in the household. On the contrary, the statistical association between public transport accessibility and employment is less clear for female and appears to be even negative for the males. In addition, both forms of job accessibility seem to be negatively associated with job quality (defined in terms of job-education mismatch), since the extent of job-education mismatch (i.e. the difference between years of schooling and the corresponding occupation average) as well as the proportion of individuals who are classified as overeducated[7] (i.e. mismatch greater that the standard deviation of schooling within each occupation) increase with job accessibility by public and private transport.

[TABLE 1 ABOUT HERE]

Nevertheless, the bivariate relationship between private and public transport accessibility to the workplace, employment and job-education mismatch that we observed in the raw data is likely to be

[7] The incidence of overeducation that we obtain from our sample (about 16% and similar for males and females) is somewhat lower than what reported in other studies of the Spanish economy (see Ramos & Sanromà 2013 for a review), probably because our data refers to the metropolitan area of Barcelona where the demand for high-skilled work is substantially higher than in other parts of the whole Spanish territory.

confounded by other individual and family/household characteristics that co-vary with these variables. Schooling attainments represent the clearest example: in fact, more educated individuals might reside in neighbourhoods endowed of a better public transport network and, in principle, they are more prone to afford the expense of buying a (more) car(s), but at the same time they face a higher risk of being overeducated. Also the bivariate relationship between public transport accessibility and car availability might be affected by confounding factors such as family structure, family wealth and neighbourhood effects. Therefore, in what follows we present the empirical strategy that we follow with the aim of ruling out the effect of covariates from the (complex) relationship between job accessibility by public and private transport, and obtaining a *ceteris paribus* effect of our variables of interest in a multivariate framework.

The explanatory variables have been selected according to standard literature related to each of the three equations that we analyse — i.e. car ownership, employment and job-education mismatch — and are listed (together with basic descriptive statistics by gender) in Table 1A in the Appendix. As individual characteristics we considered age, educational attainment, field of study, country of birth, marital status and potential work experience (measured as age minus years of schooling[8] minus six). Regarding household composition, we dispose of the number of adults (aged 20 or more), the number of children of different ages and the percentage of working adults. A shortcoming of the census data is that no information is provided on the level of household income. Given that income is a crucial determinant of the number of cars, we have partially circumvented this weakness by considering a set of variables that can be considered proxies for household income such as educational attainments, housing size, second residence property and housing tenure. Moreover, we also constructed a dummy variable that takes value 1 if the individual perception of the quality of public transport in the neighbourhood is poor and 0 otherwise (since we expect that perceived low quality of transport networks would increase the propensity to have at least one car in the household) and another that picks up households located in the central city — which has been included in order to account for the highest congestion and parking costs for those households located in the central city, as well as the higher quality of public transport. Notice that local labour market characteristics and residential segregation

[8] Years of schooling have been imputed from completed education level using the following conversion rule: 0 years for illiterate, 2 for uncompleted primary education, 6 for completed primary education, 8 for lower secondary education, 12 for upper secondary education, 12 for vocational training, 14 for advanced vocational training, 15 for short-term university degree, 17 for university degree and 20 for doctoral studies. The same variable has been used to compute job-education mismatch using the realized matches approach.

might represent another potential confounding factor, especially regarding the impact of public transport accessibility (that varies at the local level) on car availability, employment and mismatch. Although relying only on the metropolitan area of Barcelona would implicitly reduce the extent of labour market heterogeneity (possibly correlated with our measure of public transport accessibility), we also included in our empirical analysis the local unemployment rate — defined at census tract level[9] — as a proxy for neighbourhood effects (as in Büchel & van Ham, 2003, Hensen et al., 2009, Jauhiainen, 2010, Matas et al., 2010, Croce & Ghignoni, 2013, Ramos & Sanromà, 2013 among others).

3) Econometric Model

In this section we present the empirical strategy that we adopted to disentangle the relationship between public-and-private transport accessibility to the workplace, employment and job-education mismatch. Our main aim consists in estimating the impact of job accessibility on the likelihood of being employed and on the extent of mismatch between attained education and job requirements. Moreover, we also allow public transport accessibility to affect the number of cars per adult in the household, in order to take into account the interrelation and the potential substitutability between public and private transport. In doing that, we shall face two main econometric problems. First of all, given that job-education mismatch can be observed only among employed individuals, the job-education mismatch equation should be estimated conditioning on sample-selection based on unobservable factors that affect both employment decisions and job quality (as done by Büchel & Van Ham 2003, Jauhiainen 2011, Rubb 2011, Devillanova 2012, Sanromà & Ramos 2013 and by Croce & Ghignoni 2013). Second, we consider that private transport availability represents a potential determinant of both employment and job-education mismatch, which is also likely to be related with unobservable factors that affect these two labour market outcomes (as noticed by Raphael & Rice 2002, Gurley & Bruce 2005, Baum 2009, Bansak et al., 2010 among others). Therefore, the empirical analysis is based on a recursive system of equations that enables handling with these issues in a meaningful and

[9] This variable provided a better fit than other alternative measures such as the distribution of working-age neighbourhood residents by citizenship, the distribution of working-age neighbourhood residents by education or the distribution of dwellings by age of construction.

consistent way. Concretely, we estimate the following three-equation system by means of Limited Information Maximum Likelihood[10]:

$$mismatch_i = \alpha + \beta' X_i + \gamma \cdot pta_i + \delta \cdot nca_i + \varepsilon_i \quad if\ empl_i = 1 \tag{1}$$

$$\text{Prob}(empl_i = 1) = \text{Prob}\left(empl_i^* > 0\right),\ empl_i^* = \mu + \omega' Z_i + \pi \cdot pta_i + \gamma \cdot nca_i + u_i \tag{2}$$

$$nca_i = \varphi' W_i + \tau \cdot pta_i + v_i \tag{3}$$

$$(\varepsilon_i, u_i, v_i) \sim N(0, \boldsymbol{\Omega}), \quad \boldsymbol{\Omega} = \begin{pmatrix} \sigma_\varepsilon & \sigma_{\varepsilon u} & \sigma_{\varepsilon v} \\ & 1 & \sigma_{uv} \\ & & 1 \end{pmatrix} \tag{4}$$

Equation (1) relates job-education mismatch with a vector of control variables (X_i) and with job accessibility by public transport (*pta*) and by private transport (*nca*) where, as explained above, the latter form of job accessibility is approximated by the number of cars per adult in the household. Notice that we preferred to use as LHS variable in the job-mismatch equation the continuous variable "mismatch" (i.e. the difference between individual's years of schooling and the average in his/her corresponding occupation) instead of the discretized variable "overeducation", since this last option would provoke a loss of information. However, in what follows we will recover the impact of our variables of interest in terms of the "amount" of overeducation (as explained in the next section). A more fundamental issue is that, as commented above, the mismatch equation is defined only for the subsample of individuals who are regularly employed at the time of the survey (i.e. if "$empl_i = 1$"), which generates the aforementioned issue of sample-selection bias. In order to account for that, we specify the employment equation (eq. (2)), which explains the probability of being employed (using a Probit specification) as a function of individual and family characteristics (Z_i), plus public-and-private job accessibility. Finally, the number of cars per adult is modelled using a linear equation (eq. (3)), which includes a set of individual and family covariates, housing and local variables (included in the vector W_i), plus public transport accessibility. Notice also that the error terms of these three equations are allowed to be correlated — as expressed by equation (4) — and are assumed to follow a Multivariate Normal Distribution. This means that we enable the unobservable

[10] The estimations are carried out using the STATA routine "cmp", developed by Roodman (2011). Given that the three equations contain public transport accessibility in the list of regressors, which is defined at the census-tract level, we cluster the standard errors at the census-tract level in order to account for the potential correlation between the error terms of individuals who reside in the same (census-based) area.

determinants of the number of car per adult, employment and mismatch to share common elements that would bias the coefficient of interest if the three equations are separately estimated[11].

The specified system of equations follows a recursive structure, in the sense that the outcome of equation (3) enters as determinant of equations (1) and (2) and equation (2) identifies the subsample used for estimating equation (1), but (e.g.) the final outcome of equation (1) does not enter in the list of explanatory variables of equation (3). This means that the potential simultaneous relationship between the three outcomes of interest is not directly modelled, but is instead captured by the implied correlation between the error terms. Given the non-linearity of equations (2), the recursive system would be identified even if the variables included in the three equations are exactly the same. However, in order to avoid weak identification, we introduce several exclusion restrictions in the employment and cars ownership equations, i.e. variables that are strong determinants of employment and car availability but can be assumed to be unrelated to job-education mismatch. Finding valid exclusion restrictions usually represents a challenging task in this framework, since the existing databases that enables capturing spatial effects (such as the microcensus) contains a huge amount of information but few "plausibly" exogenous identifying variables. The choice that we adopted in this paper is driven by data availability, together with what has been found elsewhere in the literature. Family structure and especially the number/presence of children has been largely employed as exclusion restriction for the employment equation in several empirical works[12] (in the context of wage regression and selection into employment, see, for example, Martins, 2001, Mulligan & Rubinstein, 2008, Lee, 2009 and Chang, 2011). In this paper, we exploit the information about the number of children of different age ranges (0-4, 5-9, 10-15 and 16-19 respectively) as exclusion restrictions for the employment equation. We assume that, conditional on job accessibility and on other covariates, the number of children of different ages only affects job-education mismatch indirectly, through self-selection into employment.

Regarding the cars per adult equation, some studies have addressed the endogeneity of car ownership with respect to labour market outcomes adopting the standard Instrumental Variables approach. Raphael and Rice (2002) instrumented car ownership using insurance and gas tax costs and Ong and Miller (2005) used

[11] In the results section we also provide estimates of the correlation between error terms and their statistical significance. Failing to reject the null hypothesis of zero (pairwise) correlation means that the separate estimation of the underlying equations would produce biased parameters.

[12] Notice that Devillanova (2012) used the number of adults in the household as exclusion restriction for the employment equation. However, in our case the number of adults in the family cannot be included in the employment equation, since it is already included in the right-side of the equation (i.e. in the denominator of the variable "nca"). Therefore, we retained only the information about the presence of children of different ages.

the cost of auto ownership, the number of activities that can be conducted within the neighbourhood and the availability of alternative transportation as exclusions restrictions. The intrinsic difficulty of finding appropriate instruments for car availability (i.e. strong predictor of car availability unrelated with the final outcome of interest) is well recognized in the literature. The few exceptions are those studies that rely on exogenous changes in car-ownership related policies. For example, Baum (2009) controlled for potential endogeneity bias by jointly estimating employment and car ownership in a maximum likelihood framework, using differences in state vehicle asset rules governing welfare eligibility as instruments to identify the effect of car ownership. Bansak et al. (2010), referring to the same context, estimated a two-stage least square equation instrumenting car ownership with the asset-related welfare eligibility. In this paper, the available variables that has been selected as exclusion restrictions are the fraction of employed adults in the household (excluding the individual's contribution), housing-related variables (dummies for housing tenure and availability of a second residence, as well as housing usable space), an indicator that reflect the self-assessed judgment about transport network quality in the neighbourhood of residence and another that picks up residents in the Barcelona municipality (within its metropolitan area). The choice of these variables as determinants of car availability is in line with the general literature about car ownership (Matas et al 2009). Moreover, household-related variables — such as housing tenure and mortgage loan payment for accommodation — have been previously used as exclusion restrictions in similar studies (see, for example, Devillanova, 2012 and Croce & Ghignoni, 2013). In addition, the system's identification is reinforced by the fact that a) we include dummies for tertiary education field in the mismatch equation (which appear to be not significant in the other two equations) and b) employment and car availability are explained as a quadratic function of age, while mismatch contains potential labour market experience in the list of covariate (as also done by Büchel & van Ham, 2003 and Rubb, 2011). To the best of our knowledge, there is still no formal way of testing for the validity of overidentifying restrictions in this three-equation framework with sample selection. Therefore, caution should be taken in reading the results that will follow as true causal effects (instead of conditional correlations), since this definitively depends on assumptions that cannot be directly tested from the data.

Apart from that, there is an additional issue that should be taken into consideration. Our empirical strategy is based on the assumption that public transport accessibility represents an exogenous variable.

However, the coefficient associated might reflect, as least to some extent, endogenous residential sorting, which means that individuals who are intrinsically more likely to be employed and less likely to be mismatched are more prone to reside in areas endowed of better public transport networks (for a detailed review about the issue of endogenous residential sorting, see Dujardin et al., 2009). Åslund et al. (2010) suggested that endogenous residential sorting affects the relationship between job proximity and labour market outcomes. Using a (very specific) sample on Swedish refugees, they solved this problem exploiting a natural experiment generated by a refugee policy that randomly assigned individuals to residential locations and shown that job accessibility still matters (even under random residential sorting). Unfortunately, we were unable to directly deal with this issue, mostly because of the lack of exogenous predictors of public transport job accessibility. However, in the robustness checks' subsection, we report additional results that can be taken as falsification tests for the relevance of residential sorting in the relationship between public transport accessibility and our outcomes of interest. Specifically, we first repeat all the estimations only for those individuals who did not change their residence in at least the past 10 years (as also done by Matas et al 2010), for whom residential location can be reasonably assumed to be exogenous at the time of the survey. Secondly, we estimate the three equations only for those individuals who are living with their parents (following Dujardin et al., 2008), since their residential location within the urban area is mostly determined by their parents. Although also in these cases better public transport accessibility might be capturing long-standing unobserved family characteristics that are positively related to labour market outcomes, obtaining similar results in these additional estimations could be taken as an evidence in favour of the meaningfulness of our results (at least in qualitative terms).

4) Results

The results that we obtained from the three equations recursive system (separately estimated for males and females) are reported in Table 2. We first briefly comment the estimates associated with control variables[13] included in each equation, which are in line with the results previously obtained in the literature, and then discuss with more detail the results regarding job accessibility variables.

[13] The estimated coefficients for control variables obtained from independent equations are roughly the same and are not discussed here for brevity reasons. We only report the detailed results (estimated elasticities for each outcome) with respect to public and private job accessibility for comparison (see Table 2A in the Appendix).

The results from the cars per adults equation show that, as expected, more educated individuals have a higher number of cars per adult in the family, with similar effects for males and females, and car availability is lower for immigrants than for natives. Being married and having more children in the family increases the propensity to have more cars per adults, keeping the number of adults constant (which displays the unsurprising negative sign), as it is the case for the percentage of employed adults (other than the individual). The estimates associated to household and neighbourhood variables indicate that housing tenure, housing size and disposing of a second residence have the expected effect on car availability, suggesting that these variables are actually capturing family wealth that favour the affordability of car purchase. Moreover, individuals who consider that the quality of public transport network in their place of residence is scarce are more likely to have more cars (per adults), while we observe an opposite effect for those who reside in the capital city. Finally, residents in areas with higher unemployment rates have fewer cars per adults in the family, which reflect the general idea that residential segregation is often accompanied by insufficient job accessibility by private transport.

The employment equation suggests that educational attainments represents a fundamental determinant of the chances of being employed and that schooling might mitigate the differences in employment observed between males and females since the coefficients — and the corresponding marginal effects (not shown) — associated to each education level are significantly higher for females than for males. Those who are born outside Spain, especially if they are males, are in general penalized in terms of employment probability with respect to Spaniards (with some exception due to the low number of observations). As usually reported in the literature, residing in a neighbourhood with higher incidence of unemployment reduces employment probabilities, with a similar impact (computes as marginal effect on the predicted probabilities) between males and females. The effect marital status is, as expected, inverted between males and females, since married males are more likely to be employed, while the opposite result is obtained for females. The impact of age on employment probabilities is inverted U-shaped for both men and women and slightly more pronounced for the former. Finally, the presence of children is detrimental for employment, but significantly more for females than for males and especially when their age is lower.

Regarding the job-education mismatch equation, we obtain the usual result indicating that more educated individuals are, keeping other factor constant, increasingly exposed to the risk of a positive mismatch (i.e.

they are more likely to be overeducated). However, the incidence and the amount of mismatch among university graduates is quite heterogeneous across different fields of study, since — relative to graduates in social sciences — the difference between individuals' schooling and the occupation-average is significantly lower especially for graduates in health disciplined (mostly due to the stringent regulation of health-related professions), for males graduated in technical studies and, to a lesser extent for females who studied hard or humanities. Job-education mismatch decreases with (potential) work experience, which might be explained by both career progression for more tenured workers and/or by the impact of changes in the cohort/education composition of the workforce. Immigrant workers in general suffer of a greater degree of mismatch, with the exception of those coming from EU15 countries that are less likely to have more qualification than the average in their occupations. Finally, being married increases mismatch among male workers, but has the opposite effect among their female counterparts.

We now focus with more detail on the estimates associated to the main variables of interest of this paper, i.e. the measures of job accessibility by public and private transport. With the aim of facilitating the results' interpretation, we directly describe the elasticities of the three outcomes with respect to a 10% increase in public and private transport accessibility respectively. First of all, the negative effect of public transport accessibility on the number of cars per adult in the family is still present even in this multivariate framework. In fact, the negative and relatively high elasticity of car availability with respect to public transport accessibility confirm that public and private transport represent substitute (albeit imperfect) ways of reaching job opportunities and that individuals residing in areas endowed of better public transport networks have less incentives to have more cars in the household (conditional on household composition and other controls). Regarding the employment equation, it appears that the probability of being regularly employed among females is especially sensitive to job accessibility and, somehow contrary to our expectations, the effect of potential accessibility by private transport is slightly higher than the impact of public transport. However, the chances of being employed among males are less dependent from job accessibility, since the impact of public transport accessibility is virtually zero and car availability has only a modest (but significant) elasticity of 0.045. Finally, we also expressed the effect of public and private accessibility to the workplace on job-education mismatch. However, since — as previously commented — the lack of adjustment between formal qualification and job requirements is especially worrisome (and can be view as a form of underemployment)

when it takes the form of overeducation, we expressed the impact of job accessibility in terms of elasticities with respect to the years of overeducation[14] rather than overall mismatch. We consider that focusing on the effect of job accessibility in the total number of years of overeducation is meaningful, since it provides a picture about the amount of human capital that would be prevented from being wasted after an improvement in potential connectivity from residential places to employment centres. In contrast to what observed in the descriptive analysis, the evidence obtained from the estimated system of equations indicates that, in general, both forms of job accessibility are relevant for reducing the incidence and the extent of overeducation in the urban labour market, thus confirming the evidence reported in previous studies. More specifically, our results suggest that overeducation has a similar elasticity with respect to car availability for males and females, although public transport job accessibility is somewhat more important for reducing the positive mismatch between attained qualifications and occupations for men than for women.

It seems also worth to notice that the estimated correlations between the error terms of the three equations are always significant and go in the same direction for both males and females, which means that the interrelation between the unobservable elements that affect car availability, employment and job-education mismatch should be taken into account in order to obtain a consistent estimate of the impact of job accessibility on labour market outcomes. For comparison purposes, we also report the estimated elasticities of public and private transport accessibility that are obtained assuming that the three equations are independent (see Table 2A in the Appendix). The results obtained from independent equations show that the elasticity of public transport accessibility on car availability is almost identical to what obtained from the recursive system of equations, which is due to the fact that job accessibility by public transport is treated as an exogenous variable. The elasticity of public transport accessibility on male employment probabilities is still insignificant and virtually zero, while public transport maintains its positive effect (even if somewhat smaller) on employment chances among females. Moreover, the positive elasticity of private transport on employment outcomes is lower for both males and females when estimated using independent equations (but still positive and significant), due to the negative correlation between the error terms of car availability and

[14] More specifically, we computed the percentage difference between the sum of the "observed" number of years of overeducation (i.e. years of education that exceeds the average schooling in the individual's occupation plus one standard deviation point) and the sum of the years of "predicted" mismatch that exceeds the respective standard deviation after a 10% increase in public transport accessibility. Notice that, in order to assure the comparability between the observed and the predicted amount of overeducation, we imputed the residuals of the mismatch equation to the predicted mismatch resulting from a 10% change in public transport accessibility.

employment equations respectively. Regarding job-education mismatch, the negative elasticities of car availability obtained from independent equations are slightly less pronounced than those obtained from the system, while the effect of public transport among females is somewhat higher in the former case than in the latter among females. Nevertheless, this exercise suggests that, albeit the recursive estimation is relevant in this context (and should be taken as reference for a quantitative interpretation of the results), the evidence produced using independent equations goes in the same direction (in qualitative terms) and highlights the robustness of the overall results about the relationship between public-and-private job accessibility and labour market outcomes.

4.1) Robustness Checks

With the aim of providing additional evidence if favour of the meaningfulness of the results presented in this paper, we performed several robustness checks for our estimates. As previously commented, we are especially concerned about the exogeneity of our measure of public transport accessibility, since it might be argued that it could be mostly driven by endogenous residential sorting (see Dujardin et al., 2009). Unfortunately, we do not dispose of exogenous predictors of this variable that would enable its instrumentation, and arguing that people randomly select their place of residence seems to be rather implausible. However, we performed two falsification exercises in this regard, which taken together would indicate whether (or not) the conditional relationship between public transport accessibility and labour market outcomes is just a mirror of endogenous residential sorting. Basically we seek to replicate the analysis for different subsamples of individuals for whom residential location can be taken as exogenous with respect to labour market outcomes. First of all, as previously done by Matas et al. (2010), we re-estimate the system of equations restricting the sample to individuals who have not changed their residential location in at least the last 10 years. Second, following Dujardin et al. (2008), we consider that individuals who still live with their parents have rather limited influence on residential choices. Therefore, the relationship between public transport accessibility and labour market outcomes obtained selecting this specific subsample would be less contaminated by the endogeneity of residential sorting.

The results from these two alternative falsification exercises are reported in Table 4 (we only report the elasticities of each outcome with respect to a 10% increase in public transport accessibility), together with

the baseline results for comparison. The elasticity of public sector accessibility on car availability in both subsamples is very similar to the baseline result and remains insignificant for employment probability among males. Moreover, public transport connectivity still matters for the chances of being employed among females, although the elasticity among females who are living with their parents is somewhat lower. However, job-education mismatch (in the form of overeducation) is especially sensitive to public transport accessibility for young women — and, to a lesser extent for young men — in the urban labour market. Additionally, public transport accessibility to the workplace has a similar impact on the extent of overeducation for both males and females who spent more than 10 years residing in the same place, compared to the baseline results. Taken together, these additional results might be taken as suggestive that endogenous residential sorting, even if actually operates, does not seem to be the main explanation of the overall evidence reported in this paper[15].

Finally, we also performed an additional robustness check that aims to take into account that car ownership decisions are taken at the family level and the sample contains repeated observations within each family. The most suitable option would be estimating the cars per adults equation at the family level, as done by Matas et al., (2009), but this would introduce further complications for estimating the recursive system of equations[16]. Therefore, we repeated the analysis using only observations from individuals who declare to be the reference person in the household. The elasticities of private transport accessibility are also reported in Table 4 for both males and females. The results suggest that employment chances among the head of the household are less affected by car availability and even more in the case of women. This happens in part because they are more likely to be employed than other individuals in the household (especially if the head of the family is a woman, among whom only 18% do not work compared to 41% from the whole female sample), but also because they could be more prone to be who actually make use of the car. Consistently with this explanation, the overall risk of being overeducated in the labour market is more significantly reduced after an improvement in public transport connectivity among females who are head of the

[15] We recognize that the two falsification strategies that we followed in this work are not free of criticisms. In fact, unobserved family characteristics related with residential location might still affect both subgroups of workers if a) these represents long-standing elements and/or b) they are transmitted from parents to children and shared within the family. Moreover, some kind of endogenous sample-selection might be present, especially among young individuals living with their parents. However, observing qualitatively similar results than what obtained with the whole sample is anyway reassuring in terms of the robustness of our empirical analysis.

[16] Another option to take into account that car availability is the same for each individual belonging to the same household could be clustering the standard error at the family level. However, this could be applied only to household of more than one member in the sample, which would introduce selection bias (especially because we split the sample between males and females).

household. This evidence suggests that increasing the quality of public transport networks in urban areas would be especially relevant for job quality among this group of women who, for several possible reasons, tend to participate more actively in the labour market.

5) Conclusions

In this paper we analysed the effect of job accessibility by public and private transport on labour market outcomes in a urban labour market. More specifically, drawing on Census data from the Metropolitan Area of Barcelona, we examined the relevance of job accessibility in terms of employment probabilities and, among those individuals who are regularly employed as salaried workers) on job quality. We referred to job-education mismatch a measure of job quality, putting a special emphasis on the status of overeducation (i.e. having more qualifications than what required in the workplace), since it can be assimilated to a general case of underemployment that generates a waste of human capital. Regarding job accessibility by private transport we considered the number of cars per adult in the family, whereas public transport accessibility has been approximated using a standard measure that reflects the spatial distribution of employment potential in each zone relative to its commuting cost in terms of public transport time. Our methodological framework is based on a recursive system of equations that takes into account that car availability, employment and job-education mismatch are interrelated processes that should be jointly estimated, as well as the existing interrelation between public and private transport accessibility. The estimations have been carried out separately for males and females, with the aim of checking for gender differences in the impact of public and private transport accessibility to the workplace.

The results indicate that, in general, job accessibility matters for both employment and job-education mismatch. However, both for of job accessibility have a substantial and similar effect in terms of the chances of being employed among females, although only private transport seems to have a positive and moderate impact in the likelihood of being employed among males. Moreover, car availability has a positive effect on reducing the incidence and the amount of overeducation, with a similar effect for both males and females. Finally, job-education mismatch seems to be especially sensitive to improvements in public transport accessibility, with a slightly higher effect for males. Additional robustness checks suggest that our results are

not driven by the potential endogenity of residential sorting, albeit we were not able to explicitly deal with this issue due to the lack of identifying variables.

Overall, our analysis confirm the evidence reported in other studies regarding the importance of private transport accessibility for employment outcomes and job-education mismatch, which also holds for the urban labour market of the metropolitan area of Barcelona. Moreover, the evidence reported in this paper also highlights the special importance of public transport connectivity to the workplace, which was never explored before. Therefore, taking into account the potential congestion and pollution costs associated to fostering car availability, the main policy recommendation that can be derived from our analysis is that public policies should assign more weight to public transport relative to the private one. Indeed, improving the quality and the extension of public transport network would stimulate female labour force participation and employment outcomes, as well as job-quality among both males and females, avoiding externality costs associated with additional traffic of private vehicles in (already saturated) urban area.

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TABLES AND FIGURES

Figure 1: Public Transport Job Accessibility in the Metropolitan Area of Barcelona

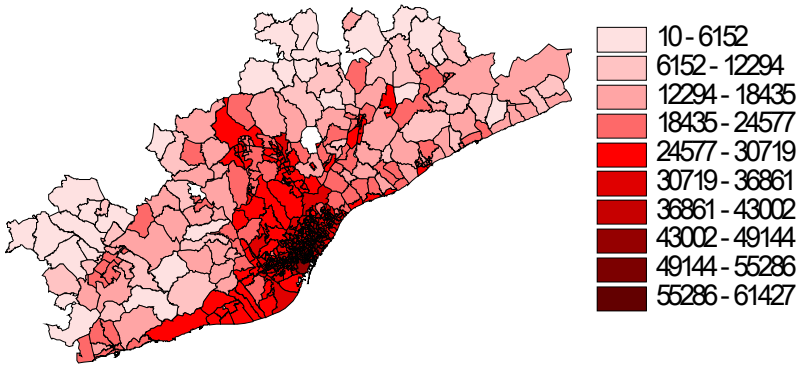
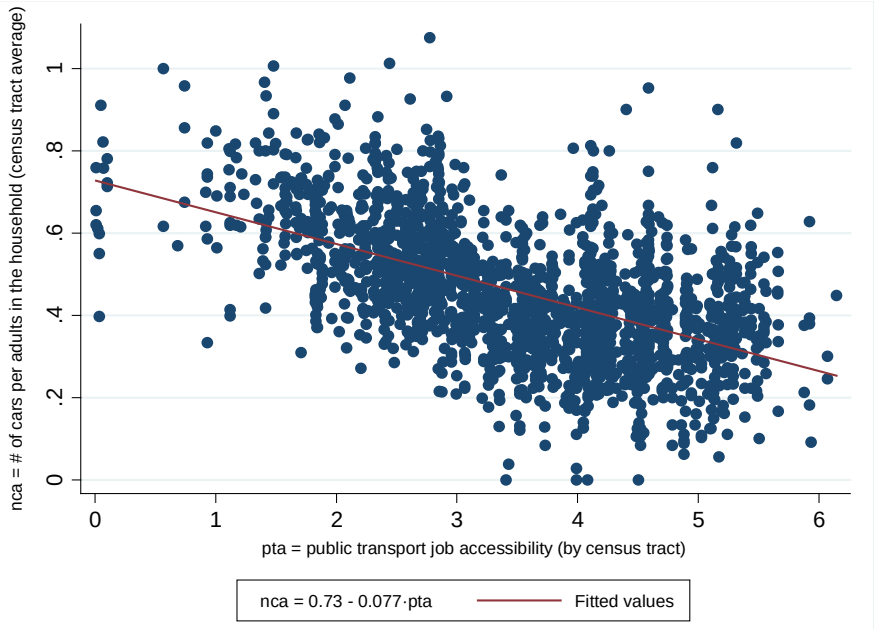


Figure 2: Public Transport Accessibility and Number of Cars per Adult in the Household



Estimation results

Table 2: Estimation Results

	Males			Females		
	nca	***empl***	***mis-match***	***nca***	***empl***	***mis-match***
constant	0.921[a]	-0.150	-5.465[a]	0.678[a]	-0.579[a]	-6.094[a]
	(36.937)	*(-1.404)*	*(-63.551)*	*(30.542)*	*(-6.616)*	*(-52.842)*
no education	*reference category*					
primary education	0.035[a]	0.015	3.939[a]	0.020[a]	0.042[c]	3.943[a]
	(5.274)	*(0.424)*	*(123.702)*	*(3.871)*	*(1.796)*	*(72.715)*
lower secondary education	0.065[a]	0.077[b]	5.315[a]	0.052[a]	0.194[a]	5.119[a]
	(9.935)	*(2.239)*	*(150.797)*	*(9.814)*	*(8.186)*	*(91.821)*
upper secondary education	0.095[a]	0.134[a]	5.861[a]	0.085[a]	0.486[a]	6.096[a]
	(12.828)	*(3.161)*	*(123.350)*	*(13.330)*	*(16.249)*	*(94.123)*
vocational education - low grade	0.094[a]	0.165[a]	8.767[a]	0.082[a]	0.396[a]	8.386[a]
	(11.841)	*(3.694)*	*(180.412)*	*(11.152)*	*(12.085)*	*(116.421)*
vocational education - high grade	0.118[a]	0.313[a]	9.721[a]	0.104[a]	0.579[a]	9.569[a]
	(14.820)	*(5.929)*	*(178.754)*	*(13.723)*	*(15.685)*	*(127.321)*
short university degree	0.119[a]	0.243[a]	8.768[a]	0.123[a]	0.956[a]	9.023[a]
	(14.006)	*(4.422)*	*(114.561)*	*(17.002)*	*(26.148)*	*(111.705)*
university degree	0.129[a]	0.354[a]	9.330[a]	0.125[a]	1.059[a]	9.836[a]
	(15.316)	*(6.133)*	*(123.704)*	*(17.077)*	*(27.342)*	*(112.034)*
doctoral education	0.129[a]	0.539[a]	11.001[a]	0.112[a]	1.143[a]	11.418[a]
	(7.999)	*(4.366)*	*(83.737)*	*(6.346)*	*(11.641)*	*(65.195)*
field of study (only for tertiary education) = social sciences			*reference category*			
field of study (only for tertiary education) = humanities			0.064			-0.166[c]
			(0.475)			*(-1.725)*
field of study (only for tertiary education) = health disciplines			-1.796[a]			-1.161[a]
			(-16.482)			*(-15.315)*
field of study (only for tertiary education) = hard science			-0.113			-0.285[b]
			(-0.956)			*(-2.434)*
field of study (only for tertiary education) = technical disciplines			-0.638[a]			-0.181
			(-8.187)			*(-1.440)*
potential experience (= age - years of schooling - 6)/10			-0.175[a]			-0.317[a]
			(-16.514)			*(-21.752)*
born in Spain	*reference category*					
born in EU15 countries	-0.076[a]	-0.300[a]	-0.394[a]	-0.038[b]	-0.400[a]	-0.518[a]
	(-4.240)	*(-3.320)*	*(-2.714)*	*(-2.093)*	*(-5.400)*	*(-2.939)*
born in other European countries	-0.155[a]	-0.114	1.006[a]	-0.092[a]	0.156	0.879[a]
	(-5.254)	*(-0.731)*	*(4.060)*	*(-3.219)*	*(1.164)*	*(2.961)*
born in Africa	-0.122[a]	-0.282[a]	0.289[a]	-0.125[a]	-0.063	0.052
	(-9.824)	*(-4.502)*	*(4.263)*	*(-8.650)*	*(-0.912)*	*(0.349)*
born in America	-0.175[a]	-0.178[a]	0.791[a]	-0.157[a]	0.190[a]	1.281[a]
	(-15.974)	*(-2.790)*	*(8.779)*	*(-16.887)*	*(3.906)*	*(12.683)*
born in other countries	-0.141[a]	0.031	0.369[b]	-0.136[a]	0.095	0.876[a]
	(-8.402)	*(0.297)*	*(2.500)*	*(-7.004)*	*(0.814)*	*(3.842)*
local unemployment rate	-0.609[a]	-3.134[a]	2.704[a]	-0.545[a]	-1.677[a]	1.171[a]
	(-11.452)	*(-11.266)*	*(8.120)*	*(-10.618)*	*(-8.435)*	*(2.627)*
public transport job accessibility (pta)	-0.049[a]	0.006	-0.168[a]	-0.059[a]	0.099[a]	-0.107[a]
	(-18.656)	*(0.629)*	*(-14.320)*	*(-23.525)*	*(13.328)*	*(-7.427)*
# of cars per adult in the household (nca)		0.614[a]	-0.553[a]		0.803[a]	-0.572[a]
		(8.440)	*(-7.459)*		*(13.583)*	*(-5.429)*

Note: [a] significant at 1% level, [b] significant at 5% level, [c] significant at 10% level; t-Statistics in parenthesis, standard errors clustered at the census tract level.

Table 2: Estimation Results (*continued*)

	Males			Females		
	nca	***empl***	***mis-match***	***nca***	***empl***	***mis-match***
marital status = single			*reference category*			
marital status = married	0.095[a]	0.407[a]	0.099[a]	0.100[a]	-0.519[a]	-0.232[a]
	(19.588)	*(15.195)*	*(3.342)*	*(21.118)*	*(-24.583)*	*(-5.991)*
marital status = others	0.051[a]	-0.135[a]	0.037	-0.033[a]	0.200[a]	0.420[a]
	(5.896)	*(-3.524)*	*(0.751)*	*(-4.333)*	*(6.958)*	*(8.473)*
age/10	-0.032[a]	0.697[a]		0.030[a]	0.459[a]	
	(-3.329)	*(14.109)*		*(3.327)*	*(12.565)*	
age^2/100	0.002	-0.083[a]		-0.005[a]	-0.090[a]	
	(1.489)	*(-15.235)*		*(-4.615)*	*(-18.834)*	
# children aged 0-4		-0.042[c]			-0.252[a]	
		(-1.698)			*(-15.600)*	
# children aged 5-9		-0.020			-0.217[a]	
		(-0.748)			*(-13.569)*	
# children aged 10-15		-0.054[b]			-0.153[a]	
		(-2.461)			*(-10.919)*	
# children aged 16-19		-0.055[a]			-0.059[a]	
		(-2.853)			*(-4.453)*	
# children aged 0-19	0.030[a]			0.032[a]		
	(12.656)			*(13.739)*		
number of adults in the household = 1			*reference category*			
number of adults in the household = 2	-0.369[a]			-0.280[a]		
	(-37.621)			*(-29.581)*		
number of adults in the household = 3	-0.459[a]			-0.358[a]		
	(-46.782)			*(-37.159)*		
number of adults in the household = 4	-0.503[a]			-0.401[a]		
	(-49.473)			*(-40.127)*		
number of adults in the household ≥ 5	-0.557[a]			-0.456[a]		
	(-51.224)			*(-42.306)*		
% of employed adults in the household	0.095[a]			0.119[a]		
	(23.849)			*(27.394)*		
housing tenure = rental	-0.100[a]			-0.088[a]		
	(-19.136)			*(-19.116)*		
second residence available	0.067[a]			0.071[a]		
	(13.316)			*(15.753)*		
housing usable space (in m^2/100)	0.116[a]			0.118[a]		
	(17.251)			*(21.399)*		
perceived quality of transport network (% bad)	0.025[a]			0.016[a]		
	(5.327)			*(3.771)*		
residing in Barcelona	-0.043[a]			-0.025[a]		
	(-7.310)			*(-4.577)*		
$\rho_{\varepsilon,u}$			0.418[a]			0.739[a]
			(12.83)			(39.11)
$\rho_{\varepsilon,v}$			0.069[a]			0.053[a]
			(5.339)			(3.479)
$\rho_{u,v}$			-0.085[a]			-0.200[a]
			(-3.881)			(-10.72)
Number of observations	44077			48961		

Note: [a] significant at 1% level, [b] significant at 5% level, [c] significant at 10% level; t-Statistics in parenthesis, standard errors clustered at the census tract level.

Table 3: Average Elasticities with respect to Public and Private Transport Accessibility

	OUTCOME		
	%Δ[years of overeducation]	*%ΔPr[employed]*	*%Δ [# cars per adult]*
MALES			
%Δ(public transport job accessibility)	**-0.113**	0.004	**-0.323**
%Δ(# cars per adult)	**-0.059**	**0.045**	--
FEMALES			
%Δ(public transport job accessibility)	**-0.076**	**0.170**	**-0.402**
%Δ(# cars per adult)	**-0.059**	**0.194**	--

Note: for each possible outcome we report average elasticities computed with respect a 10% increase in public transport accessibility and in the number of cars per adult in the household respectively. The elasticity on the years of overeducation has been computed considering as overeducated individuals with more years of schooling than the average in their respective occupation plus one standard deviation point (i.e. mismatch greater that the standard deviation of years of schooling in each occupation). Numbers in bold type indicate that the corresponding coefficient is significant at a 5% significance level.

Table 4: Sensitivity Analysis (elasticities of public and private transport job accessibility)

	OUTCOME		
	%Δ[years of overeducation]	*%ΔPr[employed]*	*%Δ [# cars per adult]*
MALES — baseline sample (n = 44077)			
%Δ(public transport job accessibility)	**-0.113**	0.004	**-0.323**
%Δ(# cars per adult)	**-0.059**	**0.045**	--
MALES — only individuals with more than 10 years residing in the same place (n = 22765)			
%Δ(public transport job accessibility)	**-0.115**	-0.018	**-0.355**
MALES — only individuals residing with their parents (n = 11116)			
%Δ(public transport job accessibility)	**-0.139**	0.014	**-0.360**
MALES — only reference person in the household (n = 23545)			
%Δ(# cars per adult)	**-0.058**	**0.014**	--
FEMALES — baseline sample (n = 48961)			
%Δ(public transport job accessibility)	**-0.076**	**0.170**	**-0.402**
%Δ(# cars per adult)	**-0.059**	**0.194**	--
FEMALES — only individuals with more than 10 years residing in the same place (n = 25871)			
%Δ(public transport job accessibility)	**-0.085**	**0.157**	**-0.425**
FEMALES — only individuals residing with their parents (n = 7461)			
%Δ(public transport job accessibility)	**-0.123**	**0.066**	**-0.526**
FEMALES — only reference person in the household (n = 15007)			
%Δ(# cars per adult)	**-0.136**	**0.069**	--

Note: for each possible outcome we report average elasticities computed with respect a 10% increase in public transport accessibility and in the number of cars per adult in the household respectively. The elasticity on the years of overeducation has been computed considering as overeducated individuals with more years of schooling than the average in their respective occupation plus one standard deviation point (i.e. mismatch greater that the standard deviation of years of schooling in each occupation). Numbers in bold type indicate that the corresponding coefficient is significant at a 5% significance level.

Table 1: Public and Private Transport Job Accessibility, Employment and Job-Education Mismatch

				Males	Females	Males	Females	Males	Females
public transport accessibility (pta)	***% nca = 0***	***%0 < nca < 1***	***% nca ≥ 1***	***% employed***		***average mismatch***		***% overeducated***	
quintile 1	10.06	60.91	29.03	89.89	56.88	-0.230	-0.061	14.25	14.69
quintile 2	12.49	65.28	22.23	89.90	57.22	-0.251	-0.096	14.62	14.52
quintile 3	16.02	66.98	17.00	89.33	56.49	-0.157	-0.006	15.66	15.59
quintile 4	24.67	65.13	10.20	87.48	57.50	-0.049	0.186	17.17	17.24
quintile 5	31.72	57.85	10.43	87.83	64.98	0.367	0.395	19.61	20.50
# of cars per adult in the household (nca)				***% employed***		***average mismatch***		***% overeducated***	
nca = 0				80.32	59.89	-0.394	-0.050	14.21	15.78
0 < nca < 1				90.02	55.00	-0.110	0.067	16	16.62
nca ≥ 1				93.44	70.48	0.334	0.316	18.48	17.55
Total	***18.96***	***63.25***	***17.79***	***89.91***	***58.65***	***-0.070***	***0.095***	***16.19***	***16.65***