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Samuel Carpentier-Postel, Philippe Gerber, Emma Guyon, Olivier Klein. Changes in residential satisfaction after relocation: The effects of commuting. A case study of luxembourg cross-border workers. *Case Studies on Transport Policy*, 2022, 10 (3), pp.1754-1766. 10.1016/j.cstp.2022.07.006 . hal-03741539

**HAL Id: hal-03741539**

**<https://hal.science/hal-03741539>**

Submitted on 20 Jan 2023

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# CHANGES IN RESIDENTIAL SATISFACTION AFTER RELOCATION: THE EFFECTS OF COMMUTING. A CASE STUDY OF LUXEMBOURG CROSS-BORDER WORKERS

Samuel Carpentier-Postel<sup>1</sup>, Philippe Gerber<sup>2</sup>, Emma Guyon<sup>3</sup> et Olivier Klein<sup>2</sup>

<sup>1</sup> ThéMA - Théoriser et modéliser pour aménager (UMR 6049), Université Bourgogne Franche-Comté

<sup>2</sup> LISER - Luxembourg Institute of Socio-Economic Research, Luxembourg

<sup>3</sup> Université de Franche-Comté

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This is a postprint version, the definitive version of this paper is :

Carpentier-Postel, S., Gerber, P., Guyon, E., & Klein, O. (2022). Changes in residential satisfaction after relocation : The effects of commuting. A case study of luxembourg cross-border workers. *Case Studies on Transport Policy*, 10(3), 1754-1766. <https://doi.org/10.1016/j.cstp.2022.07.006>

# Changes in residential satisfaction after relocation: the effects of commuting. A case study of Luxembourg cross-border workers

**Abstract:** This article aims to unravel the determinants of changes in residential satisfaction after a relocation, and in particular the role of commuting conditions in such changes, for cross-border employees working in Luxembourg, a population characterised by a large proportion of long commutes and high car use. Based on a mobility survey (n=1,960) which provides information on socio-demographic status, travel behaviours, changes of residence, and perceived residential satisfaction, a multiple linear regression model of changes in residential satisfaction following a residential move is developed. The main results highlight that the worsening commuting conditions experienced by most respondents do not seem to reduce residential satisfaction. Indeed, even as commuting conditions deteriorate in the average case, residential satisfaction rises, especially for households that have moved from a flat to a house and from an urban to a rural area. In the context of the cross-border metropolitan area of Luxembourg, the difficulties in (long) commuting to work do not seem to be a limitation to this suburban model.

**Keywords:** residential satisfaction; daily mobility; cross-border; residential mobility; Luxembourg, France, Belgium, Germany

## 1. Introduction

Long commutes, which often favour the use of cars (Ewing & Cervero, 2001; Newman & Kenworthy, 1999), generate negative externalities from both an environmental perspective (e.g. pollution, noise) and a social perspective (e.g. segregation, road safety). For this reason, they are the subject of numerous studies that focus on mode choice and aim to identify drivers in view of a modal shift towards public transportation (Cairns et al., 2008). In the more specific case of cross-border regions like that of Luxembourg, the urban sprawl which leads to such long commutes may be fostered by differences in real estate prices between countries (Diop, 2012). This leads to a kind of cross-border spatial mismatch in which the country hosting the jobs has high real estate prices, while the bordering countries attract the labour force with more affordable prices and higher land availability. However, moving away from central work areas to cheaper accommodation in the suburbs often has negative consequences in terms of the resulting travel conditions: higher transport costs, longer travel times, etc. Besides the questions of housing costs, travel costs and travel times, the motivations that lead a relatively high number of households to adopt such cross-border suburban lifestyles, often resulting in car dependency, are complex and require a deepening of current knowledge. Against this background, this article aims to examine which factors could increase or decrease the residential satisfaction of cross-border households that have moved to cross-border areas outside of Luxembourg within the ten years prior to the survey, in order to measure the effect of commuting to work compared to the more standard factors identified in the scientific literature linked to socio-demographics and reasons for moving.

### 1.1. State of the art

The issue of the links between place of residence and mobility behaviours has been received broad and long-standing attention from researchers (Boarnet & Crane, 2001; De Vos, 2015; Handy, 1996;

39 Newman & Kenworthy, 1996). Several major results relevant for our own research should be noted  
40 here. The first is the revealing of a correlation between the type of place of residence, characterised  
41 in particular by density and functional mixing, and the mode of transport used. Low-density suburban  
42 and rural areas often disfavour the development of public transport modes, mainly because they are  
43 not sufficiently profitable, and thus encourage car dependency (Aguilera, 2005). Conversely, a second  
44 result from the literature shows that dense urban areas characterised by a functional mix will generate  
45 short travel distances that favour active modes and more efficient public transportation (Ewing &  
46 Cervero, 2010; Zhu et al., 2019). While this relationship is easily identifiable in aggregate data that  
47 group modal shares by location type, at the individual level the correlation between place of residence  
48 and modal choice is less clear. For instance, the question of residential self-selection (Ettema &  
49 Nieuwenhuis, 2017) arises at this level, insofar as individuals may choose to live in a particular type  
50 of location according to a travel preference (e.g. living in the city centre to be able to walk more than  
51 in the suburbs). In addition to the effects of transport networks and accessibility, there are thus  
52 individual factors that contribute to the alignment of daily mobility and residential choices. However,  
53 when confronted with an expensive housing market, as in the case of Luxembourg, residential choice  
54 remains limited and the importance given to mobility conditions is only one factor among others in  
55 the decision process.

56 From this point of view, it is therefore interesting to study the interactions of travel behaviours  
57 and residential moves more specifically. Recent research has explored different aspects of this  
58 complex relationship. From a geographic perspective, empirical investigations in the case of the state  
59 of Virginia in the United States (Shuai, 2012) have shown that the volume of home-work flows  
60 between two locations is positively correlated with residential migrations between these same  
61 locations. Under certain circumstances linked to the respective costs of transportation and housing,  
62 there may therefore be a kind of substitution of one type of mobility by another (Huber & Nowotny,  
63 2013). Regarding the more specific question of mode choice and related attitudes, an analysis by De  
64 Vos et al. (De Vos et al., 2018), based on a survey on 1,539 individuals relocated in the city of Ghent  
65 in Belgium, confirmed that travel behaviours influence the choice of place of residence. This study  
66 also showed that mode choice and related attitudes may change after relocation, and that new habits  
67 can be established. This result is also supported by studies conducted in the German city of Stuttgart  
68 and in the cross-border urban area of Luxembourg (respectively Bamberg, 2016; Gerber et al., 2017).  
69 With regard to the issue of trade-offs and choices within households, a study about the travel  
70 behaviour and residential moves of two-earner households in Denmark has shown that their  
71 residential mobility tendencies are positively correlated with the cumulated commuting distances of  
72 both spouses, but negatively correlated with the distance between their respective workplaces (Deding  
73 et al., 2009). In a related finding, a survey conducted in the U.S. city of Seattle showed that two-  
74 worker households are more likely to reduce women's travel time rather than men's travel time in their  
75 relocation choices (Clark et al., 2003).

76 Finally, concerning the more specific question of residential satisfaction, which is at the core of  
77 our work, a study conducted in the Chinese city of Shanghai, comparing households that moved by  
78 choice and those that moved under constraint (Day & Cervero, 2010), showed that the level of  
79 perceived difficulties in terms of daily commuting is affected by the motivations for residential  
80 choice. It also highlighted the importance of income level on the stated level of satisfaction. Other  
81 determinants may also influence residential satisfaction. In addition to relatively expected

82 considerations such as housing quality or tenure status (Ren & Folmer, 2017), the residential move  
83 itself can also have a positive impact on residential satisfaction (Diaz-Serrano & Stoyanova, 2010).  
84 Regarding the role of daily mobility and commuting, which is addressed in this article, results from  
85 the British Household Panel Survey show that certain gender effects exist and that women are more  
86 sensitive to commuting time (Roberts et al., 2011). Studying the relation between commuting and  
87 subjective well-being more broadly based on data from the German Socio-Economic Panel, a recent  
88 study by Lorenz (2018) shows that commuting distance is not associated with lower life satisfaction.<sup>1</sup>

89 These empirical results show the complexity of the relationships between daily and residential  
90 mobility. From this state of the art, we may note that numerous factors are in play when linking  
91 residential and daily mobility. When moving, people have to balance their residential expectations  
92 with geographic factors (e.g. type of municipality and related accessibility issues), household-related  
93 factors (e.g. spouse, income), as well as daily mobility constraints. To establish a robust approach  
94 which allows us to overcome (to a certain extent) the contingencies linked to specific case studies,  
95 our research is based on recent theoretical developments that are developed below.

## 96 *1.2. Conceptual framework and research question*

97 The theoretical framework of this research related to residential mobility and satisfaction (Figure  
98 1) is based on a recent approach to the study of mobility known as mobility biographies (Lanzendorf,  
99 2003; Scheiner, 2007). This theory is based on the observation of the routine dimension of a  
100 significant part of daily mobility behaviours (Gärling et al., 1998), involving strong behavioural  
101 inertia. As routines are made necessary by the need to reduce cognitive burden, changes in mobility  
102 behaviour then become difficult to achieve. The various changes in individuals' life cycles are then  
103 seen as events that are favourable to creating the conditions for behavioural change (Scheiner, 2014),  
104 insofar as they result in changes in lifestyle or context. The interest of the biographical approach is  
105 linked to the growing complexity of individual trajectories in the context of recent societal  
106 transformations: individualisation of lifestyles, evolution of family structures, increased work  
107 flexibility, etc. (Sheller & Urry, 2006).

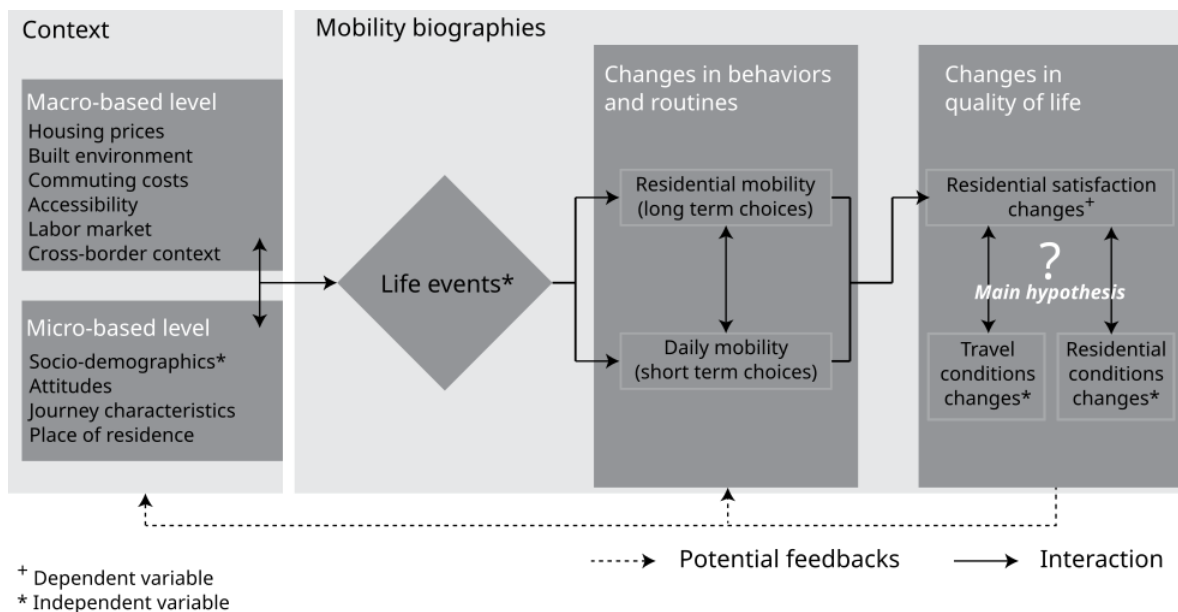
108 The result is an increase in events that may lead to residential mobility and thus affect travel  
109 behaviours and related place attachment (Bailey et al., 2021). Analysis of the determinants of mobility  
110 behaviours thus need to consider life events related to the composition of the household (couple,  
111 childbirth, separation, death...), career paths (job search and change of employment, training) and to  
112 residential paths (parental de-cohabitation, home ownership, etc.) (Coulter et al., 2016; Scheiner &  
113 Holz-Rau, 2013). These different events have been identified in previous work as significant  
114 determinants of both residential and daily mobility behaviours (Carpentier, 2010). For example, a  
115 2015 household survey in Britain indicated that the reasons for residential mobility are linked to job  
116 opportunities, housing area characteristics, and stage of life (Coulter & Scott, 2015).

117 In this context, the question of residential mobility and related residential satisfaction can be  
118 considered as an important indicator of quality of life and well-being (Dinç et al., 2014; Hamersma  
119 et al., 2014; Kroesen et al., 2010; Lu, 1999; Oishi & Tsang, 2022). Residential satisfaction has been  
120 defined as a process of alignment between household needs or aspirations and current place of

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<sup>1</sup> For the case of Germany, however, older results (Stutzer & Frey, 2008) show a negative correlation between life satisfaction and commuting distance.

121 residence (Jansen, 2012). Two analytical approaches can be taken to tackle this theoretical issue. On  
 122 the one hand, the pursuit of residential satisfaction may be considered as a primary reason for a  
 123 residential move. This is particularly the case when residential mobility is viewed as a social elevator  
 124 and an adjustment process, especially for workers reacting to changes in the job market (Clark &  
 125 Maas, 2015). On the other hand, residential satisfaction may be viewed as a result of the difference  
 126 in housing situation before and after a move (Barcus, 2004). Our research, which is grounded in the  
 127 notions of life events and related residential mobilities, relies more particularly on this second  
 128 approach, which also takes changes in commuting conditions into account. More precisely, while the  
 129 impacts of residential relocation on travel conditions are studied relatively often, especially in the  
 130 mobility biographies framework (Gerber et al., 2017; Wang et al., 2020), the same has not been true  
 131 for the reverse effect (Wang & Wang, 2020).



132  
 133 **Fig. 1.** Conceptual framework

134 Within this conceptual framework, this article studies changes in residential satisfaction after a  
 135 move, which most often leads to a deterioration of commuting conditions, in the specific case of a  
 136 cross-border metropolitan area. For the vast majority of cross-border workers living in a neighbouring  
 137 country and working in Luxembourg, the residential move implies longer commuting distances and  
 138 increased commuting dissatisfaction (Figure 4). In this context, does commuting affect changes in  
 139 cross-border workers' residential satisfaction? Does the type of residential change (e.g. from  
 140 apartment to house, from urban to rural municipality) have an impact on the overall changes in  
 141 residential satisfaction whilst also accounting for commuting constraints? These questions lead to one  
 142 main hypothesis: Changes in residential satisfaction after a move depend more on the new housing  
 143 conditions than on the new commuting constraints. This hypothesis is in line with recent results  
 144 observed in Luxembourg (Gerber et al., 2017), the Canadian city of Montreal (Zarabi et al., 2019),  
 145 and Germany (Lorenz, 2018).

## 146 2. Materials and Methods

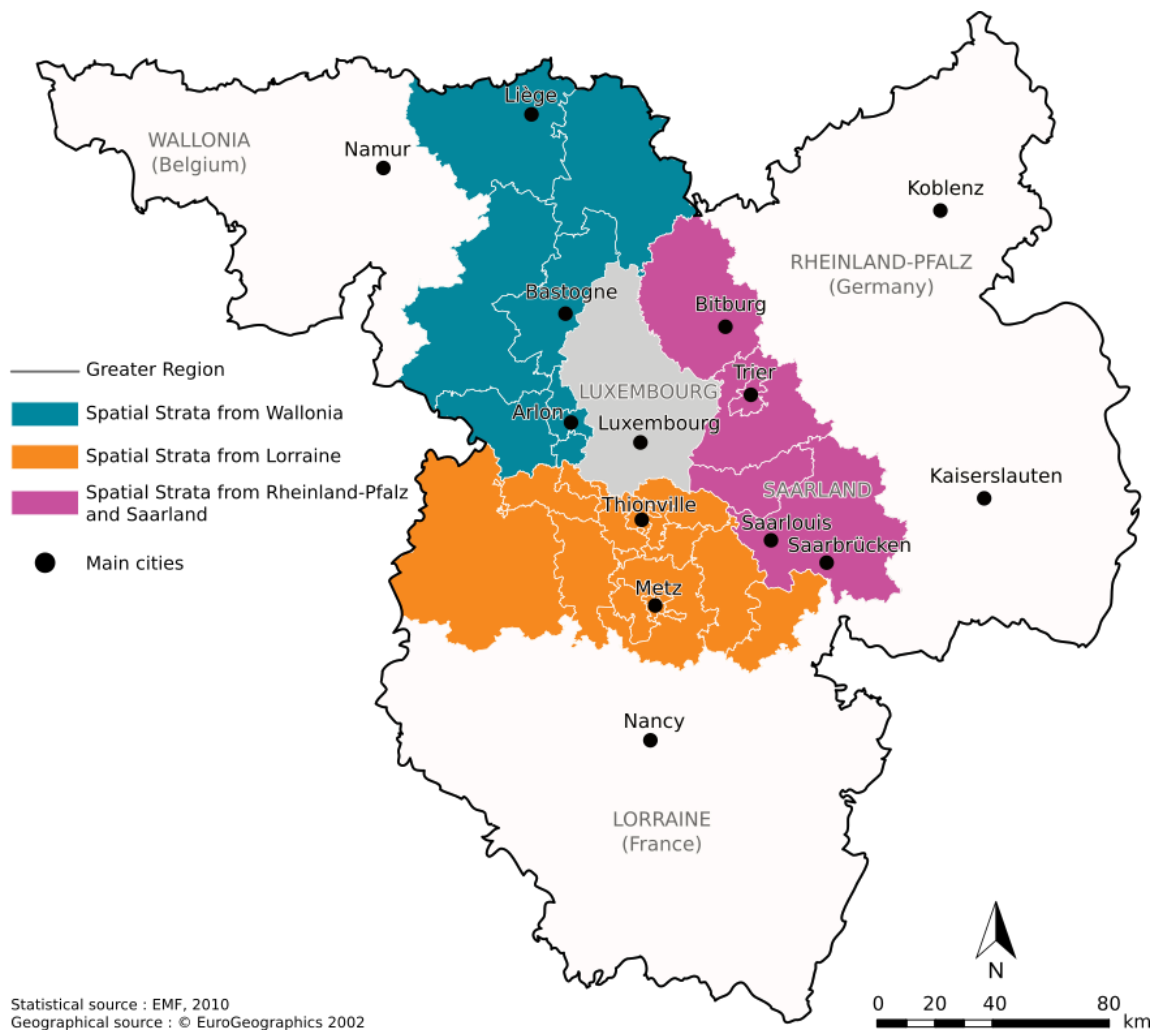
147 To answer these research questions, our empirical part is based on survey data that allow us to  
 148 take account of the individual and contextual factors of our conceptual framework (e.g. socio-

149 demographics, life events, changes in travel conditions, changes in residential condition; see Figure  
 150 1) in order to model the determinants of changes in residential satisfaction.

151 *2.1. Survey*

152 Our analysis draws on a mobility survey conducted among cross-border workers employed in  
 153 Luxembourg in 2010 and 2011 and living in France, Belgium or Germany. This dataset is based on a  
 154 two-phase self-completed questionnaire sent to cross-border workers, with Phase 1 looking at the  
 155 usual topics of a National Transport Survey, and Phase 2 focusing on respondents' perception of  
 156 commuting, residential mobility, and their impact on daily mobility.

157 The scope of the survey covers 90% of the entire population of 146,600 cross-border workers  
 158 (December 2009) within a commuting area allowing one round-trip journey to and from work per day  
 159 (Drevon et al., 2018; Eaux & Gerber, 2014). Based on a spatially stratified random sampling process  
 160 (Figure 2), 40,000 workers received the self-administered Phase 1 questionnaire. 7,235 respondents  
 161 completed this first phase (18.1% of the target population). A second phase was conducted beginning  
 162 in 2011. This second questionnaire had a response rate of 52% (9% of the initial target population of  
 163 Phase 1), leading to a dataset of 3,727 individuals who responded to both phases of the survey.



164  
 165 **Fig. 2.** Map of the study area and spatial strata of survey sampling



166 More specifically, the issue of changes in residential satisfaction has been addressed by gathering  
 167 subjective indicators with several attitudinal scales related to residential transition, such as housing  
 168 satisfaction before and after residential relocation (Figure 3). In this survey, only the difference in  
 169 satisfaction before and after the move was collected, so we do not know the perceived levels of  
 170 satisfaction for each situation.

D13 Compared to your previous place of residence, would you say that your current home, neighbourhood and environment are:

	Much worse than before	Worse than before	Identical	Better than before	Much better than before
Housing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Neighborhood	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

171  
 172 **Fig. 3.** Satisfaction scales for Housing, Neighbourhood and Environment

173 Assuming that residential satisfaction can be related to subjective and/or objective indicators  
 174 (Haslauer et al., 2015), it is important to supplement the attitudinal scales with objective indicators.  
 175 These supplementary indicators refer to environmental aspects at the macro-level, such as type of  
 176 municipality or commuting distance (Vega & Reynolds-Feighan, 2009), and are also based on the  
 177 mobility survey.

178 A final important aspect regarding data collection is the use of a cross-sectional survey to study  
 179 changes in mobility and residential satisfaction after a move. This choice is motivated by the absence  
 180 of a representative longitudinal panel survey of this cross-border population, but we must keep in  
 181 mind that the data collected relies on respondents' memories (Müggenburg, 2021; Rau & Manton,  
 182 2016) and may be subject to imprecisions. That said, events as memorable as moving or as routinised  
 183 as commuting are likely to still be well known by respondents.

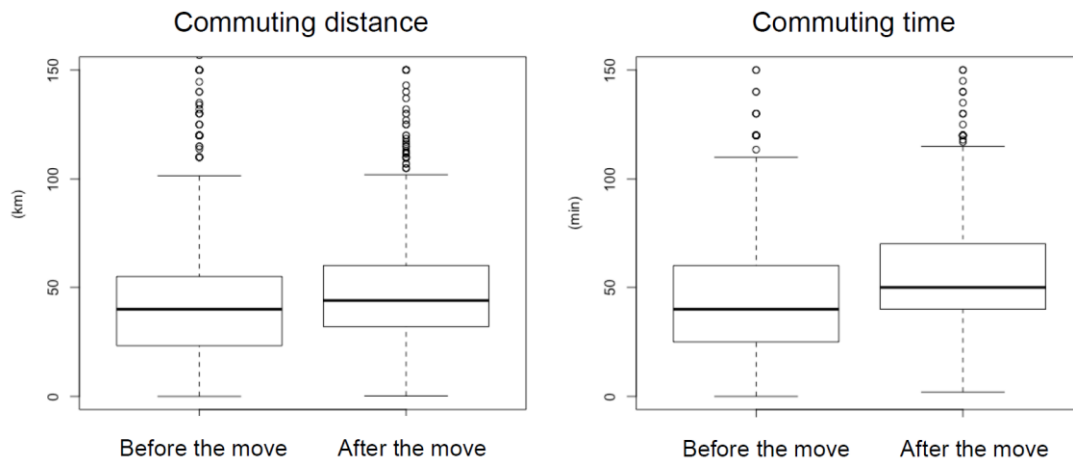
## 184 2.2. Descriptive statistics of the sample

185 In this paper, the population studied is limited to cross-border workers employed in Luxembourg  
 186 who have experienced a move in a period of 10 years prior to the survey, which restricts our sample  
 187 to 1,960 individuals out of 3,727 (53%). After the relocation situation, this subsample is younger and  
 188 less wealthy on average, and is more likely to live in flats and in urban municipalities (Figure A1)  
 189 than the cross-border population as a whole.

190 For our sample, the main reasons to move in this cross-border context are related to the life cycle  
 191 and housing conditions: Becoming a homeowner is the most commonly mentioned reason (over 51%  
 192 of respondents), with other reasons relating to the living environment or type of housing. More than  
 193 four-fifths of respondents report that they now have higher-quality accommodations (Figure A2),  
 194 suggesting higher residential satisfaction: Over 80% of cross-border workers are satisfied, but this  
 195 satisfaction is lower for households that have moved across a border (e.g. from Luxembourg to  
 196 France).

197 With regard to their commutes, our sample experienced a clear deterioration in their travel  
 198 conditions (Figure 4). On average, the distance for the trip to work increased by 5.4 kilometres (from  
 199 42.4 km to 47.8 km), and the travel time increased by 12 minutes (from 43 min. to 55 min.).





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**Fig. 4.** Changes in commute distance and travel time before and after residential move

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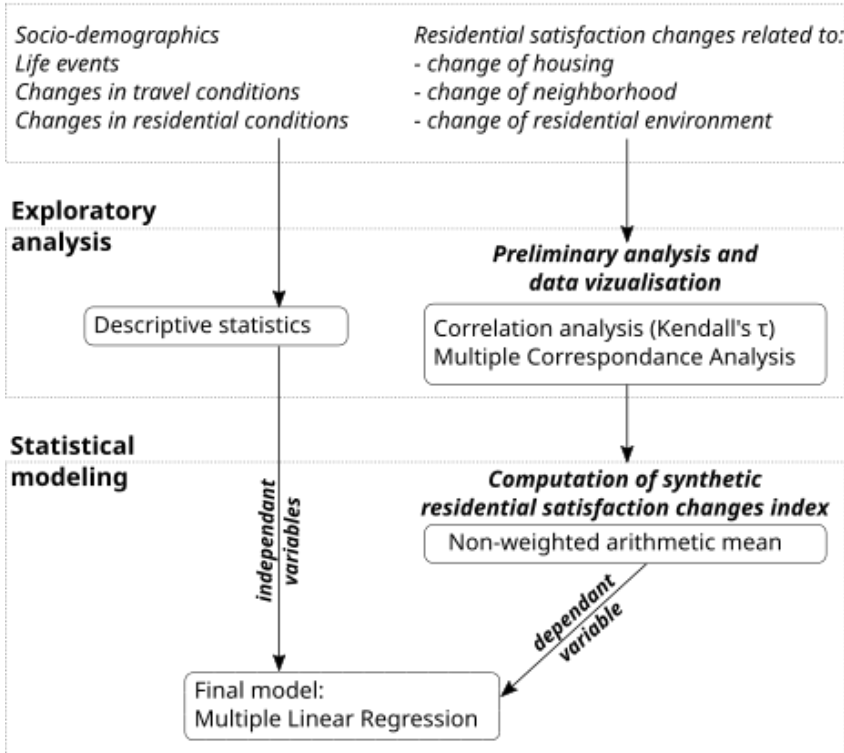
In addition, while 43% of respondents indicated that their commuting situation remained the same after the move, more than a quarter of respondents nevertheless reported that their situation had deteriorated significantly (Figure A3). This was especially true for people moving from Luxembourg to a neighbouring country (Table A3). We argue that even though a cross-border residential move is a specific type of relocation, it should be considered first and foremost as part of a suburbanisation process, supporting Alonso's (Alonso, 1964) theory. Cross-border workers, when able to choose, tend to seek out more space (for their house but also for their yard or garden) as well as more greenery and natural landscapes, while probably underestimating transportation constraints (Baudelle et al., 2004).

The next step in our methodology is to build a model based on our conceptual framework (Figure 1) and survey techniques that will allow us to determine the statistical relations between changes in residential satisfaction and commuting routines while taking account of the reasons for moving (life events) and the type of residential changes.

### 214 2.3. Methods

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To analyse the determinants of changes in residential satisfaction among cross-border workers in Luxembourg who have moved in the ten years prior to the survey, the methodology we used consists of two main steps (Figure 5). Using the questionnaire data, the first step consists of an exploratory analysis of reported residential satisfaction, based on three attitudinal scales relating to housing, environment, and neighbourhood. A correlation analysis, complemented by a multiple correspondence analysis, is then performed to identify the appropriate method for calculating a synthetic indicator of changes in residential satisfaction that summarises the information from the different scales. The second step consists of using this synthetic indicator as the dependent variable in a regression model that considers the different categories of individual, transition and contextual determinants of our theoretical model (Figure 1). These include socio-demographic variables describing households that have recently moved, as well as variables describing changes in housing conditions, travel conditions, and life events motivating these changes.

**Survey - Micro-based level variables**

227

228 **Fig. 5.** Methodological framework229 **3. Results**

230 As stated in the methodological framework, our analyses are divided into two complementary  
 231 steps: First, we calculate and analyse a synthetic index of changes in residential satisfaction that will  
 232 then be used as a dependent variable in a regression model aiming at explaining the level of  
 233 satisfaction (all statistical analyses were performed using R).

234 *3.1. Describing the residential satisfaction change index*

235 The conceptual framework used in this article requires a global view of the notion of residential  
 236 satisfaction. To achieve this perspective, we use the three attitude scales collected during the survey,  
 237 which provide information on the satisfaction reported by individuals who have moved with regard  
 238 to changes in their housing, environment, and neighbourood (Figure 3). The first step of the analysis  
 239 then consists of exploring the statistical relationships between these three dimensions of residential  
 240 satisfaction in order to identify the appropriate procedure by which to combine them into a synthetic  
 241 indicator.

242 Since the satisfaction scales used are ordinal qualitative variables, we calculated their correlations  
 243 using Kendall's  $\tau$  (Table 1). The correlation matrix shows that the three satisfaction scales are well  
 244 correlated ( $> 0.3^2$ ).

<sup>2</sup> <https://www.spss-tutorials.com/kendalls-tau/>

245

**Table 1.**

246

Correlation matrix of satisfaction related to dimensions of quality of life (Kendall's  $\tau$ )

	Housing	Neighbourhood	Environment
<b>Housing</b>	1	<b>0.37</b>	<b>0.49</b>
<b>Neighbourhood</b>	<b>0.37</b>	1	<b>0.52</b>
<b>Environment</b>	<b>0.49</b>	<b>0.52</b>	1

247

Source: LISER 2011, Cross-border mobility survey

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A multiple correspondence analysis was performed to further analyse the relationships between the three scales. The factor map of the first two dimensions (Figure 6), accounting for about 40% of variance, shows a strong correspondence between the scores on the three scales. The positive evaluations are thus positioned in the same area of the factor map, as are the negative and average evaluations. In other words, there is a tendency for individuals to assess their satisfaction with housing, the environment and the neighbourhood at the same level. People will thus tend to accumulate elements of satisfaction or dissatisfaction according to their situation.

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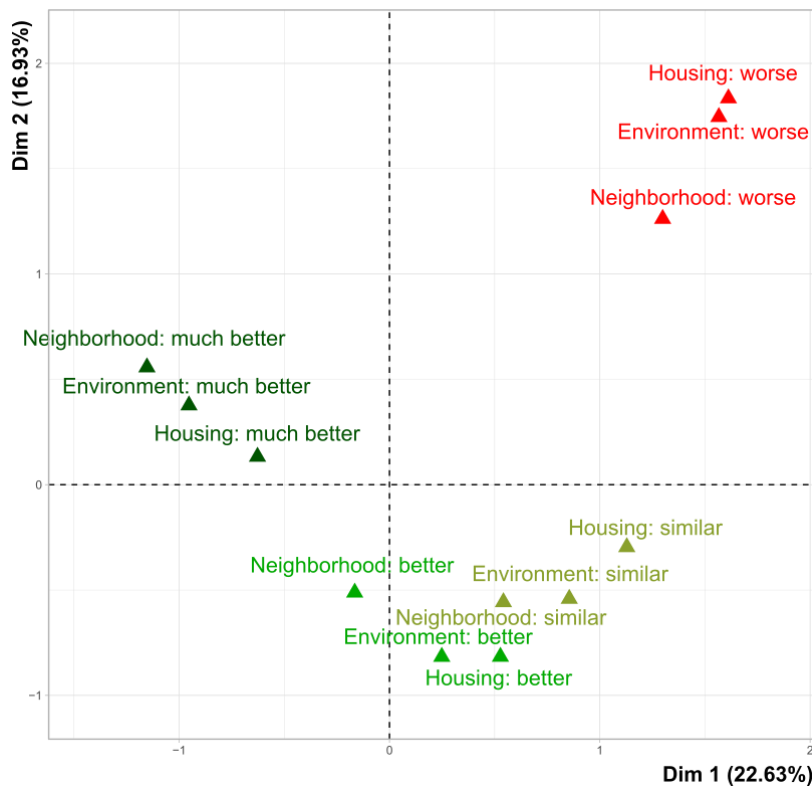
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**Fig. 6.** Factor map of the Multiple Correspondence Analysis (MCA) of residential satisfaction

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Based on the correlation analysis (Table 1) and the factor map of the three satisfaction scales relating to housing, environment and neighbourhood (Figure 6), we then opted to construct a synthetic non-weighted Residential Satisfaction Change Index corresponding to the arithmetic mean of the three scales (see Equation (1)).

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$$RSCI = \frac{HSCS + ESCS + NSCS}{3} \quad (1)$$

where:

RSCI: Residential Satisfaction Change Index

HSCS: Housing Satisfaction Change Scale

ESCS: Environment Satisfaction Change Scale

NSCS: Neighbourhood Satisfaction Change Scale

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263 This index is a pseudo-continuous variable and can thus be used as a continuous dependent  
264 variable of a multiple linear regression.

265 *3.2. Modelling residential satisfaction*

266 The statistical model of changes in residential satisfaction (Table 3) is constructed around the  
267 theoretical principles of mobility biographies described in the first section (Figure 1). On the one  
268 hand, the independent variable relies on the inclusion of different aspects of satisfaction, combined  
269 in the Residential Satisfaction Change Index. On the other hand, the independent variables belong to  
270 the four categories mentioned above: socio-demographic characteristics, changes in commuting  
271 conditions, changes in residential conditions, and life events (Table 2). The collinearity between  
272 variables was tested by computing the Variance Inflation Factor (presented in Table 3).

273

**Table 2.**

274

Descriptive statistics of the variables introduced in the model

DEPENDENT VARIABLE								
	Min	Q1	Median	Mean	Q3	Max	NA's	
<b>RSCI</b>	2.0	3.3	4.0	4.0	4.7	5.0	18	
INDEPENDENT VARIABLES								
<b>Age group</b>	(16,25]	(25,35]	(35,45]	(45,55]	(55,66]			NA's
n (%)	76 (3.6%)	861 (41.2%)	850 (40.7%)	257 (12.3%)	45 (2.2%)			5
<b>Type of Household</b>	Couple with children	Single without children		Couple without children		Single with children	NA's	
n (%)	1004 (47.9%)	446 (21.3%)		549 (26.2%)		95 (4.5%)		
<b>Reported household income<sup>3</sup></b>	less than €2,000	€2,001 to 2,500	€2,501 to 3,500	more than €3,500				NA's
n (%)	543 (27.3%)	559 (28.1%)	606 (30.5%)	280 (14.1%)				106
<b>Reported changes in journey to work<sup>4</sup></b>	No changes	Worse	Better	Much better				NA's
n (%)	918 (44.2%)	627 (30.2%)	317 (15.3%)	216 (10.4%)				16
<b>Change in country of residence</b>	Stay in France	Stay in Germany	Stay in Belgium	Move to another country in the Greater Region				NA's
n (%)	995 (48.1%)	496 (24.0%)	386 (18.7%)	190 (9.2%)				27
<b>Changes in housing type</b>	Flat to house	Flat to flat	House to flat	House to house	Other		NA's	
n (%)	770 (38.4%)	397 (19.8%)	174 (8.7%)	624 (31.1%)	39 (1.9%)		90	
<b>Changes in type of municipality</b>	Urban to rural	Urban to urban	Rural to rural (same type)	Rural to rural (different type)		Rural to urban	NA's	
n (%)	535 (26.8%)	594 (29.7%)	542 (27.1%)	168 (8.4%)		161 (8.1%)	94	
<b>Reasons for moving</b>	Home ownership	Housing type and size	Environmental neighbourhood	Move closer to familiar places	Family or financial problems	Household changes (childbirth...)	Professional and other reasons	NA's
n (%)	676 (33.3%)	337 (16.6%)	75 (3.7%)	79 (3.9%)	132 (6.5%)	250 (12.3%)	348 (17.1%)	63

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Source: LISER 2011, Cross-border mobility survey

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Socio-demographics are related to individual characteristics, such as age, household characteristics that capture social position (income) as well as characteristics related to spouses and children (type of household). For this category of variable, education level was found to be non-significant.

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To measure the effects of changes in commuting conditions, the variables for distance and time changes (Figure 4) as well as mode choice before and after the move and reported satisfaction (Figure A3) were tested. When all four variables are introduced simultaneously in the model, only the last one is significant, and it was therefore the only one selected in the final version.

<sup>3</sup> In the survey, the respondents were asked to sum up the net professional income of each person in the household, but also other monthly income such as family/unemployment allowances, pensions, bonuses, income from property, commercial benefits, etc.

<sup>4</sup> This variable is based on the answers to the following question: "Compared to your previous place of residence, would you say that your current journey to work is: Much worse than before, Worse than before, Identical, Better than before, Much better than before"

284 To capture the effect of changes in residential conditions, three complementary variables were  
285 introduced into the model: (i) change in housing type (Table A1), (ii) change in type of municipality  
286 (Table A2), and (iii) change in country of residence (Table A3), allowing the model to take account  
287 of the cross-border context.

288 The last category of dependent variables are dummies that correspond to the life events  
289 conceptualised in the mobility biographies and reflect the primary motivations leading to the  
290 residential move.

291 **Table 3.**

292 Multiple linear regression of the Residential Satisfaction Change Index (RSCI)

	Variable	Estimate	Std. Error	T value	Pr(> t )
	(Intercept)	<b>4.356</b> ***	0.063	68.345	< 2e-16
Socio-demographics	<b>(a) Age group (VIF: 1.4)</b>				
	<i>Age group 26-35 (ref.)</i>				
	Age group 16-25	<b>0.159</b> *	0.094	1.685	0.092092
	Age group 36-45	0.026	0.039	0.656	0.511605
	Age group 46-55	-0.013	0.058	-0.234	0.814789
	Age group 56-66	-0.082	0.118	-0.699	0.484763
	<b>(b) Type of household (VIF: 1.7)</b>				
	<i>Couple with children (ref.)</i>				
	Single without children	-0.034	0.052	-0.663	0.507408
	Couple without children	<b>-0.093</b> **	0.045	-2.062	0.039330
	Single with children	<b>-0.157</b> *	0.085	-1.834	0.066784
	<b>(c) Reported household income (in €) (VIF: 1.3)</b>				
	<i>Income group less than 2,000 (ref.)</i>				
Income group 2,001 to 2,500	<b>0.106</b> **	0.049	2.164	0.030624	
Income group 2,501 to 3,500	<b>0.092</b> *	0.048	1.922	0.054719	
Income group more than 3,500	<b>0.226</b> ***	0.059	3.812	0.000143	
Changes in travel conditions	<b>(d) Reported changes in the journey to work (VIF: 1.3)</b>				
	<i>No changes (ref.)</i>				
	Worse	0.020	0.042	0.474	0.635886
	Better	0.067	0.052	1.287	0.198426
	Much better	<b>0.231</b> ***	0.062	3.731	0.000197
Changes in residential conditions	<b>(e) Change in country of residence (VIF: 1.5)</b>				
	<i>Stay in France (ref.)</i>				
	Stay in Germany	<b>-0.132</b> ***	0.045	-2.900	0.003780
	Stay in Belgium	0.060	0.048	1.255	0.209737
	Move to another country in the Greater Region	0.021	0.064	0.326	0.744700
	<b>(f) Change in housing type (VIF: 2.0)</b>				
	<i>Flat to house (ref.)</i>				
	Flat to flat	<b>-0.233</b> ***	0.053	-4.345	1.48e-05
	House to flat	<b>-0.846</b> ***	0.074	-11.385	< 2e-16
	House to house	<b>-0.215</b> ***	0.044	-4.803	1.71e-06
	Other	<b>-0.319</b> **	0.129	-2.460	0.013981
<b>(g) Changes in type of municipality (VIF: 1;6)</b>					
<i>Urban to rural (ref.)</i>					
Urban to urban	<b>-0.160</b> ***	0.049	-3.240	0.001219	
Rural to rural (same type)	<b>-0.128</b> ***	0.049	-2.625	0.008753	
Rural to rural (different type)	-0.015	0.068	-0.227	0.820297	
Rural to urban	<b>-0.322</b> ***	0.072	-4.473	8.26e-06	
Life events	<b>(h) Reasons for moving (VIF: 1.6)</b>				
	<i>Home ownership (ref.)</i>				
	Type and size of housing	0.012	0.050	0.258	0.796170
	Environment and neighbourhood	<b>0.242</b> ***	0.090	2.663	0.007828
	Move closer to familiar places	<b>-0.170</b> *	0.089	-1.902	0.057390
	Family or financial problems	<b>-0.548</b> ***	0.077	-7.119	1.63e-12
	Household changes (childbirth...)	<b>-0.470</b> ***	0.056	-8.295	2.26e-16
Professional and other reasons	<b>-0.337</b> ***	0.052	-6.407	1.94e-10	

Adjusted R<sup>2</sup>: 0.27, Signif. codes: 0.01 '\*\*\*', 0.05 '\*\*', 0.1 '\*', Residual standard error: 0.689

293 Source: LISER 2011, Cross-border mobility survey



294 The model provides insights into the determinants of changes in residential satisfaction among  
295 cross-border commuters who have changed their place of residence in the ten years prior to the survey.  
296 Regarding the first category of explanatory variable, i.e. socio-demographics, the most significant  
297 determinant is household composition (b). Couples without children and single-parent families are,  
298 on average, less satisfied with their move than families with children. From a socio-economic point  
299 of view, quite logically, we observe a satisfaction gradient that increases with income (c). This reflects  
300 the greater ease with which wealthy households find housing that meets their expectations. Age  
301 groups (a) do not significantly influence the changes in residential satisfaction, except for the  
302 youngest group (from 16 to 25) who tend to be a little more satisfied than those between 26 and 35  
303 years old.

304 Besides these individual determinants, the large group of variables describing the changes in  
305 residential conditions is particularly significant. Households moving from a flat to a house (f) are the  
306 most satisfied, while those experiencing the opposite transition, from a house to a flat, are the least  
307 satisfied. However, moving from a house to another house is a less satisfying transition than moving  
308 from a flat to a house. Similarly, individuals who have moved from an urban to a rural municipality  
309 (g) are more satisfied than others, particularly those who have made the opposite transition, moving  
310 from a rural area to a city. The variation in satisfaction according to the country of residence (e) is  
311 quite weak, with only a slight decrease for households that stay in Germany.

312 Regarding the impact of changes in travel conditions, while we have previously observed that  
313 commuting (d) is not a major determinant of cross-border residential choice (since a small share of  
314 our sample chose to get closer to their workplace), from a satisfaction point of view, a clear  
315 improvement in travel conditions tends to improve residential satisfaction. This result only concerns  
316 a small proportion of the sample who reported better conditions for their commute after the move.  
317 For the vast majority of the others, this aspect is not significant and thus indicates the priority given  
318 to housing and environmental characteristics over transportation in their residential choice. We must  
319 point out here that the other variables describing changes in the commute (distance, time, modes)  
320 were also not significant (and therefore not included in the final model). This seems to demonstrate a  
321 decoupling of the changes in residential satisfaction and commuting conditions, despite a tendency to  
322 move further away which leads to worsening travel conditions

323 Finally, considering the dimension of life events, the reasons leading to a move (h) are a group of  
324 variables that are highly significant in the model. Those who moved to improve their housing and  
325 residential environment are, as expected, the most satisfied. Conversely, those who had to change  
326 their residence because of exogenous factors (financial difficulties, professional reasons, change in  
327 household composition) are less satisfied.

#### 328 **4. Discussion**

329 The residential mobility of cross-border workers in Luxembourg highlights the strong  
330 attractiveness of single-family houses and low-density areas, despite the longer commuting distances.  
331 Moreover, the fact that the variables (tested but not retained in the model) of distance and travel time  
332 do not statistically affect changes in residential satisfaction is a result in itself. Specifically, we see  
333 that whether a move takes the household closer to or further away from the workplace does not affect  
334 the quality of the change in satisfaction, all else being equal.

335 These residential choices are notably in line with the home ownership trajectories of young  
336 households with children. Overall, there is a strong correspondence in this specific case study between  
337 motivations for a move and residential satisfaction. Households which moved to improve their  
338 housing conditions are, as expected, the most satisfied, while those who moved for other reasons,  
339 personal or professional, are less satisfied, as also observed by Day and Cervero (2010).

340 However, there is some variation when it comes to the observed transitions in housing types. First,  
341 the role played by the daily commute in such residential choice is particularly interesting. Indeed,  
342 while the average long commuting distance could be seen as a consequence of relatively modest  
343 income which requires households to move away to find cheaper housing, the analysis of satisfaction  
344 reveals that it is mostly the consequence of a preference for low-density areas. Hence, this research  
345 has shown how a higher residential satisfaction can be achieved despite difficult travel conditions  
346 which are recognised as such by individuals (Gerber et al., 2017). The notions of arbitration, or even  
347 balance, which underpin many static or dynamic economic models may then be reconsidered in the  
348 light of these results, especially in Land Use Transport Interaction (LUTI) models (Gerber et al.,  
349 2018; Simmonds et al., 2013).

350 For some people, there may be a hierarchy of different life choices within which housing seems  
351 to be a high priority, which might have an influence on satisfaction with different life domains  
352 (Nowok et al., 2018; Oh, 2020; Zarabi et al., 2019). From this perspective, it appears that the commute  
353 to work and the associated modal choice are not, in this case, choices in themselves. However, any  
354 such result will have to be confirmed by further analysis. The choice of housing, as well as  
355 neighbourhood, is then considered a priority choice in the hierarchy of lifestyle choices for cross-  
356 border workers. This hierarchy is perhaps dictated by a hierarchy of activity times, where commuting  
357 time, even if long, remains less important than the time spent at home enjoying one's garden in the  
358 sun with one's children playing on the swing. This is especially true since the time spent commuting  
359 can also be spent on other activities, such as resting, listening to music or working (Gerber et al.,  
360 2020). This fact may be reinforced following the Covid pandemic, during which remote work  
361 arrangements have strongly increased both for Luxembourg residents and for cross-border commuters  
362 (Martin et al., 2022). It gives residences (and more particularly, those located in suburban areas  
363 benefiting from large outdoor spaces) an undeniable comparative advantage.

364 In light of the above, land use and housing policies should be more closely linked to transportation  
365 policies in order to facilitate sustainable mobility, especially in the context of cross-border areas.  
366 Concretely, certain INTERREG projects have been set up to promote the emergence of cross-border  
367 regions, with certain degrees of functional integration (Drevon et al., 2018). For example, some  
368 regions try to ensure greater fluidity of cross-border flows through the use of shared cross-border  
369 spatial planning tools, for instance with the SDTGR project, a Territorial Development Plan for the  
370 Greater Region shared by all the actors in the Greater Region. Even though this project brings together  
371 institutional actors from several countries, competition still exists between the regions. The actors  
372 embedded in these INTERREG projects behave paradoxically, each giving priority to their own  
373 national area despite the cross-border cooperation (Decoville & Durand, 2021). The stakeholders still  
374 need to improve the balance between economic pressure, transport and housing markets (Causa &  
375 Pichelmann, 2020).

376 Finally, regarding the sociocultural dimension of such cross-border areas, the variation of changes  
377 in residential satisfaction according to country of residence appear to be quite weak. There is only a

378 slight decrease in reported satisfaction for households moving to Germany that may reflect the  
379 relatively high proportion of Luxembourgers in this group, who can thus be assumed to have decided  
380 to leave their home country to find a larger dwelling across the border, due to the cross-border real  
381 estate price differential (Carpentier, 2010). This leads us to confirm Luxembourg as an integrated  
382 cross-border metropolis (Sohn et al., 2009) from which cross-border workers can benefit as a  
383 catchment area (Gerber, 2012).

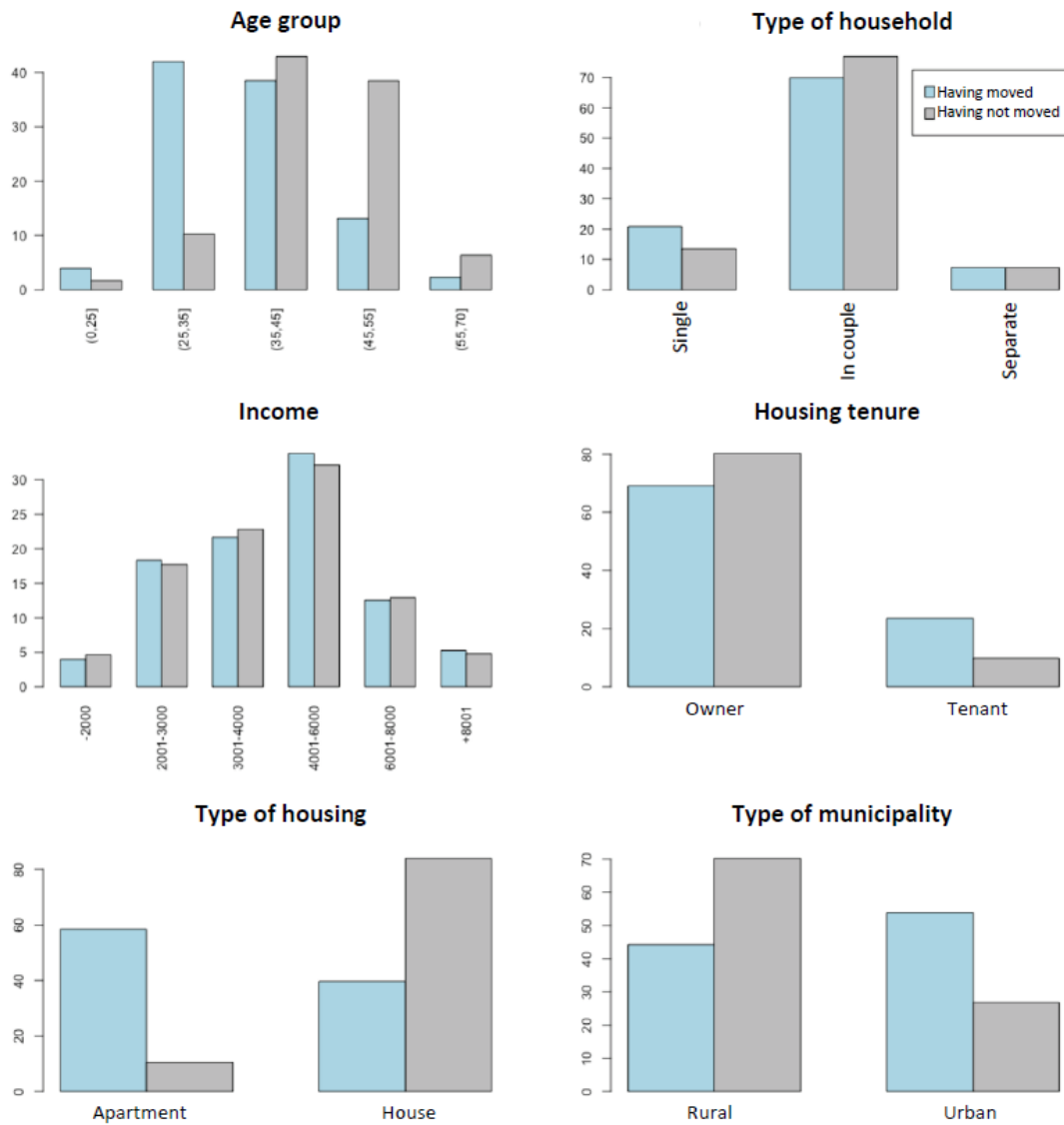
## 384 **5. Conclusion**

385 Previous studies (Gerber et al., 2017; Gerber & Carpentier, 2013) show that mobility behaviours  
386 are the result of choices relating to other spheres of daily life – including, but not limited to, the place  
387 of residence. This suggests a need for a cross-sectional analysis of the different dimensions of daily  
388 life, as suggested by the mobility biographies framework. In addition, through the use of a travel  
389 survey drawing on the concept of mobility biographies, we are able to show that the quality of travel  
390 conditions does not necessarily lead to changes in residential satisfaction, *ceteris paribus*. This also  
391 constitutes an argument for longitudinal surveys allowing researchers to link life events to mobility  
392 behaviours and possible changes in those behaviours (Müggenburg et al., 2015; Schoenduwe et al.,  
393 2015). Given that the evolution of contemporary lifestyles and related behavioural changes are at the  
394 core of discussions on sustainable development, particularly in terms of mobility, such a dynamic and  
395 systemic approach seems necessary at this point. This raises several methodological challenges, as  
396 the implementation of biographical and panel surveys remains long and costly. For example, the use  
397 of a cross-sectional survey directly addressing changes in satisfaction is probably less accurate than  
398 calculating changes in satisfaction based on knowledge of two successive residential locations, which  
399 also allows for control of satisfaction levels before and after the move.

400 Moreover, the results show the need to more carefully consider the question of residential choices  
401 and mobility biographies in integrated planning policies that coordinate housing and transport, in  
402 order to limit residential trajectories that move away from employment centres (Scheiner & Rau,  
403 2020). More specifically, we should also emphasise the difficulties associated with cross-border  
404 governance. The stakeholders involved in these issues still need to improve on this dimension with  
405 regard to housing markets and public transport. Indeed, in order to avoid the development of long-  
406 distance commuting, fiscal, legal and economic measures must be taken in order to (i) facilitate the  
407 integration of newcomers, such as migrants or cross-border workers (here becoming residents in  
408 Luxembourg), and (ii) improve the efficiency of public transport accessibility (i.e. through a better  
409 integration of cross-border development policies), among other objectives.

410

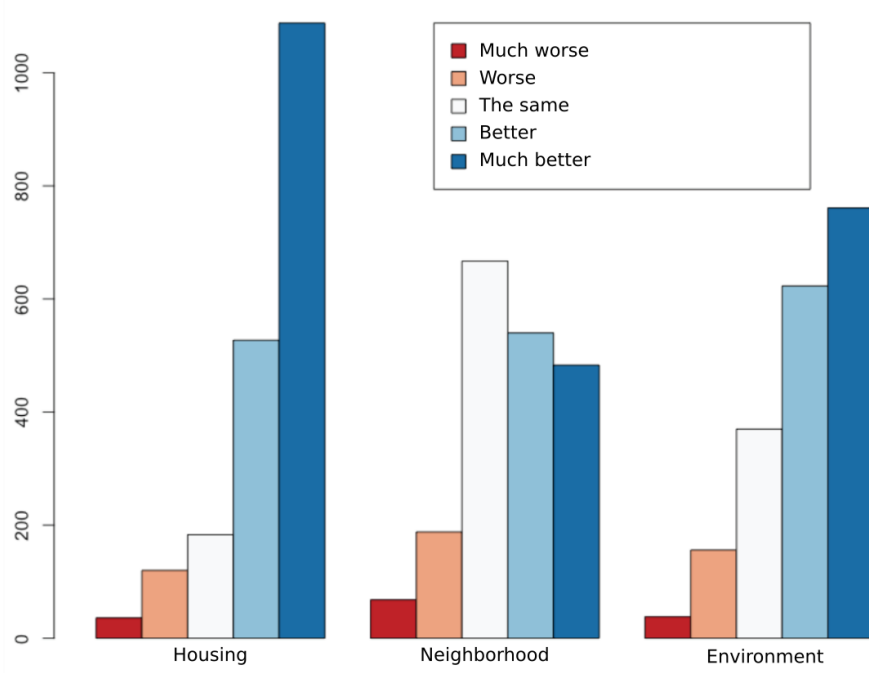
411 **Appendix A – Survey descriptive statistics**



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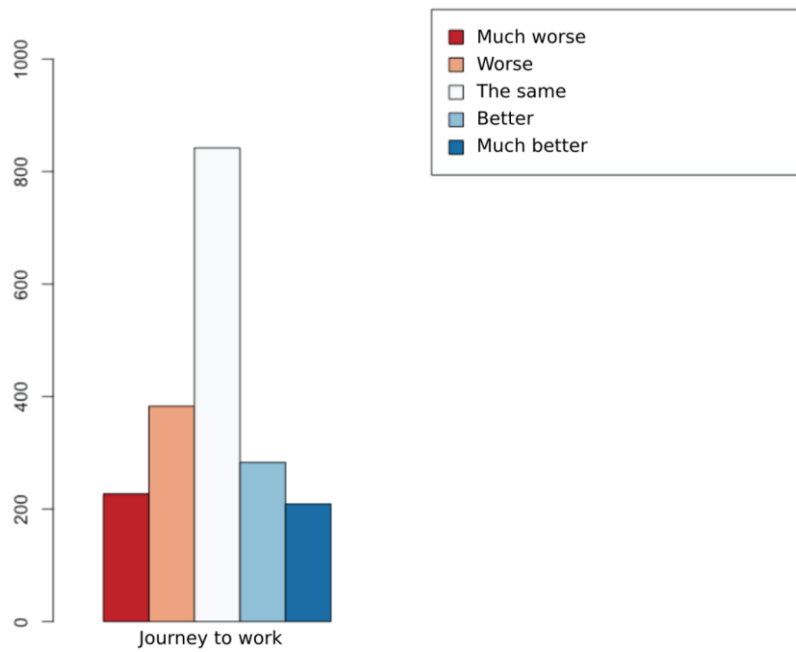
413 **Fig. A1.** Comparison of cross-border workers who did vs. did not move

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**Fig. A2.** Changes in residential satisfaction after moving



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**Fig. A3.** Commuting satisfaction after moving

421 **Table A1**

422 Origin/destination matrix of changes in housing type

<b>O/D</b>	<b>Detached house</b>	<b>Semi-detached house</b>	<b>Flat</b>	<b>Other</b>	<b>Total</b>
<b>Detached house</b>	271	60	111	7	<b>449</b>
<b>Semi-detached house</b>	150	102	49	0	<b>301</b>
<b>Flat</b>	474	238	383	10	<b>1105</b>
<b>Other</b>	6	7	5	4	<b>22</b>
<b>Total</b>	<b>901</b>	<b>407</b>	<b>548</b>	<b>21</b>	<b>1877</b>

423 Source: LISER 2011, Cross-border mobility survey

424

425 **Table A2.**

426 Origin/destination matrix of changes in municipality type

<b>O/D</b>	<b>Hamlet</b>	<b>Village</b>	<b>Market village</b>	<b>City</b>	<b>Big city</b>	<b>Total</b>
<b>Hamlet</b>	3	18	1	9	1	<b>32</b>
<b>Village</b>	63	496	42	118	17	<b>736</b>
<b>Market village</b>	4	40	12	12	4	<b>72</b>
<b>City</b>	35	340	58	363	51	<b>847</b>
<b>Big city</b>	6	48	7	52	66	<b>179</b>
<b>Total</b>	<b>111</b>	<b>942</b>	<b>120</b>	<b>554</b>	<b>139</b>	<b>1866</b>

427 Source: LISER 2011, Cross-border mobility survey

428

429 **Table A3.**

430 Origin/destination matrix of changes in country of residence

<b>O/D</b>	<b>France</b>	<b>Germany</b>	<b>Belgium</b>	<b>Total</b>
<b>France</b>	861	6	13	<b>880</b>
<b>Germany</b>	2	496	1	<b>499</b>
<b>Belgium</b>	11	0	386	<b>397</b>
<b>Luxembourg</b>	57	52	48	<b>157</b>
<b>Total</b>	<b>931</b>	<b>554</b>	<b>448</b>	<b>1933</b>

431 Source: LISER 2011, Cross-border mobility survey

432

**Table A4.**

433

Descriptive statistics of the variables introduced in the model

Dependent variable	Min	Q1	Median	Mean	Q3	Max	NA's	
<b>RSCI</b>		2.0	3.3	4.0	4.0	4.7	5.0	18
<b>Independent variables</b>								
<b>Age</b>	(16,25]	(25,35]	(35,45]	(45,55]	(55,66]			
n	76	861	850	257	45			5
%	3.6	41.2	40.7	12.3	2.2			
<b>Type of Household</b>	Couple with children	Single without children	Couple without children	Single with children				
n	1004	446	549	95				
%	47.9	21.3	26.2	4.5				
<b>Income</b>	less than €2,000	€2,001 to 2,500	€2,501 to 3,500	more than €3,500				
n	543	559	606	280				106
%	27.3	28.1	30.5	14.1				
<b>Changes in the journey to work</b>	No changes	Worse	Better	Much better				
n	918	627	317	216				16
%	44.2	30.2	15.3	10.4				
<b>Change in country of residence</b>	Stay in France	Stay in Germany	Stay in Belgium	Move to another country in the Greater Region				
n	995	496	386	190				27
%	48.1	24.0	18.7	9.2				
<b>Changes in housing type</b>	Flat to house	Flat to flat	House to flat	House to house	Other			
n	770	397	174	624	39			90
%	38.4	19.8	8.7	31.1	1.9			
<b>Changes in type of municipality</b>	Urban to rural	Urban to urban	Rural to rural (same type)	Rural to rural (different type)	Rural to urban			
n	535	594	542	168	161			94
%	26.8	29.7	27.1	8.4	8.1			
<b>Reasons for moving</b>	Home ownership	Type and size of housing	Environment and neighbourhood	Move closer to familiar places	Family or financial problems	Household changes (childbirth...)	Professional and other reasons	
n	676	337	75	79	132	250	348	63
%	33.3	16.6	3.7	3.9	6.5	12.3	17.1	

434

Source: LISER 2011, Cross-border mobility survey

435



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