Job accessibility through public transport and unemployment in Latin America: the case of Montevideo (Uruguay)

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Abstract

Accessibility to job opportunities is one of the factors that explains labor outcomes. For developing countries, public transport plays a key role in providing the population with access to employment opportunities. This paper aims to quantify accessibility by public transport to employment in Montevideo, Uruguay and to explore how accessibility to job opportunities via public transport relates to unemployment. To do so, we calculate a cumulative measure of accessibility to job opportunities for 1063 small zones—approximately 5-6 blocks each—within Montevideo. This measure yields accurate data on accessibility and can be assigned to individual households. Accessibility in Montevideo is unevenly distributed among social strata and is concentrated within the central (and wealthier) areas of the city. In addition, a multilevel logistic regression analysis indicates that greater accessibility to jobs via public transport is associated with a lower probability of being unemployed. This finding suggests that improving accessibility to job opportunities via public transit may enhance individual labor outcomes.

Keywords: Latin America; Montevideo; public transport; accessibility; urban employment

1. Introduction

Individual factors such as age, gender or education combined with structural factors related to the economy and the job market may explain individual employment outcomes. In addition to these crucial factors, access to job opportunities is also related to the probability that a person performs well in the job market. This is relevant for developing countries because public transport plays a key role in urban mobility, especially for poor households. In that sense, public transport is one of the most important policies for enhancing accessibility.

The scholarly literature that has linked urban unemployment and accessibility has referred to the lack of physical connection between households and labor markets and its effect on the job search process and on access to employment. Concerning this disconnection, the seminal work of Kain's (1968) *spatial mismatch hypothesis* (SMH) is a notable contribution to this line of inquiry. Specifically, Kain suggests that African-American households' lack of access to employment is a consequence of the suburbanization of job opportunities coupled with the concentration of the African-American population in central city areas (see Kain, 1992; Gobillon et al., 2007). This hypothesis has been empirically tested by examining access to employment. The core argument is that spatial accessibility influences the odds of a person procuring a job. In other words, individual factors, such as education level, may not suffice to increase employment in a context of low accessibility. Spatial accessibility thus may explain, at least in part, the probability of individual unemployment.

Accessibility may influence an individual's probability of unemployment through various mechanisms. Jobseekers with higher or adequate levels of accessibility to employment have more job opportunities available to them, which may shorten their job search duration as well (Korsu and Wenglensky, 2010). By contrast, jobseekers with low access to employment may experience higher commuting and job-seeking process costs. As search costs increase, motivation to pursue an opportunity decreases due both to the actual search costs and because of the projected commuter costs (Gobillon et al., 2007; Gobillon and Zelod, 2014). Moreover, distance to job centers and, as a result, to job opportunities, may harm job search efficiency, especially for low-skilled seekers as they may not know the location of suitable jobs for them, such as those that are locally advertised by flyers posted in local shops or companies. Costs associated with having to travel long distances to employment centers may result in the restriction of one's search to local neighborhoods, even if job opportunities are scarce (Gobillon and Zelod, 2014; Phillips, 2014). Accessibility also is related to unemployment through employers' lack of confidence in prospective employee's potential productivity or stability (i.e., workers with higher travel costs might constantly be looking for jobs closer to home) (Gobillon et al., 2007; Gobillon and Zelod, 2014). As this latter factor is beyond the scope of this paper, it is not directly addressed in the model we propose.

We seek to empirically explore the relation between unemployment probability and accessibility to job opportunities via public transport at the individual level in Montevideo, the capital city of Uruguay. To do so, we calculate a cumulative-opportunities accessibility measure for 1063 small zones (*segmentos censales*). The *segmentos censales* are similar to a census tract but smaller in size: approximately 4-6 blocks, depending on the area's population density. This yields a very accurate accessibility metric that can be used at the individual level. With small areas, we reduce the risk of assuming the same accessibility level for two households even when they may be in very different locations. We also develop a proxy for job opportunities, namely the location of commercial (non-residential) electricity customers. After validating the results against the mobility survey of Montevideo, our accessibility measure proved an effective method for overcoming the lack of data on job opportunities in Montevideo. Afterwards, we specified a multi-level logistic model to estimate the effect of job accessibility via public transport on the probability of being unemployed. The model includes individual-level attributes and it clusters the data at the neighborhood level (*barrio*). After presenting the findings, we discuss the distribution of accessibility among socioeconomic groups and the effect of public transport accessibility on job performance at the individual level.

Most previous empirical explorations of the SMH have been carried out in US cities. This urban context features a high level of car dependence, suburbanization of jobs and low-skilled job seekers living in the inner city as a result of housing segregation. Moreover, previous research has tended to focus on ethnic group differences in access to employment and specifically on African-American households, a demographic group with higher poverty levels than the general US population. We pose the same basic question but for a different region. Broadly speaking, in Latin American cities, the most vulnerable urban populations live far from employment centers; they tend to be concentrated in the urban periphery instead of in the city center. In addition, urban job opportunities are in the city center. Instead of opportunity being stratified by race or ethnicity, the most important segmentation is socioeconomic. Moreover, the urban poor are captive to the public transport system and must commute for long distances (Vasconcellos, 2012; Cervero, 2013; Oviedo y Titheridge, 2016).

As we mentioned above, our research explores the hypothesis that unemployment may be associated with low accessibility to job opportunities via public transport. Thus, we seek to contribute empirical research to the study of the relation between accessibility and job performance in the Latin American region. Equally important, we seek to add to the emerging body of research on the Global South and to provide an assessment of SMH in a very different context than those in which it has previously been studied. We believe that our findings will also help urban and transportation planners that work in segmented cities where there exists a low level of social development and a different pattern of modal share.

The remainder of the paper is split in five sections. Section 2 presents a review of the main empirical research work on accessibility and urban unemployment. Section 3 introduces the study area and describes the data used for the research. Section 4 discusses methods used to compute accessibility and the model specification. Section 5 presents the findings and results of the econometric model. Conclusions are presented in the final section.

2. Previous research

The main literature that has empirically tested the SMH by exploring the relation between accessibility and job performance has been produced in the Global North. The empirical strategies to test this relation have frequently included a model with a job performance variable, such as informality, unemployment (or unemployment duration) or income, an access to job opportunities variable, and a set of socioeconomic factors as control variables. Jin and Paulsen (2018) found for the Chicago Metropolitan Area that changes in job accessibility play a role in explaining unemployment rates and household income. The authors concluded that, for African Americans, increases in job accessibility decrease unemployment. Kawabata (2003) reached a similar conclusion for the metropolitan areas of Boston, San Francisco and Los Angeles. In this case, the author assessed the probability of being either employed or fully employed (30 hours or more per week) as a function of job accessibility. As expected, transit-based accessibility plays a more important role for workers who do not own a car. Korsu and Wenglensky (2010) found for the Paris Ile-de-France Metropolitan Region that both job accessibility and residing in high-poverty neighborhoods are related to job performance. More specifically, they concluded that low-skilled workers' likelihood of experiencing long-term unemployment (i.e. more than a year) is partly explained by job accessibility. Matas et al. (2010) tested the SMH hypothesis for female employment probability. They also found support for the hypothesis that job accessibility is related to employment probability (i.e. employment rates at census tracts levels) with lower accessibility being associated with a lower probability of employment. Ong and Houston (2002) also focused on women, specifically women on welfare in Los Angeles County. Instead of measuring accessibility in terms of cumulative number of employment opportunities, the authors used a measure of transport provision. Their findings show that the level of transit service near a welfare recipient's home is moderately positively associated with the probability of employment and transit use for work-related trips. Additionally, studies from the discipline of urban economics have identified a relation between distance to employment opportunities, travel time, and labor outcomes (e.g., Zenou, 2002; Pissarides, 2011; Andersson et al., 2018; Détang-Dessendre and Gaigné, 2009; Rogers, 1997).

Unlike in developed countries, in the Global South, there have been few empirical studies of the relationship between job accessibility and employment outcomes. Cervero (2013) has called attention to the importance of land use and transportation, which are the foundations of the concept of accessibility. This, however, was a conceptual paper that reviewed the importance of considering different "mismatches" but did not include empirical research. Chen et al. (2017) explored the relation between job accessibility and employment in Accra, Ghana. They computed access to employment by different travel modes (private, walking and informal shared mini-buses). With that information, they tested the effect of job accessibility on employment and informality. Their findings are consistent with those reported in the developed countries' literature.

In the Latin American context, the relation between job accessibility and individual labor outcomes has been tested by Boisjoly et al. (2017). They focused not on unemployment but on job informality. They found a significant relation between job accessibility and informality for low-paid workers. Specifically, for a low-income population, higher job accessibility was associated with a lower probability of being in the informal sector. Other Latin American empirical studies of job accessibility have been mainly descriptive in nature. For example, some studies have described the distribution of accessibility among the different social sectors, resulting in very useful equity diagnostics (Hernandez, 2018; Figueroa et al., 2018; Bocarejo and Oviedo, 2012; Guzman et al., 2017; Pereira, 2019; Peralta-Quirós and Mehindiratta, 2015) and other studies have simulated new distributions of accessibility after policy interventions (Guzman and Oviedo, 2018; Pereira, 2019). To our knowledge, however, the present paper is the first to use multivariate models to assess whether, in a Latin American country, job accessibility significantly predicts employment after controlling for other factors.

3. Area of study and data

3.1.Area of study

Montevideo is the capital of Uruguay. Even though it is the country's smallest jurisdictional area (526 km^2), more than 40% of the Uruguayan population (1.4 million inhabitants) reside there. Urban demographic growth in Montevideo since 2000 has been negligible. Socio-demographic changes in recent decades consist of the relocation of the working class population from central city areas to the suburban periphery. It is a monocentric city, with the central business district (CBD) in the southern portion of the city. Land use in the CBD is mixed; it concentrates job opportunities, households, as well as political and strategic economic and social centers (see Figures 3.1 and 3.2). The areas with the highest population densities are extend from the central coast towards the center of the department (i.e. province). Population densities are lower in areas farther away from the city center. Nevertheless, almost two-thirds of the city population reside in the urban and suburban periphery.

Figure 3.1. Population density in Montevideo (inhabitants per hectare) by census tract (*segmentos censales)* and urban regions classification.

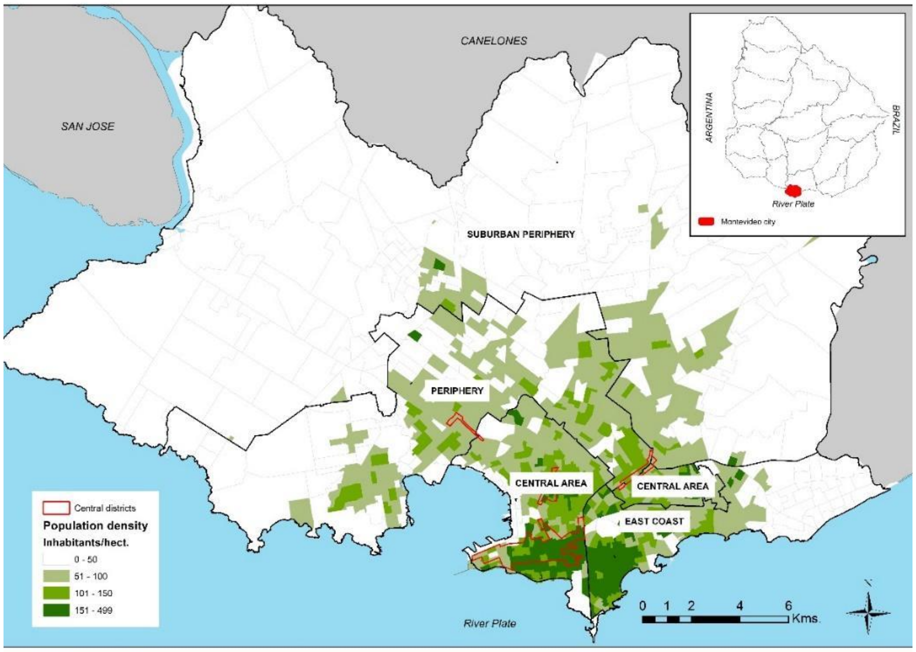
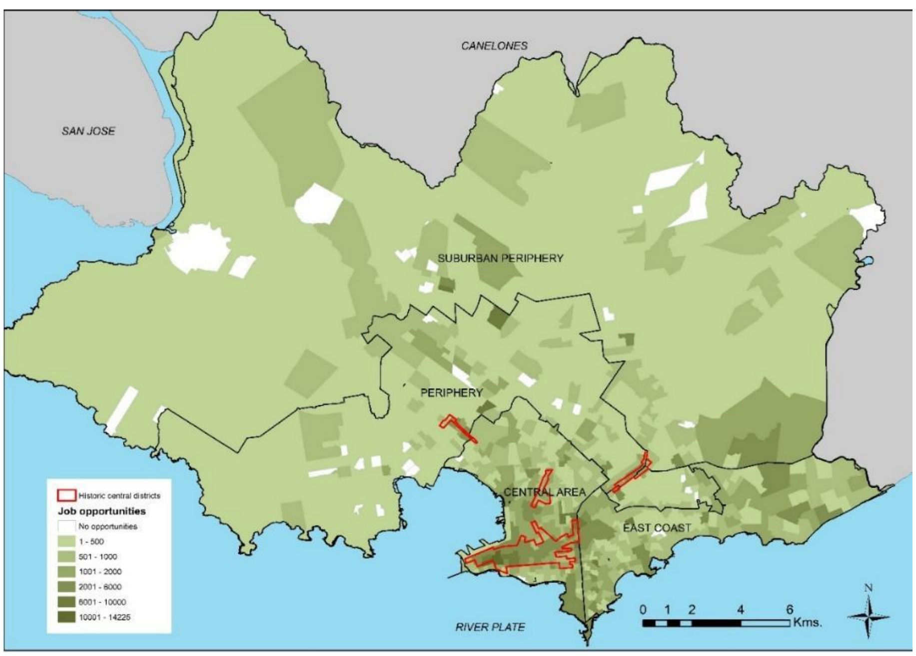
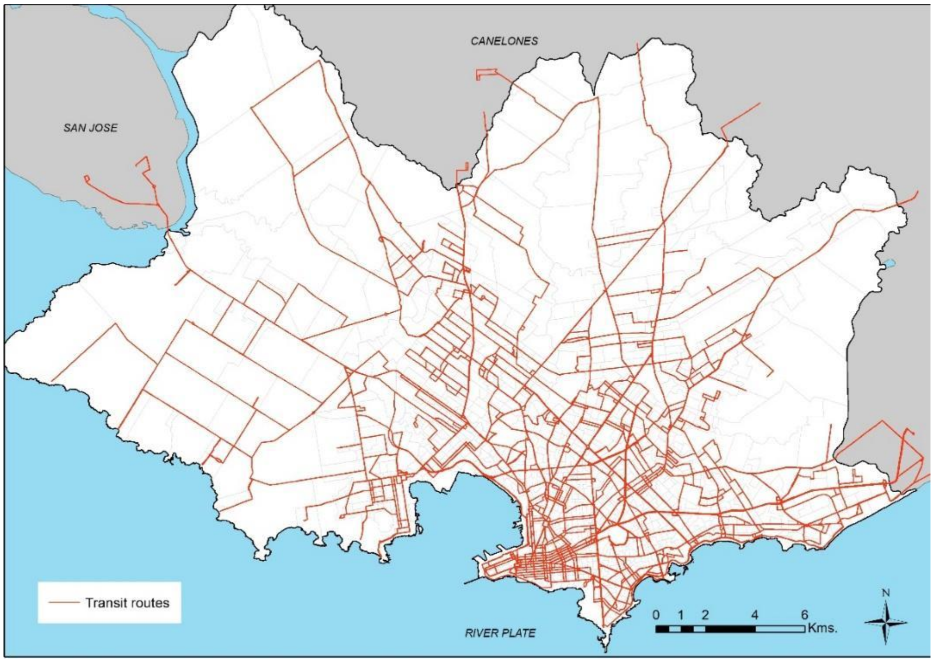


Figure 3.2. Number of jobs in the city of Montevideo by census tract (*segmentos censales)*.



Public transport in Montevideo consists of a bus system run by four companies that operate roughly 136 unique routes. Most of the routes pass through the central area of the city. The system has a fleet of 1500 buses, 4792 stops, and 3 transfer stations. According to a 2016 mobility survey, the system carries approximately 880,000 trips daily. Figure 3.3 shows the extent of the bus transportation network, which covers the entire urban area. Approximately 9 out of 10 households are located within 400 meters of a bus station (Hernandez, 2017).

Figure 3.3. Public transport network in Montevideo (urban services).



3.2. Travel time data

For research purposes, we computed a 1063 x 1063 public transport travel time matrix between *segmentos censales*. As mentioned above, these areas are small enough (comprising approximately 4-6 city blocks) to provide very accurate results. To compute travel times, we modeled the public transportation network as a graph in NetworkX (Hagberg et al., 2008), using open data regarding the roadway infrastructure, the public transportation lines, stops, and schedules[1]. We also account for restrictions on the maximum walkable distance and the maximum number of transfers allowed. A shortest-path algorithm was applied to the computed graph to obtain estimated travel times considering walking time, average waiting time, effective travel time, and transfer times. Passengers were assumed to take the shortest alternative in terms of total travel time among routes that involve at most two transfers (walking less than 20 minutes between transfer stops) and that involve walking no more than 30 minutes from the origin or to the final destination.

The estimated travel time matrix was validated against a mobility survey (Mauttone and Hernandez, 2017) and a public transport mobility online tool from the city government which provides users with the expected total travel time[2] for a given trip. The validation procedure examined a random subset of morning commutes from the survey. For each trip, three estimated travel times were compared: 1) the time reported by the passenger in the survey; 2) the time estimated by the online tool after a manual query by the research team; and 3) the time estimated using our proposed model. Results from the three data sources were highly correlated, with a Pearson coefficient of 0.90 between our model and the online tool and 0.83 between our model and the mobility survey results[3].

3.3. Data on job locations and individual data

To estimate job opportunities we used data on actual jobs similarly to the method used in the literature reviewed above. One of the challenges in conducting research on job accessibility in Montevideo is the lack of spatial information on job locations. Traditionally, researchers have adapted data from three sources: governmental agencies related to employment (e.g., the social security institute and the internal revenue office), census data or mobility surveys. For the case of Montevideo, agency data is not spatially accurate because the registered addresses are the formal ones (e.g., the address of a retail chain's administrative headquarters). Census data is not useful because the census questionnaire does not ask for the respondent's job address or location. Finally, while the mobility survey has the potential to provide spatial distribution data, the 2016 survey does not have enough cases to yield detailed data for small-area units.

To overcome this limitation, we estimated the location of job opportunities using georeferenced data of non-household customers (*clientes no residenciales*) of the Uruguayan energy company (*UTE*). This can be considered an "amenities approach" (Chen et al., 2017) to determining job location, but with

[1] Available in www.catalogodatos.gub.uy

[2] www.comoir.montevideo.gub.uy

[3] An in-depth description of the travel time estimation and validation process is available at Massobrio et al. (2017).

universal coverage and information. The non-household clients are buildings in which some type of non-residential institutional or economic activity takes place (e.g., a school, a commercial location, or a government agency). In a location of a non-household customer, it is highly likely to find an activity that employs at least one person. In contrast to other sources, these data have a precise geolocation of the premises in which the job exists, so it serves as an excellent proxy for job location at a granular level. Moreover, these data include the economic characteristics of the activity that takes place in the building. There are 21,106 premises with economic or institutional—non-residential—activity in Montevideo. To translate this number into actual jobs, we considered all individuals who work in Montevideo—856,424 according to the estimate of the Continuous Household Survey (ECH) of the National Institute of Statistics (*Instituto Nacional de Estadística*, INE), including both formal and informal workers. Then, we split the total number by economic sector (Divisions of International Standard Industrial Classification Rev. 3). The combination of these sources allows us to estimate the average number of workers by place of employment. Thus, our proxy for job opportunities across the city is the result of dividing the total number of jobs by the number of workplaces classified under each economic category.

This strategy has some potential limitations. First, because we use non-residential customers, the location corresponds to premises registered as economic or institutional units. Therefore, the spatial distribution corresponds mainly to economic units that are formally registered as such with the electricity company. One could argue that these units are part of the formal economy so we are not taking into account the spatial distribution of the informal job market. It is important to note that,, according to the INE, in 2017 Montevideo had an informality rate of 17%[4], which is very low compared to the region. In addition, it is feasible that some informal workers work in a building that is a formal non-residential electricity company costumer, so the spatial pattern probably includes part of this group as well. In short, we posit that the potential bias is not significant and does not invalidate the results provided by the indicator. A second potential limitation is that the way we estimated the number of jobs per business unit assumes that each workplace employs the same number of workers, which is almost certainly not the case, as within a particular economic sector there exist units of different sizes. Thus, our estimate is a rigorously derived educated guess.

To reduce the uncertainty regarding job locations, we validated the spatial pattern our method yielded by comparing it with a third-party source. Specifically, we used the mobility household survey of Montevideo 2016, taking the spatial unit for which the survey can report accurate figures. This was done using an aggregate spatial unit called *Centro Comunal Zonal* (CCZ), which divides the city into 18 jurisdictional areas. We compared the actual percentage of workers for each CCZ to the percentage of workers in each CCZ estimated from our method and found them to have very small differences. Thus, we can confidently state that we are able to replicate the result of a rteliable source at an aggregate level and, moreover, provide better spatial precision.

Regarding individual demographic data, we used the 2017 ECH of the INE (*Encuesta Continua de Hogares del Instituto Nacional de Estadistica).* This survey is collected throughout the year and is representative of Montevideo. It is the statistical tool used to compute national employment and poverty statistics, among others. After computing the accessibility indicator at the census tract (*segmento censal*) level, each household in the ECH takes the value of its census tract. This operation allows one

[4] http://ine.gub.uy/web/guest/actividad-empleo-y-desempleo [Last accessed: February 2020]

to analyze job accessibility at the individual level and generate the econometric model presented in the next section. For the analysis, we only consider economically active persons (23,578 cases).

4. Methods and model specification

4.1. Job accessibility index

The literature has identified a wide variety of accessibility indicators (e.g., Curtis and Scheurer, 2010; Geurs and van Eck, 2001). Among these, the cumulative opportunity index (Hansen, 1959) is the most commonly used in the literature since it is easy to interpret, and it allows one to set a travel time threshold. Moreover, it is an easy indicator to user for assessing inequality under the assumption that the more job opportunities an individual can reach, the greater the accessibility.

The threshold one selects is extremely important as it sets the ground-truth for assessing equity (see Lucas et al., 2016). We opted for the average transit time of work trips. This threshold makes sense as it allows one to disentangle hidden inequalities caused by differential accessibility to employment. In other words, if everyone had the same commuting time, we can identify sectors that perform better or worse. In addition, this measure is an excellent approach to assessing general welfare in contrast to other measures that, for instance, set a minimum number of opportunities.

Our index measures the number of job opportunities that an individual can access within a 40-minute trip on public transport. This is the "average trip length for work purposes" estimated for Montevideo by the 2016 mobility survey (Mauttone and Hernandez, 2017). The index is computed according to Equation 1.

$$A_i = \sum_j \quad O_j f\left(t_{ij}\right) \tag{1}$$

Where $A_i$is the job accessibility index for zone i, $O_j$is the number of job opportunities located in zone j, and $f\left(t_{ij}\right)$is a simple impedance function equal to 1 when the travel time between i and j by public transport is equal to or less than 40 minutes. As mentioned above, even when we calculate place-based accessibility, the analysis is individual-based. This is possible because areas for which we calculate accessibility are small enough to allow us to assign the value to the individual. Thus, we overcome the risks of committing an ecological fallacy and we avoid the modifiable areal unit. Even though the accessibility value is computed as the absolute number of jobs, we use the proportion of total jobs (A_i/856,424) for the model.

One of the limitations of this method is that it does not capture matching opportunities according to different socioeconomic profiles. This is because there is no available information regarding job opportunities to determine characteristics such as required skills or job type (e.g., management, clerical, manual). An additional limitation of this measure is that it does not corrects for the competition effect as it considers supply and not demand side. As a result, it assumes that all jobs are valid opportunities for everyone regardless of the number or people that could seek the same position. Even when this measure stands as a proper way to empirically assess access to jobs, it should be noticed that, as calculated here, this measure may overestimate actual accessibility to jobs.

4.2. Econometric model

A multilevel logistic regression model captures the effect of the accessibility index on the likelihood of being unemployed and it controls for both individual and household characteristics. The dependent variable is dichotomous and takes the value of 1 if the individual is unemployed and 0 otherwise.

Equation (2) formalizes these concepts.

$$Prob(Unemployed_i) = f\left(X_i, Access_j\right) \tag{2}$$

This formula indicates that the probability of an individual of being unemployed depends on variables associated with his/her personal and household characteristics (vector of variables X_i) and the job accessibility index ($Access_j$).

The objective is to specify a robust model of unemployment that controls for elements that theoretically determine the condition of being unemployed (e.g., age, educational level, head of household status, sex, motorized vehicle ownership socioeconomic characteristics of the neighborhood) and, thus, isolate the effect of accessibility. A hierarchical data structure was tested and the result suggests that data is clustered at the neighborhood level. To control for this and to avoid bias in the estimation, we fitted a multilevel model treating neighborhood (*barrio*) as the level at which to cluster our data.

The chosen model computes the odds ratio of the probability of a person of being unemployed. It is important to consider two potential sources of bias affecting the results of the model. The first source is potential endogeneity between accessibility and unemployment. Indeed, accessibility may causally affect unemployment, but it is also true that being unemployed could result in low accessibility. The second source is the omitted variables in the coefficients estimated by the model. The literature provides examples of research that addresses these issues (see, for example, Ihlanfeldt 2006 and Jin and Paulsen 2018). The analytical strategies described in the literature are well beyond the scope of the present paper and require data that is not available for the case of Montevideo. Given the lack of absolute certainty on this matter, we cannot draw any strong conclusions regarding the specific magnitude of the correlation between accessibility and unemployment. Moreover, although the related literature suggests a causal relationship, we make no such claims based on our findings but rather interpret the coefficients as an indication of association between the two variables; an association that is *consistent* with a causal relationship. Even though it does not represent any fundamental flaws in the proposed research, consideration is worthwhile when concluding from these results. Table 4.1. defines and provides summary statistics for each of the variables included in the model.

Table 4.1. Definition and summary statistics or the variables included in the model.

Variable	Description	Mean	SD	Min	Max
Aged 26 to 55 years	Binary variable that takes the value 1 if the individual is aged between 26 and 55 years and 0 otherwise (compared to omitted category 14 to 25)	*0.67*	*0.47*	*0*	*1*
Aged over 55 years	Binary variable that takes the value 1 if the individual is over 55 years of age and 0 otherwise (compared to omitted category 14 to 25)	*0.18*	*0.38*	*0*	*1*
Sex	Binary variable that takes the value 1 if the individual is female and 0 if male	*0.50*	*0.50*	*0*	*1*
Head of household	Binary variable that takes the value 1 if the individual is the head of household and 0 otherwise	*0.50*	*0.50*	*0*	*1*
Secondary education completed (not including individuals that pursue tertiary education)	Binary variable that takes the value 1 if the individual has completed secondary education (i.e. high school) and 0 otherwise (compared to omitted category less than secondary education completed)	*0.11*	*0.32*	*0*	*1*
Tertiary education (complete or incomplete)	Binary variable that takes the value 1 if the individual attends or has completed higher education course of study (i.e. university) and 0 otherwise (compared to omitted category less than secondary education completed)	*0.38*	*0.48*	*0*	*1*
Motorization	Binary variable that takes the value 1 if the home where the individual lives has at least one motorized vehicle (car, van or motorcycle) and 0 otherwise	*0.57*	*0.49*	*0*	*1*
Job accessibility	Continuous variable that represents the percentage of job opportunities in the Montevideo area that can be reached within 40 minutes by public transport	*0.40*	*0.29*	*0*	*0.82*

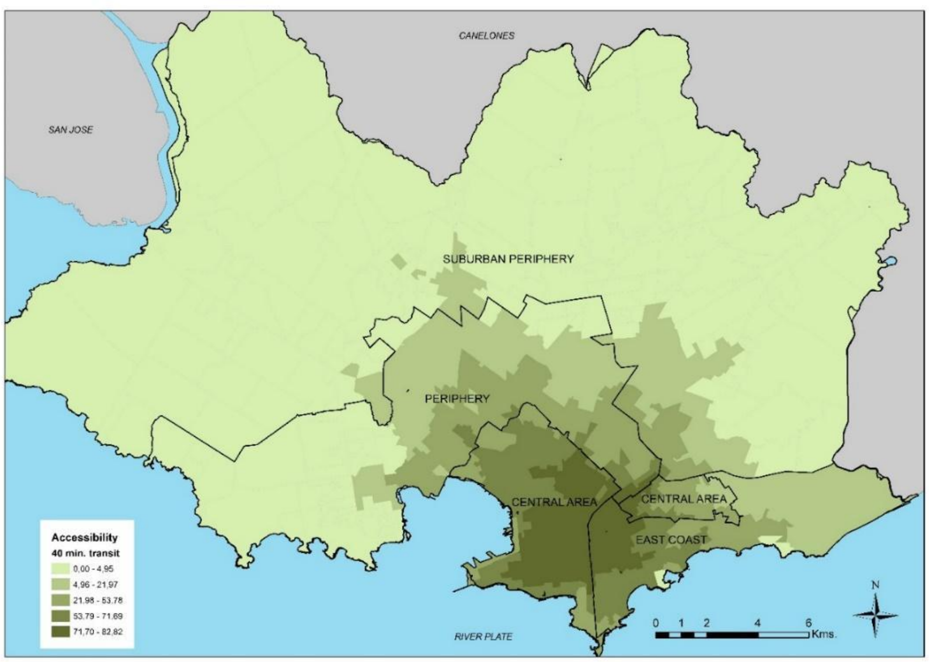
5. Results

5.1. Descriptive analysis of spatial accessibility to employment opportunities.

On average, the active population of Montevideo can access nearly 40% of the employment available in the city. In other words, this result suggests that the average economically active citizen in Montevideo can access a set of *segmentos censales*—i.e., can reach them within 40 minutes using public transportation—that collectively account for less than half of the jurisdiction's total employment opportunities.

Regarding the spatial pattern of accessibility, the highest accessibility values are concentrated in the central city area. The pattern could be described as a set of concentric irregular buffer rings (Figure 5.1). The farther an area lies from the central business district, the lower its level of accessibility. A small territory in the south-central part of the jurisdiction shows the highest level of accessibility (access to 7–8 out of every 10 employment opportunities), followed by areas to the northwest of this territory as well as areas closer to the coastline, where the accessibility levels slightly decrease. Areas far to the north, east, and west of the city center are home to populations in the lowest two income quintiles and have low accessibility; only 4% of the employment opportunities in these areas are accessible.

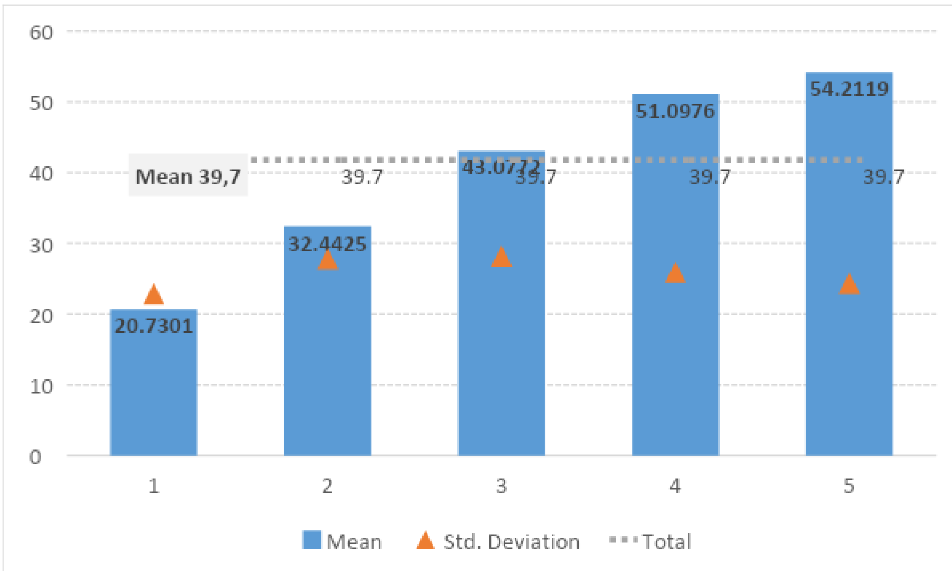
Figure 5.1. Jobs accessible within 40 minutes of travel time on public transport by census tracts (*segmentos censales*), as a percentage of the total jobs in the city.



NOTE: Accessibility quintiles define groups for classification.

The analysis of accessibility by income groups indicates that individuals with lower income have accessibility levels considerably below the average for the total population. Notably, although those in the lowest income quintile can access on average 21% of the employment opportunities, those in the second-lowest quintile can access 32%, and the value increases up to 43% for those in the middle quintile (see Figure 5.2). The difference between means is statistically significant for all income groups[5].

Figure 5.2. Average and standard deviation of job accessibility by household income quintiles. Accessibility is measured as a percentage of the total number of jobs in the city.



5.2. Multilevel logistic regression results

Following the accessibility level analysis, this subsection outlines the results of the econometric model to analyze the role job accessibility plays in the probability of individual unemployment. Table 5.1. presents the results of the estimated model.

5 Welsch Anova Robust Test of Equality of Means with statistical significance of 0.0000.

Table 5.1. Mixed logistic regression model results

Fixed effects	**Coef.**	**Std. Error**	**z**	**p value**
Intercept	*-0.65*	*0.06*	*-10.29*	*0.00*
Age (26 to 55 years)	*-1.51*	*0.06*	*-26.78*	*0.00*
Age (more than 55 years)	*-2.05*	*0.1*	*-19.74*	*0.00*
Gender (female)	*0.29*	*0.05*	*5.45*	*0.00*
Head of household	*-0.62*	*0.06*	*-10.25*	*0.00*
Secondary education (completed)	*-0.31*	*0.09*	*-3.26*	*0.00*
Tertiary education (completed or started)	*-0.35*	*0.07*	*-5.34*	*0.00*
Motorized vehicle ownership	*-0.49*	*0.05*	*-9.18*	*0.00*
Job accessibility	*-0.51*	*0.10*	*-4.96*	*0.00*
Observations: 23578				
$\chi^2(9) = 1{,}596.14$, $p = 0.00$				
Pseudo-R^2 (fixed effects) = 0.19				
Pseudo-R^2 (fixed effects) = 0.19				
AIC = 11,218.7 / BIC = 11,299.25				
Random Effects. Group Neighborhood				
Intercept (Std. Dev) 0.05				
Neighborhood (62 groups) ICC: 0.00				

The model shows the expected direction of association for traditional predictors such as age, gender, and education. Regarding our research question, the model's results support the existence of a relationship between accessibility to employment and unemployment. Indeed, job accessibility is a statistically significant predictor of unemployment and the sign of its coefficient is consistent with the findings in the literature. In other words, living in an area with low levels of access to job opportunitiesis correlated with a higher probability of being unemployed. The opposite also holds for individuals living in areas with high levels of accessibility. People with the same educational level, gender and age may be correlated with different probabilities of being unemployed related to the differences in accessibility to job opportunities by public transport. It is important to note that motorization is also a statistically significant predictor of unemployment. This means that members of households whose private resources make them less dependent on public transport are more likely to find a job. One of the empirical implications is that, as expected, the association between accessibility and unemployment may be higher for for transit-dependent riders.

To sum up, our empirical findings suggest that improving accessibility to employment opportunities reduces the probability of an individual being unemployed. This finding is consistent with the studies conducted in the Global North and provides an additional positive case to support the spatial mismatch hypothesis.

6. Conclusion

This paper aimed to explore the relationship between access to employment and the probability of being unemployed. Our empirical findings identified a spatially stratified pattern of job accessibility in Montevideo. On average, each active person in the city of Montevideo has access to a total of 39.7% of the jobs in the city, where accessibility is defined as reachable within 40 minutes when traveling by public transport. Nonetheless, this average hides a stratified with notable socioeconomic and spatial biases. These results support the conclusion that an uneven distribution of accessibility levels exists among the population, with clearly defined groups of "accessibility rich" and "accessibility poor" individuals. Thus, this phenomenon, which has been found among other Latin American cities, also exists in Montevideo.

The econometric model results indicate that territorial accessibility is associated with the probability of an individual being unemployed. Job accessibility, when controlling for a set of variables traditionally used to explain unemployment, is a statistically-significant predictor, in the expected direction, of employment status. Individuals with lower levels of accessibility are more likely to be unemployed according to the estimated correlation, when all other factors widely recognized as predictors of job performance are held constant. These results are consistent with the literature that has empirically explored the Spatial Mismatch Hypothesis and shows that the hypothesis is supported in an urban context very different from that for which it was originally developed. As noted above, the Latin American urban context encompasses segmented territories and features an “inverse” pattern of housing segregation than is traditionally seen in the USA; in Montevideo, the poorest households are located in the urban outskirts and jobs and affluent households are concentrated in the center. Moreover, transit in Latin American cities plays a key role in accessibility due to the high number of transit-dependent riders.

In terms of the policymaking process, the evidence we have presented sheds light on central urban development concerns. Efforts to boost employment options by focusing on individual factors (e.g., education) may have limited success if they are hindered by poor access to employment opportunities. The paper calls attention to the determinants of accessibility: land use and transportation policies. As the accessibility composite is not enough to tackle specific components, more research work is needed to disentangle which component has to be prioritized and how. The results of this paper suggest that labor policy should consider interventions for individuals and territories with low levels of job accessibility.

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