

Residential dissonance of teleworkers: Implications on relocation and impacts on urban sprawl in a post-COVID world

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Abstract: This paper examines the role of telework adoption and preferences in residential relocation, focusing on how residential dissonance influences the intention to move. Specifically, if individuals more positive toward telework find their current residential location mismatched with their preferences, they are more likely to experience residential dissonance. This dissatisfaction could drive them to relocate to more suburban areas, contributing to urban sprawl. In this context, the 15-minute city could play a crucial role in the decision, as individuals may be drawn to urban environments with these characteristics, potentially mitigating the pressure for suburban relocation. A Structural Equation Model is estimated to test the study hypothesis using data from an online survey conducted in the Lisbon Metropolitan Area during spring and summer 2021. The results suggest that while attitudes toward telework do not significantly influence the decision to move, teleworking practices, particularly experiences during the pandemic do, indicating that telework could contribute to suburbanization. Nevertheless, the variables that capture the push factors for residential mobility (being young, living in a small house, having children, and being a renter) have a more decisive influence on the decision to move than the effects of telework, residential satisfaction, and residential dissonance. As for living in a 15-minute city, individuals residing in areas more aligned with the concept are less satisfied with the quality of public space, although more satisfied with accessibility levels. Living in a 15-minute city has a positive effect on the intention to move. This suggests that the impact of living in a 15-minute city may not be as straightforward as often assumed, highlighting the complexities of residential satisfaction in these environments.

Keywords: telework, residential dissonance, residential relocation, urban sprawl, post-COVID cities

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1 Introduction

The COVID-19 pandemic and its associated social distancing measures have propelled the generalization of telework: from 6.5% of the Portuguese working

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population in 2019 (GEE, 2021), the percentage of people regularly working from home now accounts for 11.3% (from a peak of 13.9% in 2020) (INE, 2023). This upsurge in telework is expected to produce relevant spatial and mobility impacts, thus influencing the spatial organization of cities (Mouratidis & Peters, 2022; Sweet & Scott, 2023). For example, telework could make suburbs more attractive by reducing commuting costs (Ellen & Hempstead, 2002), thus inducing sprawl. Still, this argument is not a foregone conclusion since studies examining the intention to move to the suburbs found no statistically significant effect of teleworking on the decision to change the residence location (Ettema, 2010; Muhammad et al., 2007).

Recent research in the Lisbon Metropolitan Area (LMA) (de Abreu e Silva, 2022) has concluded that the intention to telework is associated with longer commutes and suburban residential preferences. These results support the hypothesis that telework can be more of a mechanism to cope with longer commutes and, as such, not necessarily lead to sprawl. However, these results also suggest that telework could help mitigate residential dissonance—the lack of correspondence between the current and preferred residential location (Schwanen & Mokhtarian, 2004). Urban residents with suburban land use preferences could align their location with their preferences by moving to the suburbs, enabled by telework. This possibility, however, could induce urban sprawl.

Therefore, the main objective of this work is to examine the role of telework adoption and preferences in residential relocation, with a particular focus on how residential dissonance influences the intention to move and its potential impact on the spatial organization of a metropolitan area (e.g., potentially contributing to urban sprawl). In this context, the 15-minute city may play a crucial role in the decision, as individuals may be drawn to urban environments with these characteristics, potentially mitigating the pressure for suburban relocation.

An online survey implemented in the LMA provides data on residential location, preferences and satisfaction, and perceptions about telework, telework practices and intention to engage in telework. A Structural Equations Model (SEM) is built to assess residential dissonance's effect on the likelihood of teleworkers matching their residential preferences and locations. The results are discussed with a focus on the implications of telework adoption and potential residential location in urban form in the post-COVID city, with particular attention being given to urban sprawl and the policies to counteract it.

2 Literature review

Telework has been discussed as an alternative mobility management strategy since the 1970s, with some early empirical studies showing great promise since teleworkers could reduce their commute travel without increasing their non-commute travel (Mokhtarian, 1991). However, more recent research has suggested that telework can induce household travel, eventually due to flexible work hours and expanded homemaking roles (e.g., cooking and other tasks related to home management that might induce travel, for example, to stores) (Kim et al., 2015). Additionally, since teleworkers have revealed a preference for living in suburban locations with longer commutes (de Abreu e Silva, 2022), telework may, in the end, increase total travel and induce sprawl.

Moreover, while the COVID-19 in-migration and “rural revival” were a consequence of the need for social isolation, which has ceased, the search for more spacious homes with outdoor areas may persist, particularly among larger households (González-Leonardo et al., 2022), and families with children, who have long shown a preference for suburban living (Talen, 2001). In-migration and residential mobility have been common strategies households use to adjust their residential location to their needs (Coulter et al.,

2016; Špačková et al., 2016). Telework's continued adoption may enhance the opportunities for households to do so.

However, residential satisfaction has shown a mediating effect on the decision to relocate (Špačková et al., 2016). Residential satisfaction—or “the subjective perception of the housing and neighborhood environment” (Špačková et al., 2016)—is a result of the interplay between socio-structural variables (e.g., age, education, income, and stage of life), psychosocial factors (e.g., convictions, lifestyles, emotions) and external variables, such as the material conditions of a house and the image of the neighborhood (Clark et al., 2006). Residents highly satisfied with their housing and neighborhood are implicitly expected to move less, with relocation occurring only when residential satisfaction decreases below a critical threshold (Clark et al., 2006; Herfert et al., 2013).

A parallel strain of research was developed by Schwanen and Mokhtarian (2004) to assess the efficacy of land use policies aimed at reducing auto travel. Residential dissonance was introduced as the extent to which households' actual and preferred residential location types corresponded (Schwanen & Mokhtarian, 2004). This discussion was relevant in the face of New Urbanism paradigms advocating for high-density developments where more opportunities could be reached using transit or active modes (Friedman et al., 1994). Schwanen and Mokhtarian (2004) contended that policies aimed at “artificially attracting” residents (e.g., through subsidies) to high-density developments would only be effective if they were targeted at those who already showed a preference towards high-density residential locations. Otherwise, residential dissonance would manifest through lower residential satisfaction levels and higher residential mobility.

In subsequent research (Schwanen & Mokhtarian, 2005b, 2005a), a gradient is proposed and used to evaluate the dissonance between residential location and residential preference while relating it to travel mode preference. On one end, one would have “urban consonant” residents: urban residents with urban land use preferences, using active modes and transit as much as private vehicles. On the other hand, “suburban consonant” residents would mostly use private vehicles. Residential dissonance would be found in between, either by urban residents with suburban land use preferences (“urban dissonant”) or suburban residents with urban land use preferences (“suburban dissonant”), with the share of private vehicle usage increasing with suburban land preferences.

Linking residential dissonance with residential satisfaction, the first has been primarily used to evaluate residential and travel preferences. For example, individuals who prefer a particular travel mode will use that mode more frequently and choose their residential location accordingly (Handy et al., 2005). If, for some reason, they cannot locate their residence according to their travel preference, they will become dissonant and be expected to present lower levels of residential satisfaction. However, this residential (dis)satisfaction relates only to one aspect of residential satisfaction: travel (which can be associated with lifestyle or other psychosocial or socio-structural factors). Nevertheless, their satisfaction with their housing and neighborhood conditions may still be high.

Therefore, relocation is likely to occur only when individuals experience a critical level of both dissonance and dissatisfaction. For example, when analyzing residential dissonance and travel behavior in Belgium, de Vos et al. (2012) found that mismatched rural residents with a weak or moderate difference between the actual and preferred residential neighborhood would probably not consider a move. Although telework may allow households to match their residential location with their residential preferences—thus addressing their “residential dissonance”—residential satisfaction must be considered.

The importance of residential use and travel preferences provides part of the explanation for the inefficacy of New Urbanism in reducing car travel, since by the

1990s, people had become “irreversibly mobile” (Ellis, 2002), and policymakers wanted to cater to their (auto)mobile constituents. If they preferred living in the suburbs and driving, the solution was to expand highway capacity. However, this tendency in policymaking seems now to be reversing. While the 15-minute city paradigm (Moreno et al., 2021) echoes, to some extent, the essence of New Urbanism, its increasing popularity suggests that promoting mixed land use might be successfully revived.

The 15-minute city concept gained traction after Mayor Anne Hidalgo's 2020 re-election campaign in Paris, to which it was central. The strategy devised by Moreno et al. (Moreno et al., 2021) proposes that the urban built landscape be adapted to become more dense and diverse, providing residents access to six essential urban social functions (living, working, commerce, healthcare, education and entertainment). Moreover, these should be accessible at a 15-minute distance using active modes, with urban planning being re-shifted to focus on “proximity planning” (i.e., advocating for compact and dense urban forms) or “chronourbanism” (Moreno et al., 2021) policies.

Research has promptly followed on the concept, which has since been adapted to different time thresholds (e.g., 5, 10, or 15 minutes) (Logan et al., 2022), urban environments (e.g., the suburbs) (Kamruzzaman, 2022) or to include public transport nodes and incorporate the transit-oriented development (TOD) concept (Wolański, 2023). Accessibility (proximity) analyses have included mostly contour measures and have ranged from access to grocery shops using Open Street Map data (Willberg et al., 2023) to access to amenities such as health centers, educational centers, banks, local shops and drug stores using authoritative datasets (Guzman et al., 2021), to assess who is living a “local lifestyle” (Birkenfeld et al., 2023).

Social inclusion and spatial segregation in the 15-minute city have also been a concern of most researchers (Birkenfeld et al., 2023; Guzman et al., 2021; Willberg et al., 2023), who have called attention to the potential of the concept in turning cities into “archipelagos” of neighborhoods (Glaeser, 2021). Moreover, implementing those policies in the suburbs may prove unwise: some people choose to live in the suburbs precisely because it is less “busy.” Promoting mixed land use in the suburbs may increase their residential dissonance, inviting them to relocate further into the periphery, thus increasing sprawl—and car travel.

3 Materials and methods

3.1 Case study and data

The data in this paper comes from an online survey conducted in the Lisbon Metropolitan Area (LMA), Portugal's largest metropolitan region, encompassing 18 municipalities, approximately 3,000 km², and 2.87 million inhabitants (INE, 2022). The survey was carried out during the spring and summer of 2021 after most COVID-19 restrictions had been lifted. The survey was disseminated through mailing lists and advertised through social media—mainly Facebook and LinkedIn—without any incentives being offered to respondents.

The survey was divided into four sections, namely including: (a) the socioeconomic characterization of the respondents and their household (e.g., gender, age, occupation, education, household size and composition) and their residence characteristics (e.g., size of the house, type of dwelling); (b) a travel and telework diary (five weekdays of the prior week); (c) an overall characterization of telework frequency before and during the pandemic, and prospects in its aftermath; (d) Likert scale questions on residential location satisfaction and residential preferences, and attitudes and perceptions about telework.

A total of 930 responses were collected in the survey, of which 461 were usable, as they were complete and contained sufficient information for precise residential georeferencing, which was needed to gather secondary data characterizing the residence area. The sample characteristics and their comparison with relevant and available global statistics for the LMA are presented in Table 1.

Table 1. Sample characteristics

Variable	Mean or percentage	
	Survey	LMA
Male	36.66%	47.02% (1)
Age	41.59	42.36 (1)
University degree	86.77%	28,76% (2)
Manager/senior official	14.97%	7.46% (1)
Professional occupation	63.34%	22.96% (1)
Household size	3.05	2.40 (1)
Number of cars in the household	1.49	
Household monthly gross income (Euros)	2,793.94	1,874.98 (3)
Very frequent teleworker (2019): 3 plus days/week	19.09%	
Frequent teleworker (2019): 1–2 days/week	7.37%	
Occasional teleworker (2019): 1 plus/days/month	6.07%	
Always in telework (since the beginning of the pandemic)	34.27%	
Number of teleworking days (prior week)	3.36	
Number of partial teleworking days (prior week)	0.29	
Average commute (to work) time (min)	28.95	29.14 (3)
Commuting (to work) by private car	55.31%	63.83% (3)
Commuting (to work) by public transport	26.03%	25.01% (3)
Commuting (to work) by non-motorized	17.79%	11.16% (3)

Note: (1) Census 2021 (INE, 2021); (2) PORDATA 2024 (PORDATA, 2024); (3) LMA Mobility Survey 2017 (INE, 2018).

The percentage of college-educated respondents is significantly higher than the LMA average (87% compared to 29%). Similarly, the sample is skewed toward individuals with professional occupations and managers/senior officials, which may introduce a bias toward higher-income and highly educated individuals. Although this is a limitation of the sample, which will be taken into consideration in the subsequent analysis, these characteristics make it more aligned with the population referred to in the literature as prone to adopt teleworking, such as individuals with higher education levels (de Graaff & Rietveld, 2004; Popuri & Bhat, 2003) and managerial and professional occupations (de Abreu e Silva, 2022).

The percentage of very frequent teleworkers in 2019 (three or more days per week) is also significantly higher than the share of the Portuguese labor force who typically worked from home that same year (6.5%) (Eurostat, 2024). This difference can be attributed to several factors. First, the survey was conducted in the Lisbon Metropolitan Area (LMA), which not only concentrates most of the command-and-control functions of the Portuguese economy (i.e., central government bodies and a high proportion of major company headquarters) but also has a higher concentration of service jobs compared to

the national average. Second, as previously noted, the socio-professional characteristics of the respondents are strongly aligned with telework adoption.

Nevertheless, despite some differences in socioeconomic characteristics, the variables related to commuting behavior are similar to the average patterns observed in the LMA, particularly in terms of mean one-way commute time. The commute modal split is also similar in the case of the public transport share, although distinct in the case of car and non-motorized modes. The significantly higher share of commuters using non-motorized modes can partly be explained by the more substantial share of residents living in Lisbon (municipality) in the sample, which also accounts for the slightly lower average commute time.

3.2 Conceptual model description

The objectives of this study are related to the possibility of telework adoption resulting in urban sprawl. Previous work in the LMA (de Abreu e Silva, 2022) found that teleworkers tend to have residential preferences associated with suburban environments. This paper looks more specifically into the intention to change residence location (intention to move) and the role that telework engagement and attitudes towards telework could have in influencing this decision.

The concept of residential dissonance is used to account for residents presenting lower levels of residential satisfaction and concentrating in areas not aligned with their preferences toward specific urban environment characteristics. These residents will be “residential dissonants,” showing a firm intention to change their location. Here, the concept of “residential dissonants” is applied only to dissonant urban dwellers (Schwanen & Mokhtarian, 2005b), meaning those with residential preferences aligned with suburban environments while living in more traditional urban areas. This allows us to directly link dissonance with an intention to move to more suburban environments and urban sprawl.

Other relevant latent constructs, including the urban environment surrounding the residence and residential satisfaction, are assumed to mediate the relationships between telework perceptions/attitudes and the intention to move. Moreover, we hypothesize that attitudes about telework will be related to residential dissonance. Individuals who are more positive about telework are more likely to be dissonant regarding their residential location. This hypothesis is supported by previous research, which finds that teleworkers often reside in city centers (Ellen & Hempstead, 2002; Soler et al., 2021). However, a positive attitude toward telework is usually associated with a preference for suburban living (de Abreu e Silva, 2022). Centrally located teleworkers who hold a favorable view of telework but are dissatisfied with their urban environment—dissonant urban dwellers—may consider relocating to the suburbs.

The developed model incorporates constructs that describe the characteristics of the area surrounding respondents’ residences. Given that the intention to move is influenced by residential satisfaction and dissonance, constructs related to these factors are also included. Additionally, latent constructs are introduced to capture relevant dimensions of the 15-minute city, enabling an assessment of its impact on residential satisfaction. Variables capturing respondents’ socioeconomic characteristics, residence attributes, prior telework engagement patterns, and commuting behavior are included in the model as exogenous variables. Figure 1 illustrates the conceptual framework.

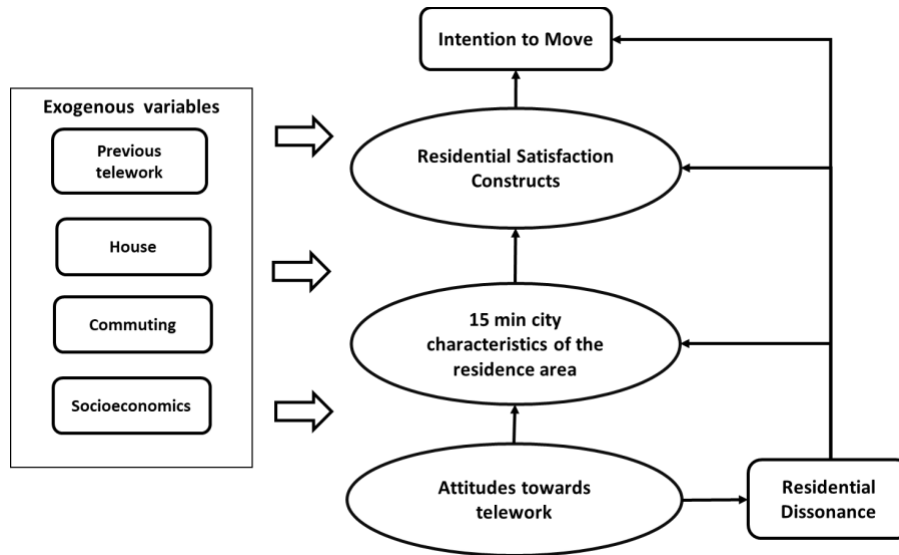


Figure 1. Conceptual model

Most dissonance measures are binary (dissonant versus consonant) and are based on residential preferences, location, neighborhood type, walkability, travel attitudes, or location (Cao, 2015). Some continuous measures exist, but most classify individuals as dissonant if they are above the mean in one dimension and below the mean in another. These continuous measures are, for the most part, a combination of binary dissonance variables and neighborhood satisfaction constructs (Cao, 2015). The characteristics of previously developed residential dissonance variables, the available data, and the objectives of this study guided the definition of the residential dissonance variables. Given that this study aims to assess the potential of telework to induce suburbanization, we are primarily interested in dissonant urban dwellers—individuals with a suburban preference living in urban areas.

The residential dissonance variable was designed to provide more detail than a simple binary classification. Therefore, we adopted an ordinal classification to distinguish between different levels of dissonance. This variable is constructed using a set of statements related to residential preferences collected from respondents, alongside secondary data on the land use characteristics of the civil parishes where they reside. Principal component factor analysis was applied to this data to extract land use factors that capture the multidimensionality of both land use and residential preference factors. The results are presented in Table 2.

Table 2. Factor analysis results for land use factors and residential preferences

Land use factors	Land Use Variables	Loadings	KMO and Total Explained Variance
Living in a central, dense and accessible area	Distance to the CBD	-0.742	KMO = 0.845, 75.8%
	% of urban area	0.733	
	Density	0.904	
	% of people 400 m from bus stops	0.770	
	% of people 400 m from heavy transit stops	0.861	
Living in a freeway accessible urban area	Distance to the CBD	-0.539	
	% of urban area	0.565	
	Compacity index	-0.600	
	% of people 400 m from bus stops	0.452	
	% of people 1000 m of freeway nodes	0.852	
Residential preferences factors	Residential Preference Statements	Loadings	KMO and Total Explained Variance
Preference for urban environment	I prefer to live in a quiet residential area.	-0.5825	KMO = 0.654, 49.95%
	I prefer to live in a central and dynamic area where I can quickly get to commerce, restaurants, cafes and leisure.	0.6699	
	I prefer to live in an apartment rather than a house.	0.7225	
	I prefer to live in the countryside or a village/town where I can have peace and quiet.	-0.7703	
Preference for accessibility	I prefer to live in a place with easy walking access to schools and parks/gardens.	0.7281	
	I would like to live close to my job.	0.5050	
	I prefer to live in a place with easy access on foot to public transport.	0.7638	
Suburban preference	I prefer to live in a quiet residential area.	0.4331	
	I like having privacy from my neighbors.	0.6803	
	I prefer to live where I feel safe to walk outside at night.	0.5753	
	I prefer to live in a place with easy road access.	0.5317	

From these factors, we selected two to build the residential dissonance variable: “Living in a central, dense, and accessible area” and “Preference for urban environment.” Dissonant urban dwellers are defined as individuals who score high on the land use factor and low on the residential preference factor. The scores for each factor were classified into quartiles, with the differences between quartiles being used to define the dissonance levels. This resulted in an ordered variable with three levels, where 0 corresponds to a non-dissonant urban dweller, 1 corresponds to a dissonant urban dweller, and 2 corresponds to a strongly dissonant urban dweller, as shown in Table 3.

Table 3. Residential dissonance codification

Factors	Preference for urban environment			
	4th quartile	3rd quartile	2nd quartile	1st quartile
Living in a central, dense and accessible area				
4th quartile	0	0	2	2
3rd quartile	0	0	1	2
2nd quartile	0	0	0	1
1st quartile	0	0	0	0

Note: 0—Non-dissonant urban dweller; 1—Dissonant urban dweller; 2—Strongly- dissonant urban dweller.

3.3 Methodology

A structural equation model (SEM) is built to test the developed hypothesis. SEM is a popular modeling technique combining two statistical methods: factor analysis and simultaneous equation models (Schumacker & Lomax, 2010). 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 SEM model used in this research includes a structural submodel (Equation 1) and a measurement submodel (Equation 2).

$$\eta = B\eta + \Gamma x + \zeta \quad (1)$$

$$y = \Lambda_y \eta + \varepsilon \quad (2)$$

where:

η is a vector ($m \times 1$) of the m latent endogenous variables,

B is a matrix ($m \times m$) of coefficients of endogenous variables,

Γ is a matrix ($m \times n$) of coefficients of exogenous variables,

x is a vector ($n \times 1$) of the n observed exogenous variables,

ζ is a vector ($m \times 1$) of errors from structural relation,

y is a vector ($p \times 1$) of the p observed endogenous variables,

Λ_y is a matrix ($p \times m$) of regression coefficients of y on η ; and

ε is a vector ($p \times 1$) of measurement and errors on y .

As several endogenous variables included in the model are ordinal and the sample size is relatively small, the Mean and Variance adjusted Weighted Least Squares (WLSMV) estimation method is used (Muthén & Muthén, 2017). The goodness of fit is evaluated using the Comparable Fit Index (CFI) and the absolute Root Mean Square of Approximation (RMSEA). Examining total and indirect effects allows for identifying mediation and moderation effects and self-defeating variables due to contrary direct and indirect effects. Total effects are the sum of both direct and indirect effects. The indirect effects are the product of the direct effects of the different mediating variables in each structural path. For a detailed explanation, see (Bollen, 1989).

4 Results

The model results are indicative of a moderate to good fit. CFI is 0.926, TLI is 0.920, and RMSEA is 0.035. The results are discussed in the following manner: first, the results from the measurement submodel are presented, followed by the direct effects from the

structural submodel. Finally, the total effects between endogenous variables and teleworking and commuting patterns are presented and discussed.

4.1 Measurement submodel

The measurement submodel is built based on a previous exploratory factor analysis using the statements collected in the survey relative to telework attitudes and perceptions and residential satisfaction complemented with secondary data characterizing the land use characteristics surrounding the respondents' residence. As a result, there are two latent constructs describing attitudes to telework, two latent constructs relative to residential satisfaction, and two land use constructs.

Regarding telework, the first latent construct, "Positive to telework," refers to aspects related to productivity, autonomy, travel savings, conditions at home, home relocation opportunities and the employer's positive perspective toward telework. The second latent construct, "Reticence to engage in telework," is related to disadvantages perceived by workers, such as needing extra space to work, feeling overworked, fear of missing out on promotion opportunities, and feeling isolated.

Regarding residential satisfaction, the two latent constructs are related to "Satisfaction with accessibility," capturing perceptions about access to different facilities, retail and amenities, access to public transport and commuting distance, and "Satisfaction with public space," which captures perceptions about public space quality, safety and security and traffic volumes in the vicinity of the residence.

The land use variables capture functional characteristics of the 15-minute city, namely proximity to low-order retail (establishments frequently visited), proximity to public facilities, accessibility to transit, urbanization level and street intersection density. The resulting latent constructs capture the proximity to public facilities and transit ("15 min city public facilities") and the presence of low-order retail and urban space characteristics ("15 min city retail and urban space"). All coefficients for all statements are statistically significant at a 1% significance level and are presented in Table 4, together with the loadings and fit indicators from the exploratory factor analysis.

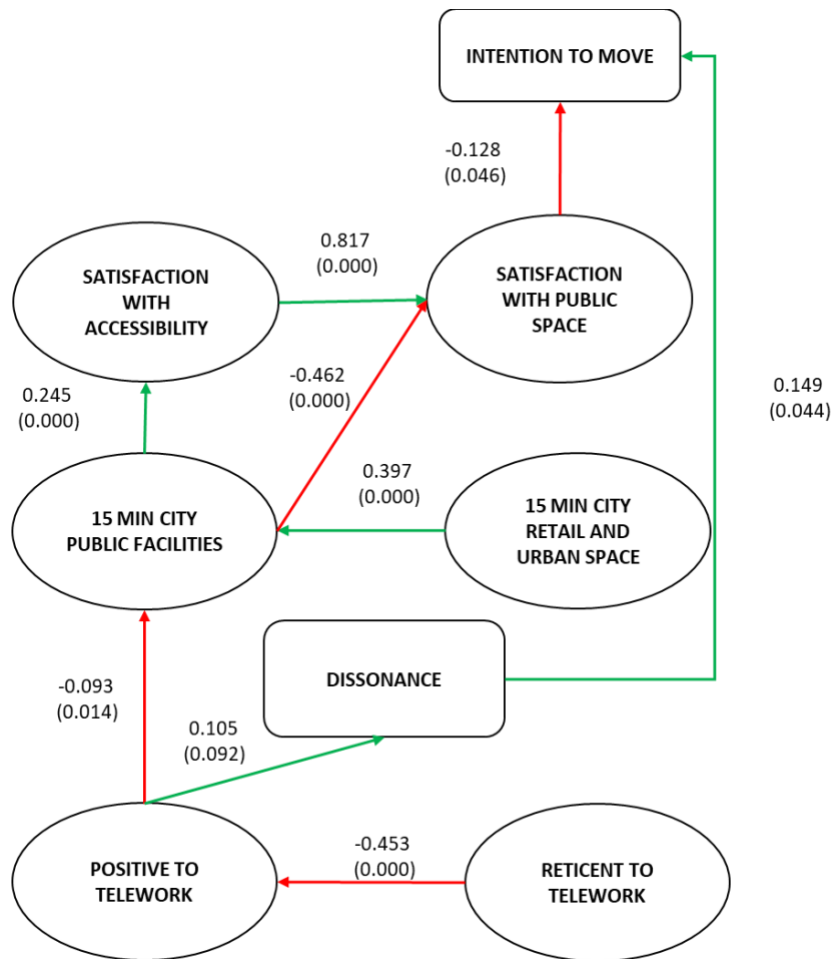
Table 4. Latent variables, exploratory factor analysis and measurement submodel

Latent construct	Variables/statements	Exploratory Factor	Measurement submodel		
		KMO, Total Explained Variance	Loadings	coef.	p-value
Satisfaction with Public Space	Public space quality and street activities	KMO = 0.786; 57.18%	0.676	0.825	0.000
	Safety/security		0.664	0.658	0.000
	Traffic volumes in the streets close to my residence		0.806	0.517	0.000
Satisfaction with Accessibility	Access to shops, coffee shops, restaurants and leisure activities		0.788	0.810	0.000
	Access to schools and green spaces		0.699	0.845	0.000
	Public Transport services		0.788	0.682	0.000
	Distance to my workplace		0.549	0.514	0.000
	% Urbanized area		-0.623	0.736	0.000

15 min city public facilities	Distance to the nearest heavy transit station	0.751	-0.698	0.000
	Distance to the nearest school	0.747	-0.400	0.000
	Distance to the nearest green area	0.808	-0.641	0.000
	Distance to the nearest health facility	0.672	-0.603	0.000
	#15 min city amenities within 600 m radius	KMO = -0.800	0.762	0.000
	# bus stops within 600 m radius	0.874; 67.97%	-0.551	0.710
15 min city retail and urban space	# pharmacies within 600 m radius	0.910	0.923	0.000
	# coffeeshops within 600 m radius	0.942	0.957	0.000
	# groceries within 600 m radius	0.933	0.962	0.000
	# road junctions within 600 m radius	0.843	0.812	0.000
Positive to Telework	Telework offers me broader opportunities related to the places where I could live	0.746	0.690	0.000
	Teleworking helps me to reduce the time and cost I spend on transport.	0.693	0.717	0.000
	Telework gives me the autonomy to create a better balance between my personal, family, and professional lives.	0.715	0.796	0.000
	I feel more productive on the days I telework	0.674	0.736	0.000
	My employer's perspective on teleworking changed positively during the pandemic.	KMO = 0.707; 43.93%	0.460	0.232
Reticent to Telework	I need extra space or room to work from home.	0.676	0.363	0.000
	Teleworking makes me feel isolated.	0.722	0.887	0.000
	I feel like I work too much on the days I work from home.	0.537	0.259	0.000
	If I work from home, I may miss out on promotion opportunities.	0.376	0.345	0.000

4.2 Structural submodel

The structural submodel is presented in Figure 2. Although globally aligned with the conceptual model, the structural submodel does not support all its hypothesized relationships. The difference resides in the lack of statistically significant relationships between dissonance, land use characteristics in the vicinity of the residence, and residential satisfaction. All other relationships and their directions align with the conceptual model.



Note: Red indicates a negative effect; green indicates a positive effect. The values in parentheses indicate the p-values.

Figure 2. Structural submodel

A positive attitude toward telework increases the likelihood of being a dissonant urban dweller (though, as shown in Table 5, this effect is only significant at the 10% level). In turn, being dissonant increases the intention to move. Nevertheless, individuals who are more positive about telework are less likely to reside in areas with high accessibility to 15-minute city public facilities.

Living in areas with high accessibility to 15-minute city amenities enhances satisfaction with accessibility but reduces satisfaction with public spaces. This negative effect suggests that residents in 15-minute city areas may be unsatisfied with traffic volumes and the quality of public spaces. At face value, this implies that people are not entirely satisfied with the “dense” 15-minute city model, which often comes with higher traffic and safety issues. Conversely, these elements—quietness and safety—are frequently marketed as integral to detached-house suburbs.

Nevertheless, it could happen that the variables we are using, which essentially capture accessibility to public facilities and retail, and the urbanization level (% urbanized area), cannot capture aspects of the public space more aligned with the respondents’ perceptions of it. This is a caveat in this study and an aspect deserving

further research, especially since higher residential satisfaction with public space reduces the likelihood of the intention to move in our model.

Nevertheless, it is possible that the variables used in this study—primarily capturing accessibility to public facilities, retail, and the level of urbanization (% urbanized area)—fail to fully capture aspects of public space more aligned with the respondents' perceptions of it. This is a caveat of the study and an aspect warranting further research, particularly since higher residential satisfaction with public space reduces the likelihood of relocation in our model.

Other relevant insights can be drawn from the standardized direct effects in Table 5, particularly the effects from the exogenous variables in the model and their relative magnitude. When looking at the direct effects on the “Intention to Move,” it can be seen that the magnitude of the effects from the exogenous variables surpasses the ones from both satisfaction with public space and dissonance. The exogenous variables mainly capture push factors for residential mobility. Younger people are more likely to move, as are households with children, and those living in smaller houses; ownership of the house where one lives is also a strong deterrent to changing residence because of potential place attachment or higher transaction costs.

Prior telework practices have contrary effects on satisfaction with accessibility. While individuals working from home 1 or 2 days a week in 2019 are more satisfied with accessibility, individuals working from home during the entire COVID-19 pandemic are less satisfied with accessibility. Individuals with shorter commutes and working in the same municipality where they live (which is also an indication of a potentially shorter commute), who commute less by car, and who rent and do not live in a detached house are more likely to live in areas ranking higher in the 15-minute city latent constructs. These effects, particularly the ones related to commuting behavior, are not necessarily causal in nature, but mere associations, as it has been argued that the causality direction goes from the location characteristics to the behavior (e.g., de Abreu de Silva, 2014).

Here, the sample size and the characteristics and objectives of this study do not allow us to consider the full causal chain of relationships between travel behavior and land use patterns. Therefore, variables describing commuting behavior were considered exogenous. Individuals with positive attitudes to telework tend to have longer commutes. The effects of commuting duration on the attitudes towards telework indicate that individuals with longer commutes are more positive towards telework. At the same time, working from home during COVID-19 is positively associated with being more positive towards teleworking, indicating that mandatory telework during the pandemic opened people's perspectives towards the advantages of telework (Colaço et al., 2024).

Table 5. Standardized direct effects

Endogenous variable	Regressor	Coef	p-value
Intention to Move	Satisfaction with Public Space	-0.128	0.046
	Dissonance	0.149	0.044
	Age	-0.221	0.002
	Household with Children	0.194	0.002
	One bedroom	0.168	0.004
	Owner	-0.258	0.000
Satisfaction with Public Space	Satisfaction with Accessibility	0.817	0.000
	15 min city public facilities	-0.462	0.000
Satisfaction with Accessibility	15 min city public facilities	0.245	0.000
	Always in telework COVID	-0.150	0.002
	Teleworking 1-2 days/week, 2019	0.161	0.002
	Five bedrooms	0.142	0.011
15 min city public facilities	Positive to Telework	-0.093	0.014
	15 min city retail and urban space	0.397	0.000
	Detached house	-0.443	0.000
	Commuting duration	-0.134	0.012
15 min city retail and urban space	One bedroom	0.096	0.015
	Works in the residence municipality	0.364	0.000
	Commuting by car	-0.209	0.003
	Detached house	-0.209	0.003
	Commuting duration	-0.137	0.010
	Owner	-0.086	0.036
	Five bedrooms	0.088	0.042
Dissonance	Positive to Telework	0.105	0.092
	Man	0.112	0.043
Positive to Telework	Reticent to Telework	-0.453	0.000
	Always in telework COVID	0.335	0.000
	Commuting duration	0.174	0.007

Analyzing the total effects provides insights into the direction and strength of one variable's influence on the remaining. Opposite direct and indirect effects can result in insignificant total effects, meaning that looking only for direct effects could lead to misleading conclusions. The total effects between endogenous variables and endogenous and exogenous variables describing telework adoption and commuting behavior are presented in Table 6 and discussed afterwards.

Table 6. Standardized total effects

		Satisfac tion with Public Space	Satisfacti on with Accessib ility	15 min city public facilitie s	15 min city retail and urban space	Disso nance	Positiv e to Telew ork	Retice nt to Telew ork	Telewor king 1-2 days/wee k, 2019	Always in telewor k COVID	Commuti ng by car	Commutin g duration
Intention to Move	coef	-0.128	-0.105	0.034	0.013	0.149	0.013	-0.006	-0.017	0.020	-0.002	-0.004
	p- value	0.046	0.047	0.068	0.073	0.044	0.325	0.326	0.000	0.049	0.100	0.408
Satisfaction with Public Space	coef		0.817	-0.262	-0.104		0.024	-0.011	0.131	-0.115	0.017	0.054
	p- value		0.000	0.000	0.000		0.077	0.086	0.002	0.006	0.005	0.005
Satisfaction with Accessibility	coef			0.245	0.097		-0.023	0.010	0.161	-0.158	-0.016	-0.050
	p- value			0.000	0.000		0.054	0.062	0.002	0.001	0.003	0.004
15 min city public facilities	coef				0.397		-0.093	0.042		-0.031	-0.065	-0.031
	p- value				0.000		0.040	0.048		0.050	0.000	0.050
15 min city retail and urban space	coef										-0.165	-0.137
	p- value										0.000	0.010
Dissonance	coef						0.105	-0.048		0.035		0.018
	p- value						0.092	0.099		0.105		0.153
Positive to Telework	coef							-0.453		0.335		0.174
	p- value							0.000		0.000		0.007

As expected, individuals who are more satisfied with the accessibility and quality of public space around their residences are less likely to move. At the same time, living in places more aligned with the 15-minute city concept increases the likelihood of moving home (although statistically significant only at the 10% level). Being a suburban dissonant also increases the intention to move, which, together with the total effects from the residential location characteristics and commuting patterns, indicates that residential moves would most likely be of a suburbanization nature. The total effects from the attitudes towards telework, although statistically non-significant, indicate that individuals who are more positive about telework would likely consider moving home. In contrast, individuals who are more reticent to telework would remain in the same location.

The effects of teleworking behavior are significant and contrary: teleworking during the pandemic increases the probability of moving, whereas teleworking 1-2 times a week in 2019 has the opposite effect. These effects can be explained by the following: Individuals more positive about telework have longer commutes, which aligns with previous research's results linking telework engagement and predisposition with longer commutes and suburban locations (de Abreu e Silva, 2022). As employment is more centralized than population, longer commutes are more likely to imply a central job and a suburban residence. This is also corroborated by the fact that being positive to telework negatively influences the likelihood of living in an area well served by public facilities.

Hence, individuals who are more positive about telework are more likely to be dissonant urban dwellers. Being in telework all the time during the pandemic increases the likelihood of being positive towards telework. As there is a reduced overlap between these individuals and the ones who teleworked regularly (1-2 days a week) in 2019, this effect could be capturing the fact that people who experienced intensive telework during the pandemic are generally positive about it. This experience might have triggered thoughts and pipe dreams about moving the residence to a more idyllic and peripheral location. This hypothesis is corroborated by the total effects of this variable (always in telework during COVID) on other model constructs, as they significantly reduce residential satisfaction with accessibility and public space and increase the probability of wanting to change residence.

The effects of teleworking 1-2 times a week in 2019 are contrary to those observed in the other teleworking engagement variable. Individuals who teleworked frequently in 2019 are more satisfied with their residential location and less likely to move. A possible explanation for this could be related to the fact that these individuals have, on average, a higher income than the other respondents. This could indicate that they have fewer restrictions on locating themselves in their preferred places, thus negatively affecting the intention to move.

Nevertheless, when comparing the standardized total effects of the endogenous variables, telework and commuting patterns with the standardized direct effects of the socioeconomic exogenous variables in the intention to move (Table 5), it is clear that the effects of the latter strongly surpass the former indicating the more substantial role that limitations (small house), needs (more space for children) and transaction costs (owning the house where one lives) have when compared with preferences, satisfaction levels, dissonance and telework engagement. Thus, in this sense, the results obtained are aligned with the ones from Ettema (2010) and Muhammad et al. (2007), who found no significant effect of the adoption of telework in the intention to move.

5 Conclusions

This work analyses the role of telework adoption, telework perceptions and attitudes, and residential dissonance in the decisions to change the residential location. Residential dissonance is assumed to act as a mediating construct between telework adoption and the intention to move. Other relevant mediating constructs are related to the alignment of the current residential location with residential satisfaction. Moreover, the 15-minute city paradigm of proximity and density (Moreno et al., 2021) also enters the model related to residential satisfaction, adding yet another layer of interpretation to it. Ultimately, analyzing these effects intends to shed light on telework's possible impact on urban sprawl. If individuals who are more positive towards telework are dissatisfied with their current (urban) residential location, preferring to live in more suburban environments (that is, if they are "dissonant urban dwellers") (Schwanen & Mokhtarian, 2005b) and unsatisfied with their current residential location, they could likely move towards more suburban areas, therefore contributing to increased urban sprawl.

The results indicate that the effect of attitudes about telework does not significantly influence the decision to move, but teleworking practices do, albeit with a low magnitude. Moreover, people with a more intense teleworking experience during the pandemic and no prior frequent telework practice are more likely to move. This could imply that the experience of teleworking during the pandemic might have triggered thoughts about moving to more peripheral locations. On the other hand, more

experienced teleworkers (the ones teleworking frequently in 2019) seem to be more satisfied with their current residential location, thus being less likely to move.

These results suggest that, although the effects of telework practices and attitudes on the intention to move seem small at best, the substantial increase of telework during the pandemic and afterwards could lead to suburbanization of these new teleworkers. Nevertheless, the variables that capture the push factors for residential mobility (such as being young, living in a small house, having children, and not owning the house) have a much stronger influence on the decision to move, indicating that the effects of telework, residential satisfaction and dissonance are secondary drivers of residential relocation.

Another relevant result is related to the relationship between the characteristics of the urban environment surrounding the residence and residential satisfaction. Individuals living in areas more aligned with the concept of the 15-minute city are less satisfied with the quality of public space, which, taken at its face value, indicates that individuals like the accessibility levels provided by the 15-minute city but dislike the higher traffic volumes and safety and security issues that eventually come with it. As stated before, this could be due to actual preferences towards suburban environments and the association of those environments with opposite characteristics (e.g., quiet and safe) or due to a lack of data to characterize the urban environment elements in a way which is more closely related to the respondents' perceptions of public space quality. This aspect, a limitation of this study, also indicates further research avenues.

A significant limitation of this study is the sample composition, which has an excessively high share of frequent teleworkers (34% have always teleworked during the COVID-19 pandemic) and individuals with a university degree (87%). While this reflects the reality that telework is more prevalent among highly educated professionals in knowledge-intensive occupations, it also means that the findings may not be fully generalizable to the broader working population. Specifically, the relationships observed—between telework, residential satisfaction, and intent to move—may differ if the sample included a larger share of occasional or non-teleworkers. As such, the results should be interpreted cautiously, keeping in mind that telework-related residential decisions may manifest differently in a more representative sample of the entire population, not just the more “telework-prone.” Future research will aim to capture a broader range of workers with varying telework frequencies to validate these findings further.

Other limitations are related to the sample size, which prevents using more complex model specifications and introducing more endogenous variables related to travel behavior patterns or other specifications for residential dissonance. Finally, we use data from the final stages of the pandemic, when the experience of social distancing measures and mandatory telework was still too recent. It will be relevant to investigate whether the relationships uncovered in this paper are still valid or how they have changed, considering the continued post-COVID telework experience for a significant percentage of the population.

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Author contribution

The authors confirm their contribution to the paper as follows: study conception and design: J. de Abreu e Silva; data curation: J. de Abreu e Silva, R. Colaço; methodology: J. de Abreu e Silva; analysis and interpretation of results and draft manuscript preparation: J. de Abreu e Silva, R. Colaço. All authors reviewed the results and approved the final version of the manuscript.

Appendix

Survey dataset available as a supplemental file at <https://doi.org/10.5198/jtlu.2025.2693>.

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