Residential location and travel in a polycentric city

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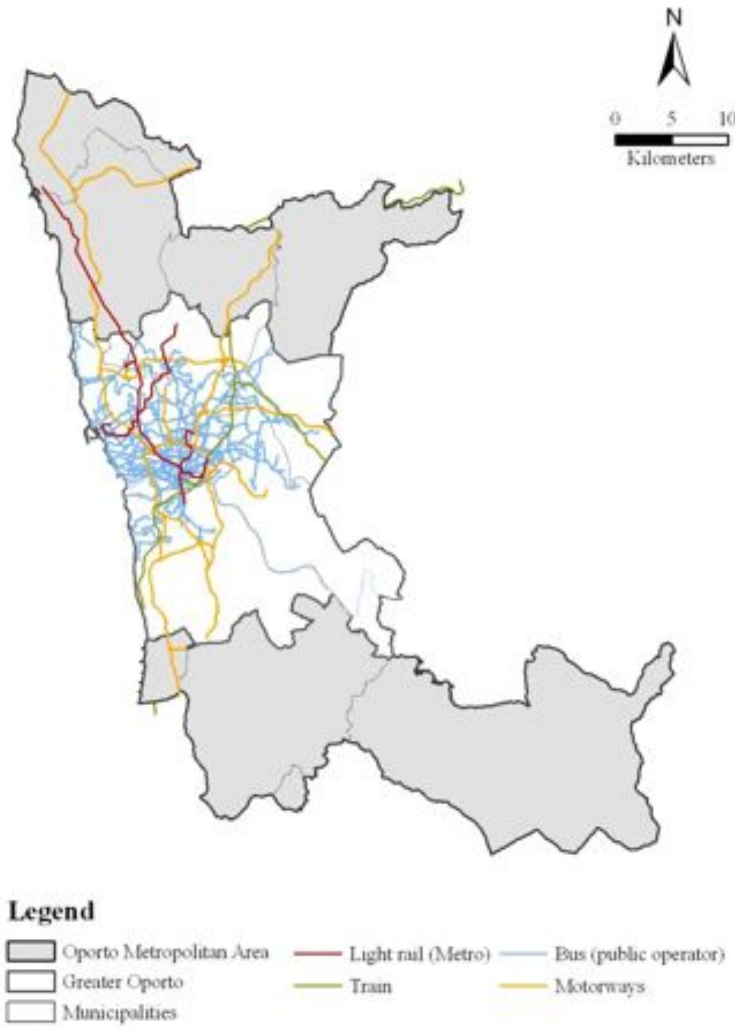
The Greater Oporto case

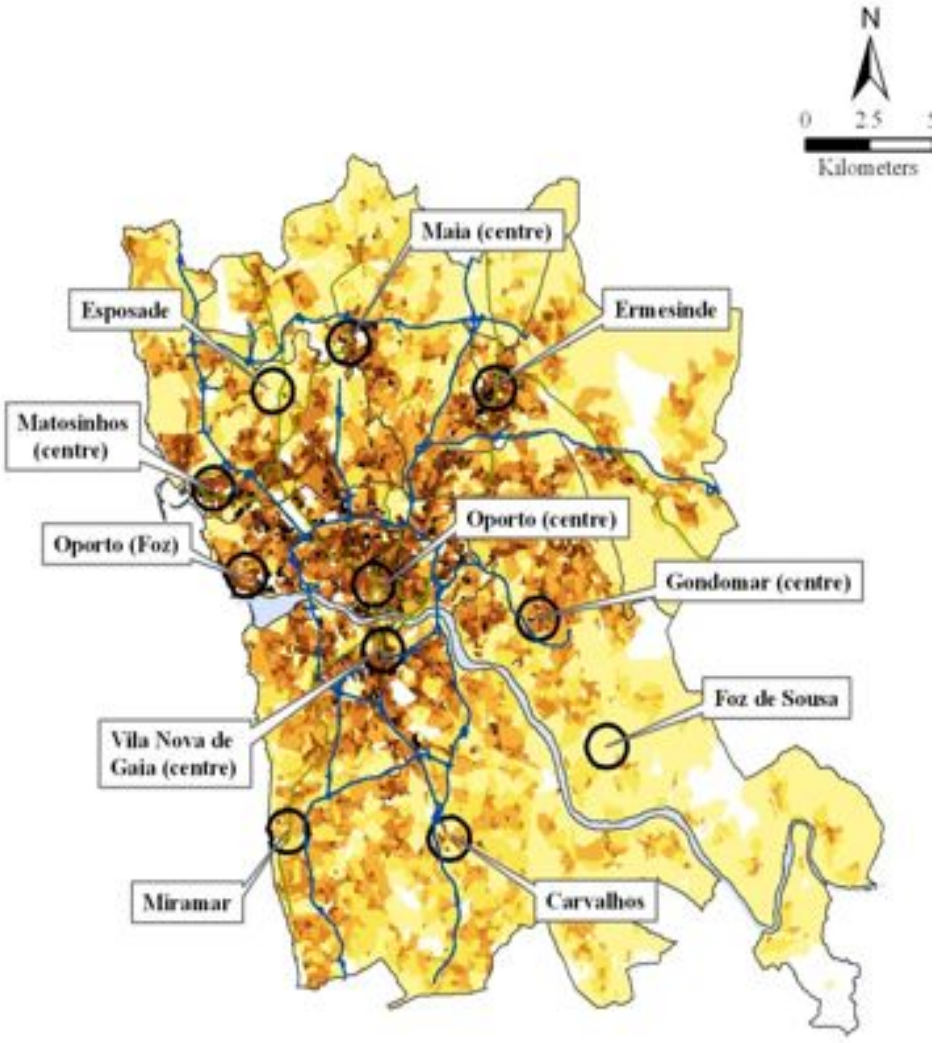


- Greater Oporto has 1.1 million inhabitants out of a total metropolitan population of 1.6 million
- Greater Oporto has a particular type of polycentric in structure, where several centralities can be found within a metropolitan core of relatively high density:
  - the inner city center (currently losing power)
  - a ring of developing areas in the surrounding municipalities (presently experiencing population and job increase
  - and a few more peripheral centers

Polycentric cities – a context less covered by studies on land use and travel

- In wealthy and high-mobile North European cities, travel behavior tends to be influenced primarily by the location of the dwelling relative to the main city center, and only to a lesser extent by proximity to local centers and local-area density
- In these cities, the inhabitants tend to prioritize opportunities for choice over proximity
- Will this also be the case in a more polycentric city in Southern Europe, where, among other things, the income level as well as workforce participation (in general and especially among females) is lower?

Methods



- Travel survey among residents of 11 neighborhoods within the more or less continuous urban area of Oporto (each subdivided into three local districts)
- Different urban structural and socio-economic contexts are represented
- Respondents have higher income, car ownership and education levels than the general Oporto population
- 1045 respondents, of which 442 with valid values on all variables of the regression model

Methods (continued)

- Four residential location variables:
  - linear distance from the dwelling to the main city center
  - linear distance from the dwelling to the closest second-order center
  - logarithmic distance to the closest main regional retail center
  - density of inhabitants and jobs in the local neighborhood
- Twelve socio-demographic control variables:
  - sex, age, number of household members below 7 years, number of household members aged 7-18, workforce participation, whether the respondent is a student/pupil, whether the respondent is a pensioner, personal annual income, whether the respondent holds a driver's license for car, whether the respondent has a long education, regular transport of children to school or kindergarten, and whether or not the respondent had moved to the present dwelling less than 5 years ago
- Dependent variables: logarithms of total weekly travel distance, travel distance by car/mc, and travel distance by non-motorized modes
- Due to non-normal distribution, a Heckman's sample selection method was used in the analyses of car/mc and non-motorized travel

Variables influencing total weekly travel distance

(N = 441, Adj. R2 = 0.332)

	Standardized coefficients and p-values
Local-area population and job density	-0.160 (0.000)
Distance from the dwelling to main city center	N. S. (p=0.235)
Logarithm of dist. to closest main regional retail center	N. S. (p=0.521)
Distance to closest second-order center	N. S. (p=0.470)
Pensioner	-0.189 (0.000)
Driver's license for car	0.180 (0.000)
Personal annual income	0.146 (0.001)
Sex (female = 1, male = 0)	-0.145 (0.000)
Long education	0.136 (0.003)
Workforce participation	0.122 (0.010)

The remaining six socio-demographic variables were all insignificant

Differences between education level groups in the variables influencing total weekly travel distance

	High education	Low education
Local-area population and job density	0.181 (0.009)	N. S. (p=0.558)
Distance from the dwelling to main city center	N. S. (p=0.971)	0.162 (0.003)
Logarithm of dist. to closest main regional retail center	N. S. (p=0.449)	N. S. (p=0.349)
Distance to closest second-order center	N. S. (p=0.871)	N. S. (p=0.520)

The effects of the socio-demographic variables are quite similar to those in analysis where respondents were not split according to education levels

Variables influencing weekly travel distance by car and motorcycle (N = 441, Adj. R2 = 0.392)

	Standardized coefficients and p-values
Local-area population and job density	-0.121 (0.002)
Distance to closest second-order center	N. S. (p=0.435)
Distance from the dwelling to main city center	N. S. (p=0.488)
Logarithm of dist. to closest main regional retail center	N. S. (p=0.663)
Driver's license for car	0.473 (0.000)
Pensioner	-0.154 (0.000)
Personal annual income	0.101 (0.018)
Long education	0.073 (0.095)

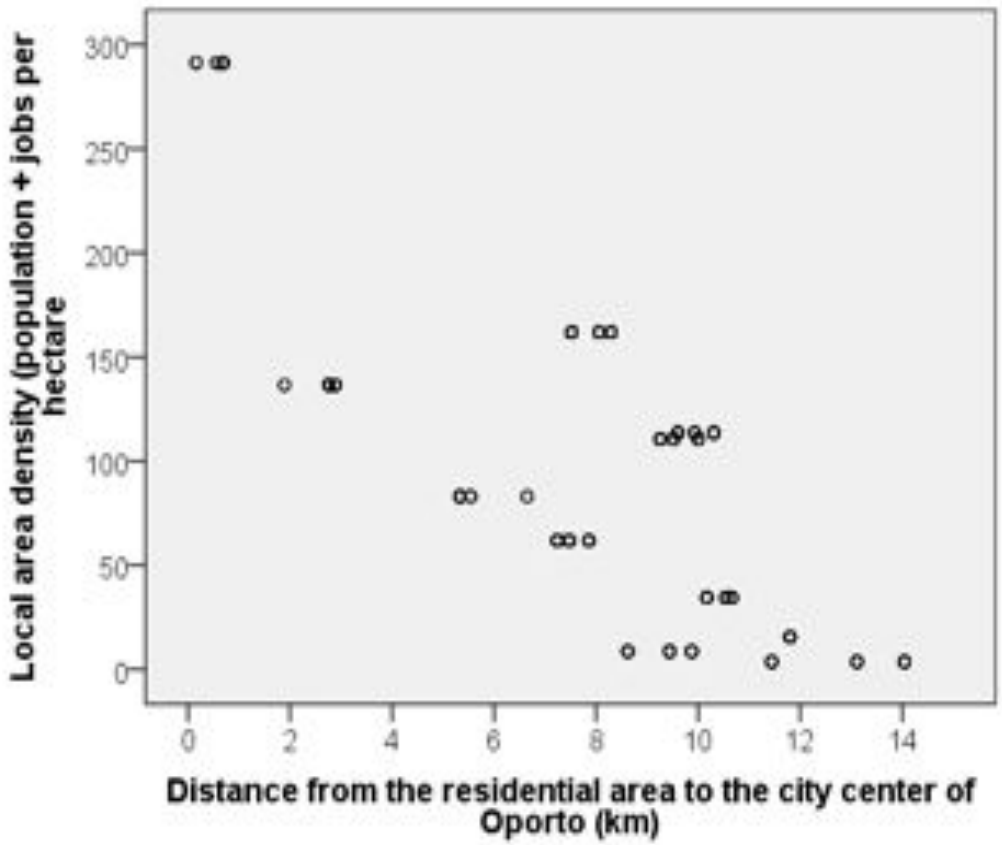
The remaining eight socio-demographic variables were all insignificant

Variables influencing weekly travel distance by non-motorized modes (N = 441, Adj. R2 = 0.191)

	Standardized coefficients and p-values
Local-area population and job density	0.114 (0.114)
Distance from the dwelling to main city center	-0.107 (0.114)
Distance to closest second-order center	N. S. (p=0.202)
Logarithm of dist. to closest main regional retail center	N. S. (p=0.814)
Workforce participation	-0233 (0.000)
Driver's license for car	-0.098 (0.035)
LAMBDA	-0.108 (0.035)

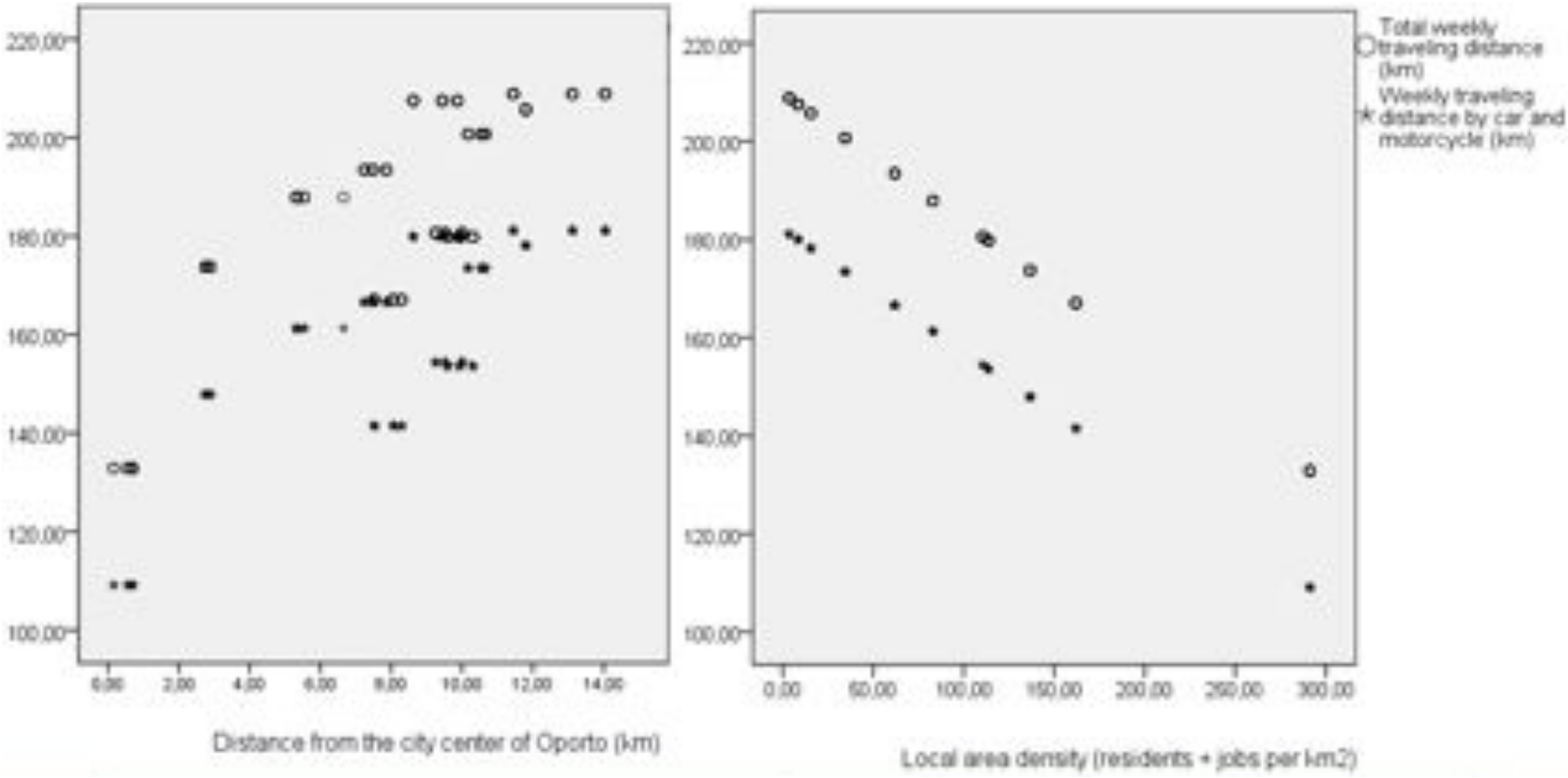
The remaining ten socio-demographic variables were all insignificant

Proximity to downtown matters, also in a polycentric urban region



Local-area densities are strongly influenced by the location relative to the city center (Pearson's r = 0.8)

Mean predicted weekly traveling distances in total (circles) and by car (asterisks) among respondents from investigated residential areas in Greater Oporto, plotted against the distance from the dwelling to the city center of Oporto (to the left) and local-area density (to the right)

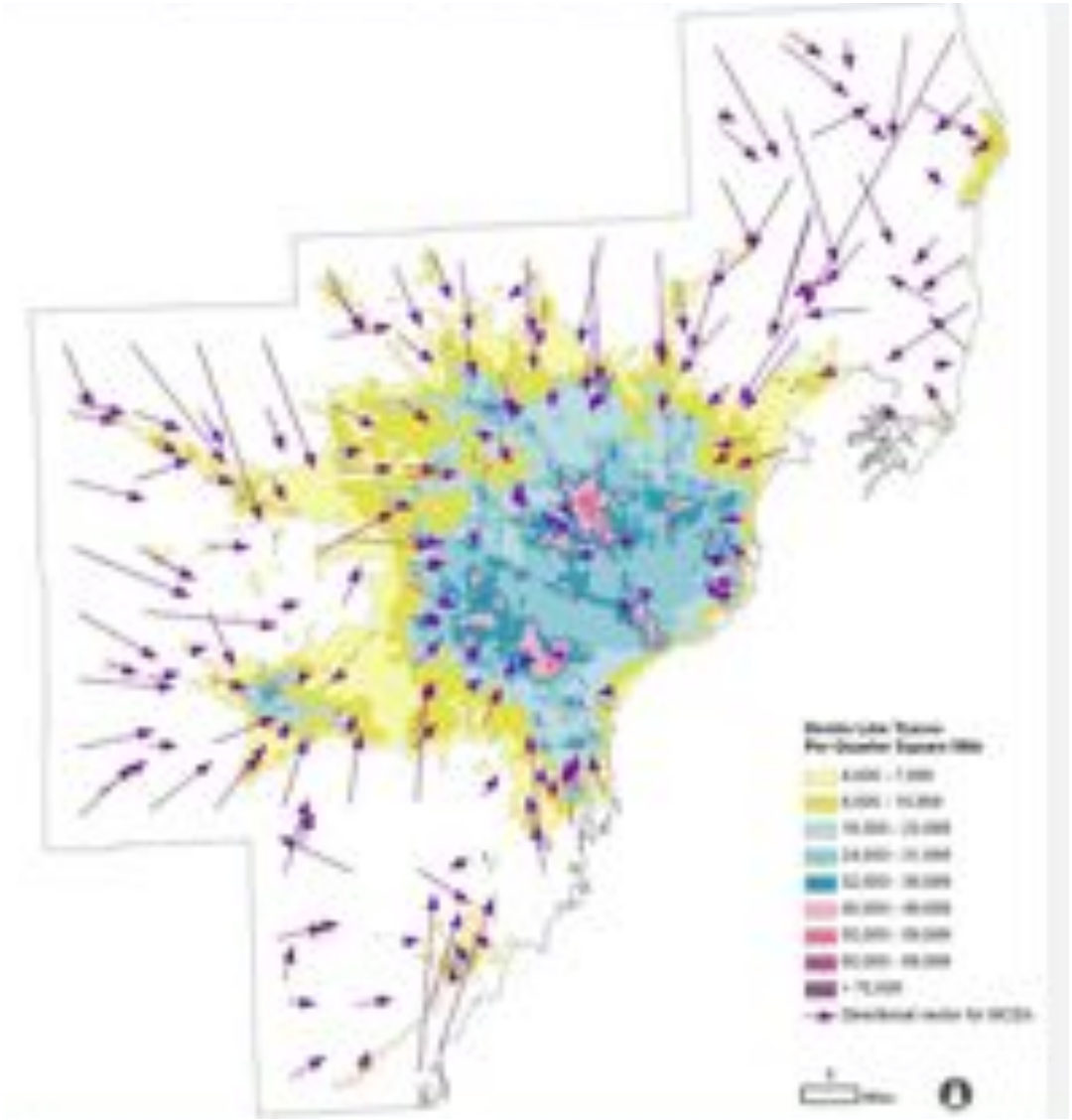


The graphs are based on the effects of the residential location variables shown in previous tables, and with all other investigated variables kept constant at mean values

The scale of the investigated area matters

- Compared to many previous studies of residential location and travel, the Oporto study covers only the part of the metropolitan area consisting of more or less continuously urbanized land
- Most of the respondents therefore live within the part of the metropolitan area where employment and service facilities are concentrated
- Their commutes and other trips in daily life are therefore not so much directed inward toward the city center, but also to other employment and service concentrations in more local centers
- In the remaining parts of the metropolitan area there is a deficit of jobs compared to workforce participants, and a high proportion of the inhabitants therefore make inward commutes
- Generally, the importance of the distance to local employment and service concentrations will increase and the importance of the distance to the main city center decrease, the smaller is the geographical area studied

Detroit as a similar example: The polycentric core region is surrounded by a large suburban and exurban area where most journeys to work are inward-directed. (Source: Nielsen et al., 2011)



Conclusions

- Due to Oporto's relatively strong concentration of jobs, shopping opportunities and service facilities in suburban centers, the residential locational characteristics most influential to travel behavior in Oporto differ from those in monocentric cities
- A lower workforce participation, especially among women, in Oporto than in previously investigated North European monocentric cities reinforces these differences, since it is easier for a couple to find a dwelling close to a suburban workplace if only one of the spouses is a workforce participant
- However, there is a strong center-periphery gradient in the density of population as well as jobs also in a polycentric city region such as Oporto
- The distance from the dwelling to the city center thus exerts important indirect influences on travel behavior via local-area densities, in addition to its direct influence among the mobile and high-educated population groups