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ORIGINAL ARTICLE

Residential preferences, telework perceptions, and the intention to telework: insights from the Lisbon Metropolitan Area during the COVID-19 pandemic

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Abstract

Confinement measures imposed during the COVID-19 pandemic forced many people to work from home. As telework reduces commuting costs, there is the possibility of contributing to urban sprawl as it allows people to move to the periphery. A web-based survey focusing on telework was conducted in the Lisbon Metropolitan Area. A structural equation model was built to study the influence of residential location preferences, perceptions about telework, and current residential location with the intention to engage in telework. People willing to telework more frequently have a higher probability of living in suburban locations, preferring this type of environment and having longer commutes. These results support the premise that telework acts as a mechanism to reduce commute burden.

KEYWORDS
intention to telework, residential preferences, structural equation modeling, telework

JEL CLASSIFICATION
R14, R23, R42

1 | INTRODUCTION

Up until the COVID-19 pandemic, home-based telework,[1] despite all the hype and buzz around it, had remained a niche practice. Forecasts made during the 1970s and 1980s have, up until 2020, remained largely unfulfilled, mostly owing to reticence from both companies and workers (Adobati & Debernardi, 2022). In Europe and generally everywhere, telework experiences were relatively limited (Adobati & Debernardi, 2022). In the case of Portugal, less flexibility and a stronger emphasis on being present in the work location (Gschwind & Vargas, 2019) meant that telework was marginal, with only 3.8% of the working population teleworking more than four times a month (López Soler et al., 2021). During the COVID-19 pandemic, the measures of social distancing adopted by several governments led to the wide adoption of telework, sometimes enforced by a government mandate. According to the Eurostat (2023), the percentage of people regularly working from home has remained relatively stable at about 5–6%, but in 2020 more than doubled, reaching 13.9% of the total workforce in Portugal. The reaction to COVID-19 infection rates and strong uptake in telework contributed to the decrease of several traditional resistances to the adoption of working from home (Adobati & Debernardi, 2022), particularly the ones related to productivity (Aguilera et al., 2016; Beck & Hensher, 2021). The impacts of these measures were massive and clearly visible. Mobility restrictions during the initial stages of the COVID-19 pandemic, and the widespread adoption of telework, resulted in relevant reductions of air pollution (Badia et al., 2021), leading to recommendations for the wider generalization of telework as an antipollution policy. Independent of any recommendations made, there is a relative consensus that telework adoption will increase after the pandemic (Conway et al., 2020; Jain et al., 2021; Kroesen, 2022). This is related to positive experiences from both employees and employers (Olde Kalter et al., 2021). Thus, even if telework adoption is reduced after the pandemic, its levels will not go back to the pre-2020 situation.

This wider popularity of telework creates a series of relevant challenges to policymakers and planners as, despite decades of research, there is still some controversy regarding the environmental, spatial, and mobility impacts of telework adoption. One of the most studied topics is related to the use of telework as a mobility management tool. Earlier studies generally tended to conclude that teleworking would reduce trips and miles driven (e.g., Hamer et al., 1991; Henderson et al., 1996). More recent studies have a less rosy perspective of telework, pointing to either no reduction or even an increase in the total travel (e.g., de Abreu e Silva & Melo, 2018; Kim et al., 2015; Lingqian & He, 2016). Related to the travel impacts of telework are the location patterns of teleworkers, their jobs, and the possibilities that telework might induce sprawl. With telework being more popular, cities could become less attractive, strongly impacting spatial planning (Adobati & Debernardi, 2022), but these possible effects will not be spatially homogeneous. The potential growth of telework is mainly an issue of large cities (Aguilera et al., 2016), and mostly owing to the type of jobs with high levels of flexibility and autonomy that could be done from home. These tend to be related to professional and/or managerial occupations (Adobati & Debernardi, 2022; Aguilera et al., 2016; de Abreu e Silva & Melo, 2018; Singh et al., 2013), and in knowledge-intensive economic sectors (Denham, 2021). Jobs that could be done at home tend, on average, to pay more than the ones which cannot, and their relative proportion depends on the wealth and economic specialization of each country (Dingel & Neiman, 2020). Related to these topics, there is already relevant literature that investigates the effects of telework adoption in regards to the spatial configuration of cities and location patterns of teleworkers (e.g., Alonso et al., 2017; Ettema, 2010; Muhammad et al., 2007; Safirova, 2002). The results have so far been mixed, with some studies concluding that telework induces sprawl (e.g., Alonso et al., 2017; Safirova, 2002), while others argue that it is mainly a practice adopted to offset the costs and burdens of long commutes (e.g., de Abreu e Silva & Melo, 2018; Ory & Mokhtarian, 2006). More recently, a new stream of studies in transportation began to look at attitudinal variables and preferences to explain the adoption of telework. Several of these studies relate telework adoption and satisfaction to attitudinal constructs in

[1]Home-based telework is used here as a synonym of home-based telecommuting, or working from home, but the general concept of telework could be extended to include any work outside of the official workplace (Adobati & Debernardi, 2022).

relation to telework perceptions and attitudes about work (Haddad et al., 2009; Jain et al., 2021; Loo & Wang, 2018; Tahlyan et al., 2022). So far, to the best of my knowledge, none of the studies relating telework adoption to residential location patterns have explicitly incorporated variables describing attitudes and residential location preferences. This perceived gap serves as inspiration for this study.

This work aims to relate the intention to telework after the end of the COVID-19 pandemic to residential location preferences and perceptions about telework. It is hypothesized that perceptions about telework are also influenced by residential location preferences, and both influence the intention to telework. The proposed framework also controls for current residential location patterns, commuting behavior, past telework patterns, and socioeconomic characteristics. Using this framework, this paper aims to contribute to the debate about possible effects of telework on sprawl. If people who have residential location preferences aligned more with suburban or even exurban environments and are the ones who intend to telework more often, then telework will facilitate them to either turn those preferences into reality or, if they are already fulfilled, to maintain them or even to move farther away if they live in less attractive and qualified suburbs (Adobati & Debernardi, 2022). To test these general hypothesis data from a recent web survey conducted in the Lisbon Metropolitan Area (LMA), a structural equation model (SEM) is built. As the COVID-19 pandemic generalized telework and removed several objections to its wider adoption, it is important to understand whether the pandemic brought about any change in the location patterns, commuting behavior, and perceptions of teleworkers. The results obtained here will be relevant both for transportation and urban planners by providing insights about the location and residential preferences of prospective teleworkers, as well as useful in informing urban planning and transport policy decisions.

The remainder of this paper is organized as follows: The next section presents a literature review focused on the spatial impacts of telework and on the factors that affect the intention to telework. Section 3 presents the data used here and compares it with global indicators for the LMA to evaluate the magnitude and implications of potential biases. Section 4 briefly describes the modeling method and is followed by the discussion of the results in Section 5. The paper ends with conclusions and a brief discussion about policy implications, limitations of the current study, and future avenues of research.

2 | LITERATURE REVIEW

2.1 | Spatial impacts of telework

Although there are several published studies about the spatial impacts of home-based telework, particularly its effects on residential location and firm location, these are still a matter of some controversy. The relationship between teleworking and residential location is associated with generalized commuting costs. By not commuting or commuting less frequently, the commuting burden, travel time, and out-of-pocket costs are reduced. Thus, it weakens the relationship between urban structure and travel (Elldér, 2017). As a result, there is a relative consensus that teleworkers tend to have longer commutes (Adobati & Debernardi, 2022; de Abreu e Silva & Melo, 2018; Denham, 2021; Melo & de Abreu e Silva, 2017; Mokhtarian et al., 2004; Ravalet & Rérat, 2019; Wells et al., 2001; Zhu, 2012, 2013). A relevant proportion of studies agree that teleworkers tend to reside in suburban areas (Bhuiyan et al., 2020; de Abreu e Silva & Melo, 2018; Fu et al., 2012; Kim et al., 2012), or have suburban preferences (Ettema, 2010; Tahlyan et al., 2022). Nevertheless, there are still some studies reporting that teleworkers live in more urban and central areas (Ellen & Hempstead, 2002; López Soler et al., 2021).

Another relevant point of contention is related to the causality direction between telework adoption and commuting distance. Does telework adoption allow for people to move farther away from their work location or, on the contrary, is telework used as a tool to cope with costly commutes? The two hypotheses have different policy implications. If teleworking adoption influences residential relocation, then sprawl will ensue, but if teleworking is a response to long commutes, then it might not result in sprawl, but rather in the maintenance of the current spatial

status quo. The spatial impacts of telework, if they indeed materialize, will be felt mostly in metropolitan areas and their immediate rural vicinities, since the jobs compatible with telework tend to be concentrated in major metropolitan areas, mirroring the spatial distribution of highly skilled professions and also high congestion levels (Adobati & Debernardi, 2022). It is expected that the need to travel at least some days to the office could limit the range of residential movement toward the immediate surroundings of metropolitan areas (Denham, 2021).

The arguments that telework increases sprawl are strongly based on location theory and its application regarding urban models (Delventhal & Parkhomenko, 2021; Larson & Zhao, 2017; Lund & Mokhtarian, 1994; Rhee, 2008, 2009; Safirova, 2002) or land use transport interaction models (Alonso et al., 2017; Moeckel, 2017). The general assumption is that the reduction of commuting costs will flatten bid rent curves, making suburbs more attractive for teleworkers (Ellen & Hempstead, 2002). Generally, it is predicted that telework will cause sprawl, but in some cases that result is not a foregone conclusion (Rhee, 2008, 2009), since it depends on the relative strength of both centrifugal and centripetal forces produced by telework (Rhee, 2009). Other works supporting the argument that telework increases sprawl include stated preference or combined stated preference/revealed preference models of residential location (Tayyaran et al., 2003; Tayyaran & Khan, 2003, 2007), but they are contradicted by some studies that look at the intention to move, which found no statistically significant effect of the adoption of telework regarding home relocation (Ettema, 2010; Muhammad et al., 2007.

The contrary line of argument, mostly based on empirical studies, argues that telework adoption is a response to costly commutes (de Abreu e Silva & Melo, 2018; Gubins et al., 2019; Helminen & Ristimäki, 2007; Nurul Habib et al., 2012; Ory & Mokhtarian, 2006; Peters et al., 2004; Wells et al., 2001). Particularly relevant is the study of Ory and Mokhtarian, (2006) who found that teleworkers, when changing their residence, would move it to locations closer to their workplace. Also, Gubins et al. (2019) conclude that the long-run effects of telework on commuting distance might be absent, or if they exist, are rather small. They attribute this result to a possible sorting effect, as workers facing long commutes are more likely to start teleworking. A more nuanced vision is provided by Muhammad et al. (2008) and Denham (2021), who argue that the general effect of telecommunications, including the ability to telework, is a mixture of centralization and deconcentration patterns. Telecommunications have enabled centralization, mainly owing to the agglomeration benefits of knowledge-intensive economic sectors, and thus it is expected that these patterns will continue. On the other hand, telework could enable individuals working in these metropolitan areas to live farther away, implying higher levels of sprawl.

2.2 | Socioeconomic and attitudinal factors influencing the adoption of telework

Telework adoption is influenced by both socioeconomic characteristics and attitudes. The number of studies looking at attitudinal questions to explain telework adoption is much scarcer in the transportation literature, being far more common in the other literatures focusing on telework (e.g., organizational psychology, policy analysis, and work studies). As telework tends to be associated with managerial and professional occupations (Adobati & Debernardi, 2022; Singh et al., 2013), and with stronger computer skills, several studies focused on the characteristics associated with these types of professional functions, namely having a higher degree of education (de Graaff & Rietveld, 2004; Pouri & Bhat, 2003) and higher household income (de Abreu e Silva & Melo, 2018; He & Hu, 2015; Hensher et al., 2022). The effects of age tended to be mixed, some indicating that younger people have a higher willingness to telework (de Graaff & Rietveld, 2004; de Abreu e Silva & Melo, 2018), while others concluded otherwise (Pouri & Bhat, 2003). The pandemic seems to have had an effect on the willingness of young adults to telework, making them more reticent to work from home (Beck & Hensher, 2021; Conway et al., 2020; Hensher et al., 2022; Tahlyan et al., 2022). Younger people are reporting being less satisfied and feeling less productive when teleworking (Conway et al., 2020; Tahlyan et al., 2022). A possible explanation might be related to the loss of networking opportunities and the need to advance their careers (Tahlyan et al., 2022). Other aspects influencing telework adoption include social influence (Páez & Scott, 2007) and past behavior feedback effects (Salomon, 1998).

Attitudes also influence telework adoption, as individuals who prefer to telework have different personality characteristics (Brüggen et al., 2017). Haddad et al. (2009) showed the importance of including attitudinal variables to explain the intention to telework. Although attitudes are relevant, they are conditioned by social and employer support and the perception that the job can be done remotely (Jain et al., 2021). Attitudinal variables used to explain telework adoption or the intention to telework are related globally to perceived advantages and disadvantages of telework, as well as perceived barriers and difficulties to telework (Jain et al., 2021). Perceived advantages include higher productivity, work–life balance, avoidance of commuting, and time spent with the family (Haddad et al., 2009; Jain et al., 2021; Loo & Wang, 2018; Olde Kalter et al., 2021; Tahlyan et al., 2022), whereas perceived disadvantages include isolation and lack of socialization, reduction of promotion opportunities, potential to overwork, and conflicts with personal life (Haddad et al., 2009; Jain et al., 2021; Tahlyan et al., 2022). Social and/or workplace factors are related to the perception of others (either family or friends), the enjoyment of the office environment, and the employer perception of telework (Haddad et al., 2009; Jain et al., 2021; Loo & Wang, 2018; Páez & Scott, 2007). Practical difficulties are related to the possibilities of working from home and also the type of job, the individual skills, and the conditions at home, namely adequate office space (Haddad et al., 2009; Jain et al., 2021; Tahlyan et al., 2022).

3 | DATA

The data used here come from a web survey conducted in the LMA between April 26 and July 7, 2021. The survey was directed to employed residents in the LMA. A total of 930 responses were obtained, of which 532 could be used in the present analysis after data cleaning and removing incomplete surveys. The survey collected data on the socio-economic characteristics of the respondent and their household (including gender, age, occupation, education, household size and composition, household income, and vehicle and transit pass ownership), residential and work locations, commuting characteristics and past (prior to the pandemic) teleworking habits, as well as teleworking adoption during the different stages of confinement during the pandemic. It included a series of Likert scale questions (using a five-point scale) related to residential location satisfaction, residential preferences and telework perceptions, and perceived experience. Finally, the questionnaire also included a 5-day travel and telework simplified diary, characterizing the work and travel patterns of the weekdays in the week prior to the survey and the intention to engage in telework. The questionnaire is available at: https://fenix.tecnico.ulisboa.pt/homepage/ist24709/inquerito-sobre-telework. The self-administered survey was disseminated through mailing lists, social media (Facebook and LinkedIn), and the websites of municipalities within the LMA and other public entities. The LMA is the largest metropolitan area in Portugal, comprising 18 municipalities, occupying 3,015 km^2, with a total population of around 2.87 million inhabitants, according to the preliminary results of the 2021 Census (INE, 2023). It is the wealthiest and most dynamic region in Portugal, as it represents about 28% of the country's population and around 46% of its gross added value, as of 2014 (Costa, 2016). Figure 1 shows the LMA, its municipalities, and their spatial classification.

Table 1 presents the descriptive statistics from the survey and compares them with relevant global statistics for the LMA. As expected, and as in any survey disseminated through the Internet, the sample is biased towards younger, wealthier, and more educated people. Nevertheless, the average age is not strongly biased downward, and the observed difference could be partially explained by the fact that retired people were excluded from the sample. The percentage of college-educated respondents is strongly biased upward, when compared with the global values for the LMA (about 85% compared with 29% of the LMA). This characteristic, together with the high proportion of individuals with a professional occupation and managers/senior officials (representing about 86% of the total sample), makes the sample more representative of the population that has been referred to in the literature as being prone to adopt teleworking, such as individuals with higher education levels (de Graaff & Rietveld, 2004; Pouri & Bhat, 2003) and with a professional and or managerial occupation (Adobati & Debernardi, 2022; Singh et al., 2013).

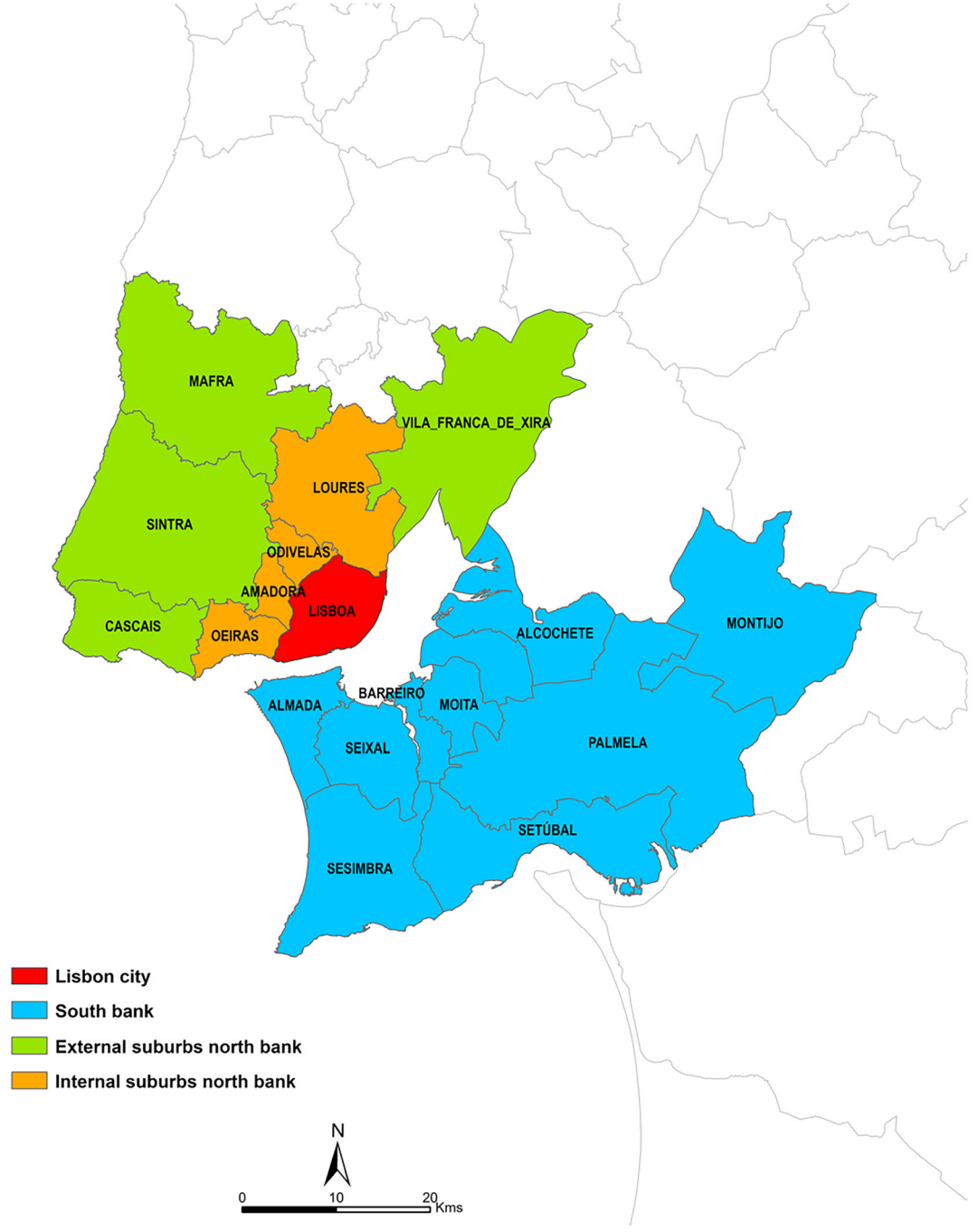

FIGURE 1 Municipalities in the Lisbon Metropolitan Area

This assumption is also corroborated by the reported previous teleworking patterns of the respondents, which is quite high when compared with data reported for Portugal prior to the pandemic (López Soler et al., 2021).

Average household size is larger, but not much, and once again it could be explained by the fact that households of retired adults are not included in the sample. The distribution of respondents by spatial divisions of the LMA

TABLE 1 Sample characteristics

	Mean or %	
Variable	**Survey**	**LMA**
Male	36.99%	47.02% (1)
Age	41.46	42.36 (1)
University degree	84.57%	28.76% (2)
Manager/senior official	15.24%	
Professional occupation	60.97%	
Household size	3.11	2.40 (1)
Household with children	25.84%	
Owns transit pass	19.15%	
Owned transit pass	28.25%	
Owns driver license	93.12%	
Number of cars in the household	1.51	
Household monthly gross income (euros)	2,793.94	1,874.98 (3)
Very frequent teleworker (2019): 3 plus days/week	18.77%	
Frequent teleworker (2019): 1–2 days/week	6.51%	
Occasional teleworker (2019): 1 plus/days/month	6.69%	
Since 2020 always in telework	33.09%	
Lives in internal suburbs on north bank (Figure 1)	24.00%	23.80% (1) (22.22%) (2)[a]
Lives in external suburbs on north bank (Figure 1)	13.42%	29.51% (1) (11.10%) (2)[a]
Lives on south bank (Figure 1)	10.96%	27.82% (1) (8.86%) (2)[a]
Number of teleworking days (prior week)	3.17	
Number of partial teleworking days (prior week)[b]	0.26	
Average commute (to work) time (min)	27.83	29.14 (3)
Commuting (to work) by private car	56.69%	63.83% (3)
Commuting (to work) by public transport	24.91%	25.01% (3)
Commuting (to work) by nonmotorized	17.66%	11.16% (3)
Intention to telework		
Less than 1 day/month	8.70%	
1–3 days/month	9.83%	
1–2 days/week	30.43%	
3 or more days/week	51.04%	

(1) Census 2021,
(2) PORDATA,
(3) LMA Mobility Survey 2017.
[a]Salaried employees with a university degree (2019).
[b]Days teleworking either during the morning or afternoon.

(internal and external suburbs on the north bank of the Tagus River and south bank of the river) is biased toward individuals living in Lisbon, although the percentage of respondents living in the internal suburbs is quite close to its weight in terms of working-age population. However, if one considers the spatial distribution of salaried employees holding a university degree, then the bias is strongly reduced. About 25% of the respondents declared teleworking more than 1 day a week in 2019, and more than 50% of respondents have the intention to engage in telework three

or more days a week after the pandemic. Despite the strong differences in terms of some of the socioeconomic characteristics, the variables related to commuting (to work) behavior are similar to the observed average patterns of the LMA, particularly the mean commute time (one-way commute). The commute modal split is similar in the case of the public transport share, but distinct in the case of car and nonmotorized modes. The significantly higher share of commuters using nonmotorized modes could be partly explained by the stronger share of residents in Lisbon, which is also in agreement with slightly lower average commute time.

The data relative to the average modal shares and mean household income in the LMA comes directly from the Mobility Survey conducted by the National Statistics Institute in 2017 (Instituto Nacional de Estatística, 2018). The 2017 Mobility Survey consists of a 1-day travel diary of all household members aged between 6 and 84 years old. The data were collected via a web survey complemented with personal interviews between October and December of 2017. In the LMA, 27,911 households (corresponding to 58,751 individuals) were surveyed. More information about this survey and the general indicators obtained from it are available at the INE website (https://www.ine.pt/xportal/xmain?xpid%3DINE%26xpgid%3Dine_publicacoes%26PUBLICACOESpub_boui%3D349495406%26PUBLICACOESmodo%3D2%26xlang%3Dpt).

4 | METHODOLOGY

A structural equation model (SEM) was built to test the hypothesis develop here. SEM is a popular modeling technique combining two types of statistical methods: factor analysis and simultaneous equation model (Schumacker & Lomax, 2010). This work studies the role that residential location preferences and perceptions about telework have on the intention to telework, while at the same time controlling for current residential location patterns, commuting behavior, past telework patterns, and socioeconomic characteristics. SEM is an adequate technique to perform this study, as it can simultaneously incorporate latent variables (preferences and perceptions) and several equations modeling the relationships between the control variables and the latent variables, as well as between these and the intention to telework. As one of the main objectives is to study the relationships between the different constructs and exogenous variables, and not to estimate the penetration of telework, the model does not use any weights to correct for sample bias.

A full-fledged SEM model includes both a measurement submodel and a structural submodel. The measurement submodel associates indicators with latent constructs (similar to factor analysis), and the structural submodel incorporates the relationships between different latent constructs and between these and the observed variables. The specific SEM model used here includes a structural submodel (Equation 1) and a measurement submodel (Equation 2)

$$\eta = B\eta + \Gamma x + \xi \tag{1}$$

$$y = \Lambda_y \eta + \varepsilon \tag{2}$$

where:

η is a vector (m*1) of latent endogenous variables,
B is a matrix (m*m) of coefficients of endogenous variables,
Γ is a matrix (m*n) of coefficients of exogenous variables,
x is a vector (n*1) of observed exogenous variables,
ζ is a vector (m*1) of errors from structural relation,
y is a vector (p*1) of observed endogenous variables,
Λ y is a matrix (p*m) of regression coefficients of y on η, and
ε is a vector (p*1) of measurement and errors on y.

As several endogenous variables included in the model are ordinal, and the sample size is relatively small, the weighted least squares mean and variance adjusted (WLSMV) estimation method is used (Muthén & Muthén, 2017). Goodness of fit is evaluated using the comparative fit index (CFI) and the absolute root mean error square of approximation (RMSEA).

5 | RESULTS AND DISCUSSION

The model estimation used the following steps: the first one consisted of an exploratory factor analysis with the objective of exploring the latent dimensions related to residential location preferences and perceptions about telework. The second step consisted of regressing the obtained factors as a function of socioeconomic, locational, and commuting behavior variables and using an ordered probit (Greene & Hensher, 2010) specification to regress the intention to telecommute as a function of the obtained factors and socioeconomic, locational, and commuting behavior variables. All of these preliminary analyses helped to specify the SEM model that is presented here. The factors resulting from the exploratory factor analysis were the base for the measurement submodel, and the regressions guided the construction of the structural submodel. The endogenous variables included in the SEM are the latent variables described in Table 2, plus the intention to telework after the pandemic. The exogenous variables included include the following dimensions and variables:

- Socioeconomic characteristics of the respondent and their household: gender, whether the respondent is a millennial, household size, number of cars in the household, and household gross monthly income;
- Locational characteristics of the respondent and their household: if the respondent lives in a single-family house, if the respondent lives in the internal or external suburbs of the north bank, if the respondent lives on the south bank, and if the respondent works in the external suburbs;
- Commuting habits: if the commute time is shorter than 15 min, if the respondent's commute time is between 15 and 30 min, if the respondent commuted using non-motorized modes, and if the respondent owned a transit pass before the pandemic;
- Teleworking practices: if the respondent has always telecommuted during the pandemic, the number of days of telework in the week prior to the survey, and the number of days of partial telework in the week prior to the survey.

5.1 | Exploratory factor analysis and measurement submodel

From the ten statements related to residential location preferences, and using principal components extraction and varimax rotation, three factors were extracted explaining 51% of the total variance and presenting a Kaiser–Meyer–Olkin test (KMO) score of 0.662. The first of these factors was suburban preference, as it is related to the desire to live in an area that is quiet and safe and provides privacy and easy road access. These are all attributes associated with suburban areas. The second factor, named preference for urban environment, loads positively in the preference for central and dynamic urban areas and living in an apartment, and negatively in the desire for a quiet place and living in a village or the countryside. The third factor, named preference for accessibility, is related to the desire to have a short commute, and preference for places with good public transport and walking accessibility.

Related to perceptions about teleworking, the questionnaire includes 11 statements that were transformed into 3 factors also using principal component extraction and varimax rotation. The obtained KMO is 0.779, and the factors explain 52% of the total variance. The first factor is associated with positive views regarding teleworking being able to reduce commute burden, increase productivity, reduce residential location constrains, increase

TABLE 2 Latent variables and measurement submodel

		Exploratory factor analysis		Measurement submodel	
Latent construct	**Statement**	**KMO total var explained**	**Loadings**	**Coefficient**	***p*-Value**
Suburban preference	I prefer to live in a quiet residential area.	KMO = 0.662, TVExp. = 51%	0.459	0.236	0.000
	I like having privacy from my neighbors.		0.459	0.337	0.000
	I prefer to live in a place where I feel safe to walk outside at night.		0.570	0.756	0.000
	I prefer to live in a place with easy road access.		0.548	0.579	0.000
Preference for urban environment	I prefer to live in a central and dynamic area, consisting of homes and other activities (commerce, restaurants, cafes, and leisure).		0.656	0.727	0.000
	I prefer to live in a quiet residential area.		−0.554	−0.590	0.000
	I prefer to live in an apartment rather than a house.		0.737	0.549	0.000
	I prefer to live in the countryside or in a village/town where I can have peace and quiet.		−0.765	−0.631	0.000
Preference for accessibility	I prefer to live in a place with easy walking access to schools and parks/gardens.		0.755	0.697	0.000
	I prefer to live in a place with easy access on foot to public transport.		0.768	0.882	0.000
	I would like to live close to my job.		0.544	0.354	0.000
Positive to telework	Telework offers me broader opportunities related to the places where I could live.	KMO = 0.779, TVExp. = 52%	0.677	0.744	0.000
	Teleworking helps me to reduce the time and cost I spend on transport.		0.647	0.722	0.000
	Telework gives me the autonomy to create a better balance between my personal, family, and professional lives.		0.679	0.809	0.000
	I feel more productive on the days I telework		0.455	0.592	0.000
	My employer's perspective on teleworking changed positively during the pandemic.		0.628	0.244	0.000

TABLE 2 (Continued)

		Exploratory factor analysis		Measurement submodel	
Latent construct	**Statement**	**KMO total var explained**	**Loadings**	**Coefficient**	***p*-Value**
Good conditions to telework	I have at home all the infrastructure and equipment necessary for telework (computer, good Internet connection, etc.).		0.656	0.678	0.000
	I have the necessary work environment (calm, quiet, uninterrupted) to work from home.		0.661	0.768	0.000
	I feel more productive on the days I telework		0.575	0.205	0.003
	I feel like I work too much on the days I work from home.		0.504	0.230	0.024
Reticence to engage in telework	I need extra space or room to work from home.		0.662	0.443	0.000
	Teleworking makes me feel isolated.		0.675	0.809	0.000
	I feel like I work too much on the days I work from home.		0.686	0.447	0.000
	If I work from home, I may miss out on promotion opportunities.		0.385	0.356	0.000

autonomy, and contribute to better work–life balance. It is also related to positive views about teleworking from the employer's perspective. Consequently, it is named positive to teleworking and is related with the perceived advantages of telework referred to earlier. The second factor is related with the perception of having good conditions to engage in teleworking. The statements that present high loadings in this factor are related to having both the physical infrastructure and the work environment necessary to telework, as well as the sensation of higher productivity and working too much when teleworking. The final factor is reticence to engage in telework and is related to the perceived disadvantages of telework and practical difficulties of engaging in telework, as well as feeling isolated, missing promotion opportunities, not having enough space to have a home office, and the sensation that one works too much when teleworking.

Table 2 presents both the results from the exploratory factor analysis and the standardized coefficients obtained in the measurement submodel and respective *p*-values. The results show that the measurement submodel is in accordance with the exploratory factor analysis and all the coefficients are significantly different from zero.

5.2 | Structural submodel

The model fit indicators show that the SEM presents an adequate to good fit. The CFI is 0.906, and the RMSEA is 0.032. In Figure 2 the structural relationship between the endogenous constructs is shown (with the positive effects in green and the negative in red), and in Table 3 the coefficients obtained for the standardized direct effects and respective *p*-values are presented. Table 4 presents the estimated standardized indirect and total effects from several variables regarding the intention to telework. These variables include the different latent variables representing residential preferences and teleworking perceptions, as well as the exogenous commuting patterns and residential location variables. On the basis of the tables and figure, the relationships between the different endogenous latent

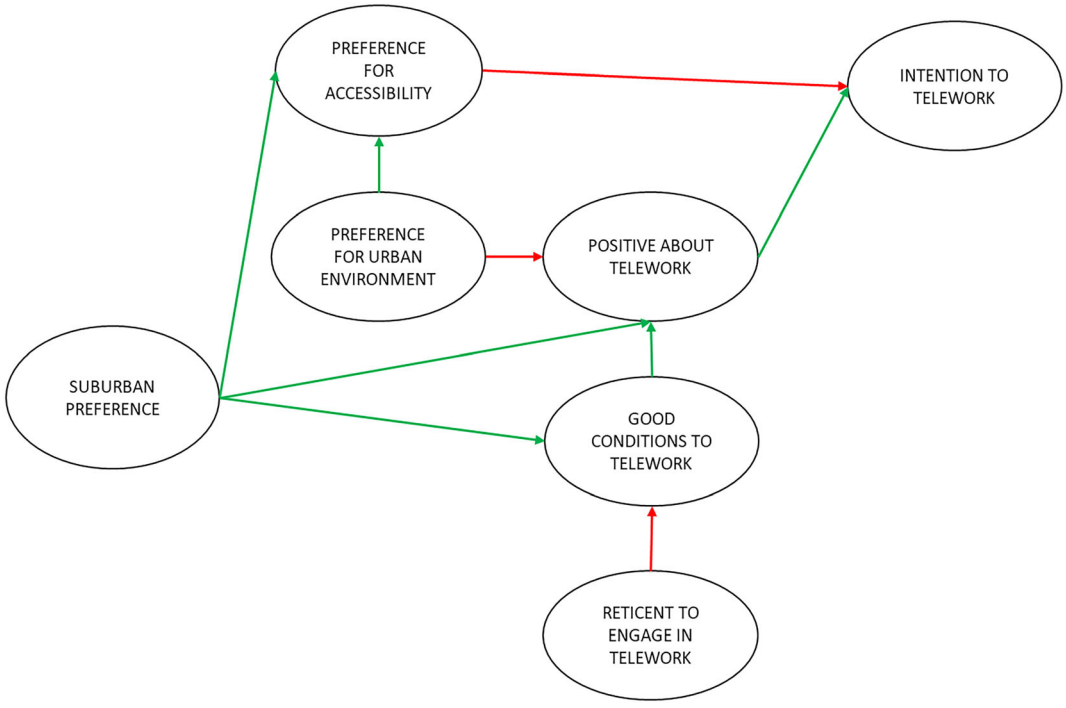

FIGURE 2 Structural model (endogenous variables)

TABLE 3 Direct effects

Parameters			
Endogenous variable	**Regressor**	**Standardized coefficient**	***p*-value**
Suburban preference	Gender (1 if man)	−0.216	0.000
	Household size	−0.182	0.015
	Number of cars in the household	0.180	0.025
	Commuting by nonmotorized modes (1 if yes)	−0.268	0.000
Preference for urban environment	Gender (1 if man)	−0.158	0.001
	Single-family house (1 if yes)	−0.313	0.000
	Lives in internal suburbs of north bank (1 if yes)	−0.174	0.002
	Lives in external suburbs of north bank (1 if yes)	−0.118	0.045
	Lives on south bank (1 if yes)	−0.172	0.002
	Commute time between 16 and 30 min (1 if yes)	0.176	0.005
	Works in external suburbs (1 if yes)	−0.115	0.024
Preference for accessibility	Household size	0.372	0.000
	Number of cars in the household	−0.362	0.000
	Transit pass before COVID-19 (1 if yes)	0.140	0.019
	Commuting by nonmotorized modes (1 if yes)	0.223	0.002
	Suburban preference	0.735	0.000
	Preference for urban environment	0.326	0.000
Positive to telework	Always telework during the pandemic (1if yes)	0.189	0.000
	Household monthly income	−0.192	0.000
	Number of days teleworking previous week	0.179	0.002
	Household size	0.098	0.031
	Preference for urban environment	−0.137	0.012
	Suburban preference	0.235	0.000
	Good conditions to telework	0.601	0.000
Good conditions to telework	Number of days teleworking previous week	0.329	0.000
	Suburban preference	0.242	0.000
	Reticence to engage in telework	−0.682	0.000
Reticence to engage in telework	Millennial (1 if yes)	0.116	0.048
	Household size	0.152	0.007
Intention to telework	Number of days teleworking previous week	0.132	0.005
	Number of days partial teleworking previous week	0.192	0.001
	Commute time ≤ 15 min (1 if yes)	−0.157	0.011
	Commuting by nonmotorized modes (1 if yes)	0.122	0.005
	Positive to telework	0.767	0.000
	Preference for accessibility	−0.184	0.000

TABLE 4 Indirect and total effects

Indirect and total effects of latent variables on the intention to telework				
	Indirect effects		Total effects	
Latent variable	Estimate	*p*-Value	Estimate	*p*-Value
Preference for accessibility	N.A.	N.A.	−0.184	0.000
Good conditions to telework	0.462	0.000	0.462	0.000
Reticence to engage in telework	−0.315	0.000	−0.315	0.000
Suburban preference	0.157	0.001	0.157	0.001
Preference for urban environment	−0.165	0.000	−0.165	0.000
Indirect and total effects of commuting patterns on the intention to telework				
	Indirect effects		Total effects	
Variable	Estimate	*p*-Value	Estimate	*p*-Value
Commute time ≤ 15 min (1 if yes)	N.A.	N.A.	−0,157	0.011
Commute time between 16 and 30 min (1 if yes)	−0.029	0.020	−0.029	0.020
Commuting by nonmotorized modes (1 if yes)	−0.083	0.001	0.039	0.423
Indirect and total effects of residence location patterns on the intention to telework				
	Indirect effects		Total effects	
Variable	Estimate	*p*-Value	Estimate	*p*-Value
Lives in internal suburbs on north bank	0.029	0.015	0.029	0.015
Lives in external suburbs on north bank	0.019	0.075	0.019	0.075
Lives on south bank	0.028	0.020	0.028	0.020

Note: N.A. there are no indirect effects.

variables are discussed, followed by the direct effects from the exogenously observed variables. Finally, the indirect and total effects of variables with behavioral and policy relevance are discussed. Analyzing total and indirect effects could reveal cases where contradictory direct and indirect effects could result in statistically insignificant total effects, thus helping to identify self-defeating policies.

5.2.1 | Direct effects between endogenous variables

The model results show the existence of significant relationships between residential preferences and between these and telework perceptions. Both suburban and urban residential preferences have a positive effect on the preference for accessibility. The somewhat puzzling positive effect of suburban preferences on the preference for accessibility could be explained by the fact that individuals tend to want the best of both worlds, in the present case, wanting simultaneously the benefits of higher accessibility and suburban characteristics. This type of behavior has been reported by Tian et al. (2015), who found that individuals, despite exhibiting preferences for single-family housing and other suburban characteristics, also valued short commutes, walkability, and closeness to transit. Being positive to telework is strongly influenced by the perception of having good conditions to telework. Individuals with suburban preferences and preferences for urban environments have contrary perceptions about telework, with the first being positive and the latter negative. These effects are corroborated by previous research that associated telework with suburban environments (Kim et al., 2012) and reduced transit accessibility levels (de Abreu e Silva &

Melo, 2018), but living in the suburbs also contributes to the increase in the perception of teleworking benefits (Tahlyan et al., 2022). The perception of having good conditions to telework is positively influenced by suburban preferences, which might be also related to houses being larger in suburban areas on average, and negatively by reticence to engage in telework. This last latent variable is only dependent on exogenous variables. The intention to telework is positively influenced by being positive to telework and negatively by the preference for accessibility. A relevant aspect is that the effects of the perceptions regarding telework have a much larger magnitude than residential preferences with the intention to telework, which corroborates the results of both Jain et al. (2021) and Tahlyan et al. (2022) in regards to the importance of attitudinal constructs influencing the intention to telework and satisfaction with telework.

5.2.2 | Direct effects from exogenous variables

The effects from the exogenous variables are globally in accordance with what has been reported in literature. A suburban preference is associated with higher motorization rates and negatively with commuting using non-motorized modes. Preference for urban environments is negatively associated with living in the northern suburbs of the LMA and on the south bank of the Tagus River, living in a single-family house, and working in the external suburbs, and it is positively associated with short commute time. The effects of the current residence location on residential preferences might be an indication of low levels of residential dissonance (Schwanen & Mokhtarian, 2004), at least from the people living in the suburban areas of the LMA. Accessibility preferences are negatively associated with household motorization rates and positively associated with owning a transit pass prior to the pandemic (as the social distancing measures strongly reduced the need to travel) and commuting using non-motorized modes. Working at home continuously since the beginning of the pandemic increases the likelihood of being positive to telework. The more days a respondent teleworked in the previous week, the more positive they are to telework. Somewhat surprisingly, income reduces the chances of being positive to telework, which is contrary to what has been reported in the literature (de Abreu e Silva & Melo, 2018; He & Hu, 2015; Hensher et al., 2022). One possible reason for this effect could be related to the sample characteristics, as it is strongly biased toward wealthier individuals with the professional and educational abilities to engage in telework. Thus, within this group it is possible that income might have a different effect. Good conditions to telework is only influenced directly by one exogenous variable, which is the number of teleworking days during the previous week. Reticence to engage in telework is positively influenced by being a millennial and household size. The first effect, although at first sight counterintuitive because millennials are considered digital natives and therefore much more at ease with communication technologies, has been reported in literature (Beck & Hensher, 2021; Conway et al., 2020) and could be explained by the perception that telework could deprive millennials of socialization. Regarding household size, this effect could be explained by the teleworking experience during the confinement periods, where teleworking was mandatory and children were be homeschooled. Thus, larger households would likely have more difficulty in managing the situation, and as a result would find it more uncomfortable and stressful.

The intention to telework is positively influenced by the number of days of complete and partial telework during the previous week. This effect, combined with the effect that other variables related to past (current) experience of telework have on perceptions about telework, is indicative of the effect that past experiences could have on the intention to telework as advanced by Páez & Scott (2007). The intention to telework is negatively affected by having a commute equal to or less than 15 min and positively influenced by commuting using nonmotorized modes. The effect of the use of nonmotorized modes is counterintuitive, because telework engagement is usually associated with longer commutes (e.g., Melo & de Abreu e Silva, 2017) and nonmotorized modes tend to be more associated with shorter commutes. In the present sample, as nonmotorized modes include bicycle, there are several observations where commute time is longer than 30 min, which could explain at least part of the positive effect of commuting using nonmotorized modes regarding the intention to telework. Another important aspect here is related to the

indirect and total effects of using nonmotorized modes regarding the intention to telework (Table 4). It is possible to see that the standardized indirect effect of commuting is negative and with a magnitude that strongly dampens the positive direct effect, which results in a positive but statistically insignificant total effect.

5.2.3 | Total and indirect effects

Globally, the total effects support the premise that the intention to telework is influenced by residential location preferences. Urban and higher accessibility preferences reduce the intention to telework, whereas suburban preferences increase the intention to telework. With the exception of preference for accessibility, the total effects of the other residential preferences result from indirect effects pass through the preference for accessibility and perceptions about telework. Shorter commutes reduce the intention to telework, confirming previous results from literature implying that teleworking is mostly a tool to cope with longer commutes (de Abreu e Silva & Melo, 2018; Gubins et al., 2019; Helminen & Ristimäki, 2007; Nurul Habib et al., 2012; Ory & Mokhtarian, 2006; Peters et al., 2004; Wells et al., 2001). Living in the suburbs increases the intention to telework, and these effects are passed through the negative effects of suburban residential location, on both the north and south banks of the Tagus River, when they have a preference for an urban location. This result reinforces the aforementioned idea that at least some alignment between residential preferences and current residential location exist. People who do not prefer to live in urban areas currently live in the suburbs. It is possible that this result could be owing to the specific characteristics of the sample, which are strongly biased toward highly educated respondents and wealthier than average Portuguese households. As a result, they will face fewer restrictions in choosing a residential location more aligned with their preferences. Thus, residential preferences act as one of the mediators between residential location and the intention to telework. This alignment between residential location and residential preferences, as well as from those to perceptions about telework and the intention to telework after the pandemic, support the hypothesis that, at least in the short term, telework acts mostly as a tool to cope with long and costly commutes.

6 | CONCLUSIONS

This paper uses a web survey collected in the Lisbon Metropolitan Area to study the influence of residential location preferences, perceptions about telework, and current residential location regarding the intention to engage in telework after the end of the COVID-19 pandemic. It innovates by explicitly relating attitudinal constructs to residential location patterns and commuting behavior of would-be teleworkers. To perform this analysis, a SEM was built, allowing for a richer interpretation of the obtained model coefficients. It can be concluded that, although there is a strong intention from the respondents to engage in telework, this popularity of telework does not mean that locational patterns and residential preferences of teleworkers are substantially different from what has been reported about teleworkers prior to the current pandemic. People willing to telework more frequently have a higher probability of living in suburban locations and of having residential location preferences associated with suburban (or exurban) environments. They also have longer commutes. Another interesting result obtained here is that perceptions about telework act as mediators of residential preferences, particularly people who are positive to telework tending to exhibit preferences for more suburban environments. These results support the premise that telework acts as a mechanism to reduce commute burden. Telework does not lead directly to sprawl, but it could allow individuals to transform their residential location preferences into actual residential locations. However, if residential preferences are aligned with current location patterns, it could help to sustain the current levels of sprawl. The policy implications of these results are that telework would be at best neutral regarding sprawl, and if an increase in travel is seen as previous research has concluded (de Abreu e Silva & Melo, 2018; Kim et al., 2015; Lingqian & He, 2016), then it is not a beneficial policy. These recommendations have a relevant caveat related to the fact that they are only

considering the location of residences, but firms could also react to the wider adoption of telework in ways that are not easily foreseen. They could follow teleworkers to the suburbs (Kim et al., 2012), or they could concentrate even more in central areas, taking advantage of their prospective reduced need for space. Ultimately, it is likely that the effects of telework adoption in the urban structure will be dependent on the total share of workers engaging in telework. This, in the end, is dependent on the characteristics and levels of economic specialization of each metropolitan area.

This study has also some caveats and limitations, the most easily identifiable of which are related to the characteristics of the sample used here, which is strongly biased toward highly educated individuals. Another major limitation is related to potential problems of self-selection, as people volunteered to answer the survey, and the sample size is relatively small. Also, the results obtained here open some possibilities for future research, the most promising one being related to the dissonance between the current residential location and location preferences, and how the intention to telework could contribute to eliminating this dissonance. This avenue of research could contribute to better understanding of the relationships between urban sprawl and telework.

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