ESPON

EUROPEAN UNION

Co-financed by the European Regional Development Fund

Inspire Policy Making with Territorial Evidence

FINAL REPORT //

Cross-border housing markets in Europe

Measuring and understanding the dynamics in 11 countries through web-scraping processes

Main Report // July 2022

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Executive Summary

This report publishes findings and analysis from *ESPON2020 Data and Maps Update II: Lot 4 Updating and Integrating Big Data and Housing Datasets.* The project addresses challenges in measuring and understanding the dynamics of housing markets within cross-border regions while incorporating novel techniques in acquiring housing data through web scraping processes. Hence, this multi-faceted research utilises the harvesting of informal data sources from real estate webpages to inform policymakers on the conditions and status of cross-border housing markets across Europe.

Six case study regions were selected based on several criteria including substantial cross-border movements, integrated labour markets, regional differences in economic welfare, the institutionalisation of cross-border cooperation and development of cross-regional governance structures. These six case study regions also displayed a diversity of geographies incorporating large metropolitan regions, rural environs, extensive commuter corridors, major urban agglomerations, several capital cities and important tourist areas. Altogether, capturing the housing sector dynamics across the case studies allowed for more in-depth analysis and greater conceptualisation of cross-border housing markets.

A key aspect to this research was updating housing indicators from the previous *ESPON Big Data for Territorial Analysis and Housing Dynamics* project while also developing new indicators which specifically consider border effects in their measurement. Overall, 15 housing indicators are produced which allow for cross-border analysis of housing markets. Moreover, the update and development of indicators permits interoperability across case studies where comparative analysis is possible through the harmonisation of data.

Over the course of three months, real estate webpages from across each of the border regions were routinely scraped for data on housing characteristics within that region. In combining these informal sources of data with formal sources from Eurostat, we can determine and analyse figures on affordability and wellbeing across different European housing markets. Critically, we can determine how interregional differences across the indicators can impact market conditions on opposite sides of the border. For instance, we can assess how differences in affordability can interplay with housing prices near borders and cause speculation on dwellings subject to foreign income. Hence, this research's methodology combines information from big data sources with information on regional wellbeing to ascertain a more detailed and critical understanding of housing markets within functional cross-border areas.

The following findings provide some insight into what this research was able to uncover regarding cross-border housing markets:

- **Regional Inequality –** major differences in regional incomes across borders can act as a major impetus toward the establishment and foundation of a cross-border housing market
- **Growing Housing Unaffordability –** across almost all cross-border housing markets, households are less able to afford their accommodation expenses
- **Spill over of Negative Externalities –** unaffordable housing costs in the core region has knock-on negative effects on housing prices in neighbouring regions
- **Potential for further Cross-Border Collaboration –** interregional coordination on housing policy can potentially alleviate many issues stemming from the growth of cross-border housing markets
- **Markets and Social Wellbeing –** the housing market is complex and multifaceted, and social wellbeing accounts as an critical factor in a household's decision to migrate across a border
- **Dependency of Housing Markets on Fiscal Policies –** activities in the housing markets are linked to interest rates and national fiscal policies, such as subsidies
- **Relevance of Accessibility –** while accessibility measurements did not play a critical role in impacting housing price, cross-border accessibility does allow for the development of cross-border housing markets via permitting larger cross-border movements and flows

The project developed an overview of housing policies, prices and offers in eleven European countries, in the context of border regions. Through this analysis it becomes apparent that comparing different housing markets and planning systems in the EU, allows to understand the commonalities and practicalities of

housing markets. The project proofed that a qualitative analysis of housing markets and systems joined up with a an analysis of quantitative data allows for developing a good basis for understanding the functioning of housing markets in Europe. Specific topics to look at would be affordability across different age and income groups, and price developments across a longer range. The price differences in the real estate market across border regions are in parts considerable. However, the project showed that these price differences only lead to increased housing market activities across the border in cases where other factors such as culture, language, administrative or educational systems facilitate border commuting, which in some border regions leads to rather harder borders due to these additional factors. The research also finds that price differences in border regions are higher in proximity of metropolitan areas, and where Purchasing Power Parity differences are substantial.

1 Introduction & Goal of Project

Housing, housing markets and the debate around a contemporary housing crisis are becoming commonplace topics in everyday news. Terms such as gentrification and regeneration have become part of the public discourse. Indeed, even popular culture has incorporated topics of gentrification and increasing house prices into our media as illustrated by the Netflix series 'Gentefied'. Processes of regeneration, the commodification or financialization of housing, migration processes and the role of global corporate landlords are all in part explanations of the increased pressure on local housing markets. As such, understanding housing market dynamics remains a key to ensure the wellbeing of European citizens.

Receiving substantial attention, housing markets are often analysed in comparison to their national averages and incomes. As a result, the specific dynamics of border regions and the implications for housing markets are often only analysed in an exemplary manner. The differences in house prices and cost of living incentivises people to move across the border and thus leads to a substantial commuting pattern across the border. The Geneva Metropolitan Region is one such example, where the relative importance of the city surpasses across the border leading to a spatial dynamic where citizens live on one side of the border and work on the other. The impact of large urban conglomerations on a neighbouring country's housing markets is just one example of the specific dynamics in housing markets across border regions.

More recently, border regions have received renewed attention as a third of Europe's population lives in border-regions according to the European Commission's Communication on "Boosting Growth and Cohesion in EU Border Region" (European Commission, 2017). As such, this project contributes to the European Commission's agenda by providing evidence on cross-border housing market dynamics.

This project aims to investigate cross-border housing markets in more detail. Given how these types of markets can be subject to significant border effects and have unique particularities due to cross-border flows, further exploration and definition of the concept provides context for the data collection components of the project.

In trying to understand the diversity of dynamics of cross-border housing markets across Europe, the project analyses six cross-border case studies. A key goal of the project is to identify indicators that measure the specificity of cross-border housing markets. These indicators shall allow us to analyse border effects by explaining the role of the border, the interactions across the border and the implications for flows across the border. In doing so, the project extends on the ESPON Big Data for Territorial Analysis and Housing Dynamics Projects which focussed on the wellbeing of European citizens regarding housing affordability.

The main outcome of the project is then the assessment of potential benefits in further cross-border cooperation on housing issues in order to reduce negative border effects so as to improve access to housing and the quality of life for border residents. In short, the project

- developed a conceptualisation of cross-border housing markets based on a thorough literature review from both housing studies and border studies
- analysed housing policies, markets and planning policies in relation to housing in 11 European countries, outlining the relationship between spatial planning and different types of housing policies
- collected and analysed conventional indicators relevant for housing
- developed 11 phyton scripts to web scrap housing data from real estate platforms showing the opportunities as well as limits for a harmonised analysis
- developed new cross-border indicators that allow to analyse the price differentials and profitability, as well as affordability from different sides of a border to live at the other side of a border. In other words, the project analysed the affordability with the income from one side of a border to live on the other side of the border in comparison to living in the country where wages are earned.
- analysed the data and discussed the individual case studies as well as it developed an across case study analysis, thus allowing an identification which border regions in the EU show the highest differences or are integrated the most.
- Analysed the accessibility in the border regions and analysed the interdependency with housing prices.

- Reflected on the results and suggests further research avenues on a conceptual level as well as in view of further opportunities to analyse the data in more depth as well as in view further integration with other data sources.

Figure 1: Project Approach

By incorporating a four-step approach as outlined in Figure 1: Project Approach, we were able to successfully implement indicators to allow for detailed analysis of the data gathered throughout the project. First, we defined the territorial scopes for each case study and determined the comparative housing indicators to be used. Then, we harvested the data through the web scrapping process while also collecting data from formal sources, interviews and document analysis. Following data collection, we mapped the data through the use of our comparative housing indicators and subsequently analysed the information and maps. Throughout the duration of the entire project, we corroborated our approach against initial policy analysis and interviews carried out with local experts. By underwriting the project findings with a desktop study and local interviews, we sought to provide comprehensive analysis and understanding of the scraped data and project findings.

The report is structured as follows: The second chapter conceptualises what a cross-border housing market is by providing definition and further specificities on a cross-border housing market's characteristics. The third chapter outlines the methodology used for this project while also updating the methodologies used for the previous ESPON Big Data for Territorial Analysis and Housing Dynamics project. The fourth chapter provides a comparative review of the case studies through the use of harmonised indicators and comparative analysis. The fifth chapter discusses the project findings and presents several concluding remarks. The sixth chapter outlines scope for future research in relation to this study and its findings.

This report focusses specifically on the comparative analysis of all 6 case study regions, along the lines of three main themes (Offerings and Prices, Affordability and Profitability as well as Duration), and is accompanied by a total of 9 Annexes, including further methodological descriptions as well the case studies.

1. The Annex No. 1 is a technical guidance document, including details on the methodology, the indicator development and the in-depth literature review.

2. The Annex No. 2-7 are the case study reports with a detailed analysis of each case studies, including a detailed analysis of their housing markets and policies, planning policies and frameworks, as well as an analysis of all the mapping exercises for the full case study regions, whereas this comparative report focusses on zoomed-in mapping exercises.

3. The Annex No. 8 provides a Link to all Phyton Scrips and displays an example script.

4. The Annex No. 9 provides a summary of the accessibility mapping exercise, as well as regression analysis with housing prices.

2 Conceptualisation of Cross-border Housing Markets

A key central concept to this project has been the identification of cross-border housing markets as mechanisms for studying the border effect on housing prices in functional cross-border regions. In preparation of developing new housing indicators which assess border effects, we accept that a general definition of what constitutes a cross-border housing market was needed. Hence, we developed a simple definition which could be applied to cross-border housing markets in this study as well as in future research.

Annex 1: Technical Guidance Document incorporates a more in-depth literature review focussing on (1) characteristics of housing markets, (2) types of policy interventions, (3) trends in housing markets, (4) housing in the European Union, and (5) border studies and housing. Based on this literature review, we conceptualise cross-border housing markets below.

We define cross-border housing markets as*:*

a housing market in which a critical mass of activity has led to a minimum integration where households work and live on different sides of a border. As a consequence, the distribution of jobs and residences across a border form new functional relations.

Further, the definition of a cross-border housing market incorporates how complex internationally driven market dynamics have evolved as a consequence of cross-border movements driving changes in demand leading to differences in both price levels and household responses. This integration has been made possible by ensuring that a minimum level of accessibility into the territory of the other state is maintained and links foreign households to proximity of job markets near international borders. Reasons for moving include regional differences in income, affordability, cost of living and amenity. Border regions may consequently attract specific migratory patterns that change the dynamics of demand and supply in housing across the border.

Following this definition, we also outlined some common specificities unique to cross-border housing markets. We note how cross-border housing markets have:

- Housing price differentials from supply and demand determined by the dynamics of cross-border movements (Decoville, et al., 2013)
- Regional differences in cost of living, in accessing services of general interest and in overall amenities (Decoville & Durand, 2019)
- Linkages between different regional income levels impacting housing prices and causing economic asymmetries (Sohn, 2013)
- Expanding functional regions which cross an international border and interplay with local market prices (Chilla & Heugel, 2022)

The process of conceptualising a cross-border housing market as a discrete term began when we noticed how housing studies and border studies were infrequently linked within the literature. We understood that by crossing the two streams of literature via an extensive literature review could provide the context required to integrate these fields and begin study of cross-border housing markets. By joining housing studies with border studies in Ch 2.5 of the Technical Annex, we were able to consider how housing affordability might be impacted by adding a border dimension for this research.

We note how certain concepts from different fields of study were observed within our cross-border housing markets. For instance in cross-border studies, an integrated labour market, substantial cross-border flows, regional differences in incomes and access to certain amenities and services of general interest were all motivating factors in causing households to migrate across a border and change their place of residence (Chilla & Heugel, 2022; Christmann, 2015; Claveres, et al., 2020). Likewise, income-to-rent/debt ratios, disparities in accessibility, changes in population density and market cycles all play important roles in housing studies (Aalbers, 2016; Schwartz & Seabrooke, 2009; Stamsø, 2010). Housing characteristics like its expense relative to incomes, the requirement for independent accommodation, borrowing influenced by interest rates, houses as durable goods with value for generations, dwellings as consumer goods and

investments, housing supply inelasticity, housing stock's immobility, land as a scarce resource and housing as a necessity all have an impact on how we understand and address housing issues. In crossing these two streams of literature, we interlink how border effects can play a critical role in determining housing prices whereby housing price dynamics in a functional cross-border region are influenced by activity from cross-border flows and cause a cross-border housing market to emerge.

Conceptualising this research topic caused there to be significant implications on what should ultimately be measured for these cross-border housing indicators. We needed to consider how differences in regional income levels, differences in accessibility, differences in amenity and differences in market strengths could impact the price dynamics for a cross-border housing market. This meant that the new indicators would need to be multifaceted as the market's quantification needs to be assessed through a comparative lens. Given how internal market differences in price are commonplace in a cross-border housing market and comparative advantages from economic asymmetries are present throughout a functional cross-border region, the measurement of cross-border housing markets encompasses the multiplicity of information being supplied from the data (Durand & Decoville, 2020; Sohn, 2013). Hence, our indicators have been developed with respect to understanding how regional differences caused by an international border can be measured within a cross-border housing market. In Ch 4 of the Technical Annex, we further describe the methodology used to develop these new indicators.

In addition to comparing differences within a market, we also have designed the new indicators to allow for interoperability between case studies. Essentially, when harmonised, these indicators allow for comparability of cross-border housing markets across different case studies. In making inter-case study comparisons possible, the new cross-border indicators allow for further in-depth consideration as to how cross-border housing markets are affected in different geographic contexts. Within border studies, a common obstacle in international comparison is the lack of a harmonised knowledge base (Chilla & Heugel, 2022). We often find that most border study research is case study-led and prohibitive of comparative analyse as the uniqueness of each functional cross-border region hampers interoperability across the field. Thus, the development of cross-border housing indicators provides a format for generating comparison across future cross-border studies. Moreover, the new indicators will allow for the long-term review of housing price dynamics as these functional cross-border regions become permanent features within European policymaking frameworks.

Given this conceptualisation, a key tenet to the success of any cross-border housing market is open borders with ease of access to nearby labour markets. As this research project took place during the Covid-19 pandemic, it would be remit of us to not discuss the significant implications the pandemic has had on cross-border movements. As open border policies and freedom of movement are hallmarks of European policymaking, Member State governments have been quick to reintroduce border controls and limit international travel since the wake of 2015 migration crisis. This reintroduction of border controls in many places has adversely impacted the market as people more cautious to consider moving during such a time of uncertainty. The pandemic coupled with the migration crisis has arguably changed the normality of open border policies across Europe and stands as a potential limitation to the evolution of cross-border housing markets. Of course, social distancing standards and public health advice has also spurred new trends in housing demand as many households are no longer confined to certain regions due to teleworking and can instead work remotely in more spacious, greener surroundings. Hence, the pandemic has challenged cross-border housing markets in two ways: firstly, by restricting the typical cross-border movements which allows for the market's existence and secondly, by broadening the scope for people's household choices as they are no longer confined to their region of their work and can instead move elsewhere to take advantage of teleworking freedoms. Consequently, consideration of the pandemic dimensions has been a critical part of the research's work and analysis.

Beyond the implications for this body of research itself, the conceptualisation of cross-border housing markets and consequent development of new housing indicators aimed at measuring and assessing border effects has a wider contribution to housing and border studies. Given how few studies were found which analyses and measures a cross-border housing market, this study sets forth a research agenda which details how to continue the study of cross-border housing markets. While previous studies either focus on housing data from one side of the border region or focus on other aspects such as cross-border commuting patterns, this study not only analyses cross-border housing markets in their entirety but has also developed a system for researchers to follow which will allow continuity in studying, theorising and analysing cross-border housing markets as a collective and comparative bodies of research.

3 Project Methodology

3.1 Case Study process

Overall, six case studies were selected based on a number of different criteria. Crucially, each case study hosts a cross-border functional area which was used to identify and measure components of a cross-border housing market, or the case study regions holds the potential to develop a cross-border housing market.

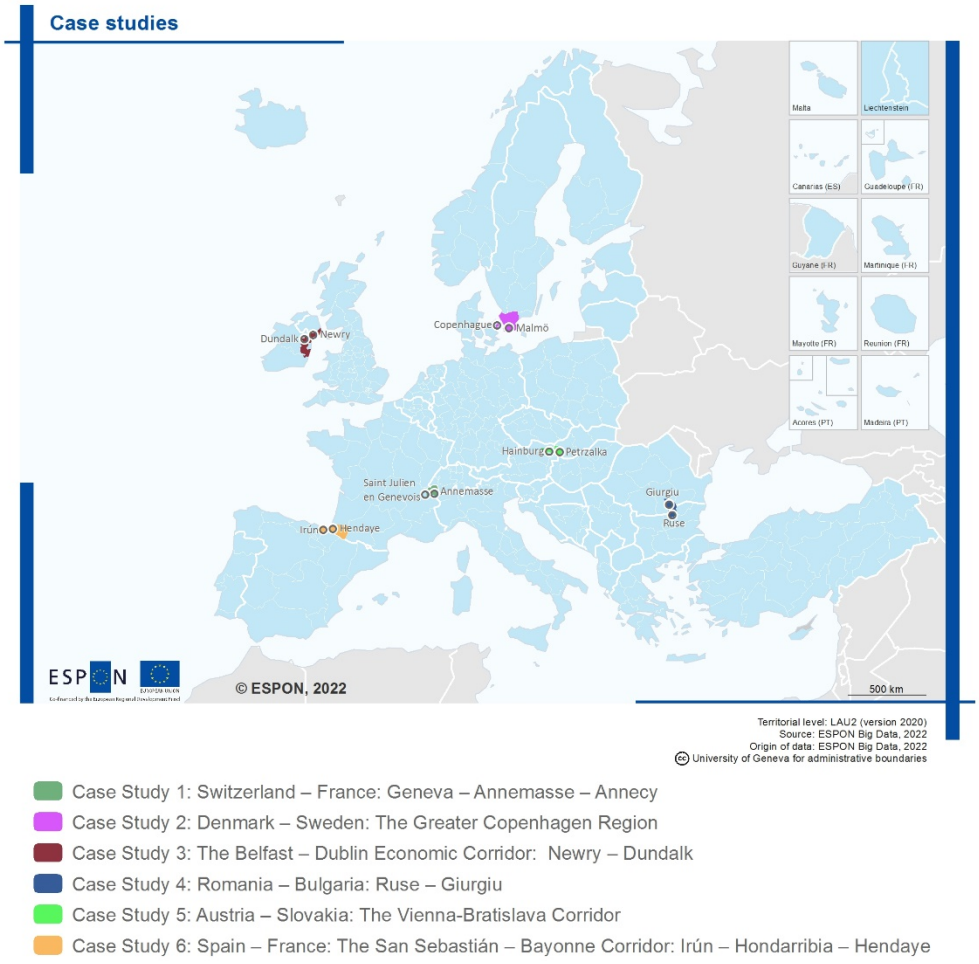


Figure 2: Overview Case Studies

Following selection of the case studies, the project methodology closely follows the procedures set out in Figure 1. A more detailed account of the project methodology is set out within Annex 1: Technical Guidance Document. The following steps outline the project methodology as short overviews which summarise the main techniques and processes carried out during research:

1. *Background Collection on Case Studies*

   The research commences with extensive desktop research which provided detailed overviews for each of the case study regions. In order to summarise the vast amount of information collected, the team developed comparative fiches for each case study (see Ch 2 of each Case Study Annex) which could contextualise findings through a broad overview of statistical data. For instance, differences in unemployment rates, housing tenure and average mortgage interest rates were collected. This desktop study on the background of each region ultimately allows for better interpretation and understanding of the data.

2. *Governance Analysis*

The next step in developing a clear picture of each case study region was to understand and analyse the governance structures and legal frameworks operating in each region. We developed institutional schematics for each region's government hierarchy which allowed for quick comparative analysis across the different types of regional governance structures. Furthermore, we completed a document review of local government publications which permit us to understand the spatial planning practices and legal frameworks across the regions. Simultaneous with the document review, we completed a policy compilation in relation to each region's housing sector. This housing policy compilation situated our comprehension of how each government approached their local housing market. As such, the case studies provide an overview of the most relevant political guidance, decisions and strategies to date. Furthermore, the policy analysis incorporated cross-border considerations of housing policies in addition to recognising the impacts of domestic housing policies on border regions.

3. *Literature Review of Housing Market Trends*

   Our literature review consisted of two main foci. One focus was to conceptualise cross-border housing market and situate our research within the literature. The second focus was to be able to understand the barriers and opportunities generated from border effects on housing affordability. As such, the literature review provided the team with the knowledge it required to comprehend how different local markets were acting. Further research on grey literature and scoping of local media, allowed the team to then identify the local factors and issues driving potential cross-border housing markets.

4. *Interviews with Regional Stakeholders*

   Interviews were conducted to identify the views of key stakeholders from within the regions. The interviewees were asked about key issues and topics relating to housing from their respective positions. In addition, the interviews served as tools to ask stakeholders for further clarification on the proposed territorial coverage of the case studies as well as to ask for advice as to which type of indicators and measurements stakeholders may be interested in.

5. *Update and Development of Indicators*

   Following completion of the case study narratives, policy analysis and interviews, the team could proceed with updating the indicators from the previous project while also developing new housing indicators built to measure border effects. Ch 3.2 further details some of the updates and novelties incorporated into this research.

6. *Web Scrapping and Data Collection*

   With the indicators identified, we could begin the data collection process. This project used a combination of both formal and informal sources to gather data on cross-border housing markets. For the formal data sources, traditional databases such as Eurostat were accessed. For the informal data sources, web scraping was performed on real estate websites to collect statistics on each region's housing market. The Annex 1: Technical Guidance Document (see Ch 4, 5 and 7) further details the methodology for web scraping and data collection. The Annex No. 8 provides a link for the Phyton Scripts.

7. *Mapping and Visualisation of Indicators*

   Following cleaning and review of the data, the statistics could be mapped and visualised using the indicators as frames of reference to understand the housing dynamics of each region. This form of statistical analysis consequently produced a vast array of thematic maps, regressions, calculations and data tables which could be interpreted and considered against the background contexts for each case study.

8. *Comparative Analysis and Mixed-Method Review*

   Finally, we prepared additional statistical analysis targeted at the comparison of case studies, to understand the diversity of cross-border housing markets. We then interpreted and compared the studies with each other by combining the quantitative results with the qualitative findings to produce an answer to our hypothesis on whether a cross-border housing market had developed for each case study region.

3.2 New Indicator Development and Indicator Update

A key goal for the project was to develop new indicators aimed at capturing dynamics specific to cross-border regions in addition to updating indicators from the previous ESPON Big Data project. Following the conceptualisation of cross-border housing markets and the subsequent identification of specificities unique to these markets set out in Step 3 of the methodology, we then defined and created new cross-border indicators. The goal is to develop cross-border indicators that aggregate data from different countries into harmonised datasets permitting comparative analysis.

While border studies had developed cross-border indicators which can analyse and understand critical dimensions of a functional cross-border region such as an integrated labour market or commuting flows, we did not find indicators measuring the border effect on housing markets. We did observe many studies measuring important aspects such as residential migration within a border region or regional economic differences. Using these indicators as a base for developing our new indicators allowed us to connect our research to previous work on cross-border studies.

We knew in developing these indicators that we would need to address potential issues in combining non-harmonised data into cohesive and comparative indicators capable of deciphering border effects on housing markets. Consequently, we reviewed previous indicators from the previous ESPON Big Data and Housing project, developed a framework for combining the non-harmonised datasets and approached the task using a comparative perspective. This allowed us to update the old indicators and develop new indicators to suit the needs for measuring and analysing cross-border housing markets.

Box 1: Example of Indicator Development

One of our main interests for measuring cross-border housing markets was understanding how differences in household income within a cross-border region would impact how much a household could afford to buy in different parts of the case study area. To find this, we needed to first identify what exactly needed to be measured. We found that finding the difference in how many days a household would need to work to purchase a property on either side of the border could display this indicator. Hence, we wanted to find the difference in days of average income between both countries that a household would be required to work in order to buy 1sqm.

To build this measurement, we would need four different quantitative datasets:

- Incomes for Country A
- Incomes for Country B
- Advertised Sales Prices for Residential Properties in Country A
- Advertised Sales Prices for Residential Properties in Country B

Having these four datasets would allow us to find how much a household on an income from County A could afford in both Country A and Country B and likewise, how much a household on an income from Country B could afford in both Country A and Country B. This information would allow us to understand how housing market dynamics interplays with cross-border labour market to impact residential mobility in these cross-border regions.

Following acquisition of this information, we formulated what was being measured to ensure that the indicator is suitable for a cross-border comparisons; it can effectively measure how different incomes from different parts of a region can or cannot afford property in other areas of the region. This type of measurement allows us to then critically analyse how residential migration may occur within a cross-border region and to understand what economic factors may be pushing or pulling people to buy houses in different parts of an integrating cross-border housing market. Hence, we can then ask a question such as: how many days would a household earning its income in Switzerland need to work to buy a house in either Geneva or Annemasse? This style of phrasing is replicable for all parts of our case studies and can also allow for further comparison across different cross-border housing market.

Following the qualitative research portion of our methodology, we then identified potential indicators which could measure the specificities of cross-border markets. The indicators were selected on the basis that they

could capture information illustrative of cross-border dynamics (CROSSREFERENCE). For example, one proposal was to measure how regional differences in income could affect a household's ability to afford housing on either side of the border.

Indicator	*Justification*	*Visualisation*
Mean Difference in Income Affordability to Purchase 1sqm	Allows us to understand the economic price differential in purchasing a property across the border.	Data table
Mean Difference in Income Affordability to Rent 1sqm	Allows us to understand the economic price differential in renting a property across the border.	Data table
Length of Advertisement Posting	Allows us to understand whether certain parts of the market are more active in terms of new transactions across a border region	Thematic Map
Housing Type	Allows us to see if the type of housing (i.e. single family, apartment, terrace) plays an impact on if households choose to migrate within a cross-border region	Thematic Map
Accessibility to Employment Centres (city centre is used as a proxy)	Allows us to understand how accessibility to job centres near the border can impact housing prices in border regions	Accessibility Maps
Accessibility to SGIs	Allows us to understand how accessibility to services within the catchment area of the border can impact housing prices in border regions	Graphs from Regressions & Accessibility Maps

Table 1: Overview of Cross-Border Reasonings for New Indicators

Additionally, developing the new indicators allowed the researchers to consider how to update the previous project's indicators to better reflect the dynamics present in a region with borders. For instance, previous indicators used to measure metropolitan housing markets such as Sales Price Affordability or Advertised Price of Residential Property for Rent were discussed collectively in order to ensure that data could be aggregated into harmonised datasets which could be easily used for analysis and comparison. As the international borders create non-harmonised data for each case study, it was essential to ensure that all indicators could be updated and reconfigured to display information for an integrated cross-border market.

More detailed steps on indicator development can be found in Annex 1: Technical Guidance Document. The following box presents an example of this cross-border logic which we incorporated into both the new and updated indicators:

4 Comparative Review of Case Studies

This chapter comparatively analyses the differences between case studies in order to further review and understand how cross-border housing markets manifest across Europe. By updating and developing the indicators to measure housing from a cross-border perspective, we can compare results not only within a case study but also across case studies as the indicators allow for comparative analysis. This represents a significant step within cross-border research as our research bridges the gap between case study-led findings and theoretical conceptualisations.

For the main report, we focus on analysing the border themselves. By comparing the impacts of the border effect on housing within the highlighted corridors, we can position and frame the housing situation of each border region within the context of the wider case study area. This focus on the border and its effect on housing permits for greater comparison and analysis across case studies. Consequently, we incorporate zoom-in maps of the border region and side-by-side figures to improve our comparisons. Maps of the entire case study region were only incorporated in certain instances for case study comparison or as examples of how some of the indicators can work. For further information and in-depth analysis on the intricacies of each case study, please refer to the dedicated annex for each case study (see Annex 2-7).

In Ch 4.1, we have summarised each case study in Table 3 in order to provide a comprehensive, comparative context for the housing data which is to be analysed. We focus on some of the unique specificities within each case study region while also interconnecting how the border regions' accessibility over its border can also act as a major driver in cross-border housing market dependent on cross-border flows and movements.

Following this overview, we can then compare the case studies with each other over a variety of different indicators. Ch 4.2 focuses on the number of offerings and the prices collected from the web scraping. Ch 4.3 focuses on the affordability of the cross-border housing markets along with a measure of its potential profitability. Ch 4.4 focuses on advertisement duration and activity observed within each market during the web scraping period.

By comparing the case studies with each other over a variety of different indicators, we are able to build up a larger picture of how cross-border housing markets are functioning and how each case study compares against other cross-border markets. This comparative angle provides a novel way of considering cross-border case studies. It also enables us to dive further into the conceptualisation and functioning of how cross-border housing markets by interconnecting different policy with different contexts and is a useful exercise and tool for European policymakers to consider as it can relate to topics of social cohesion and the Green New Deal.

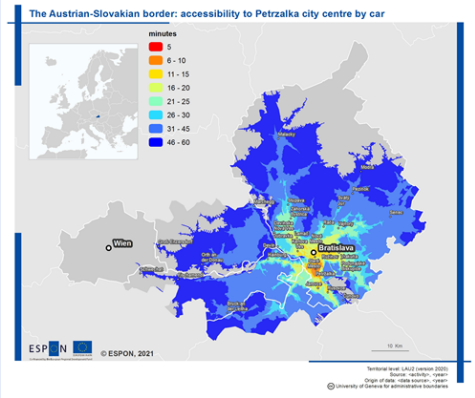
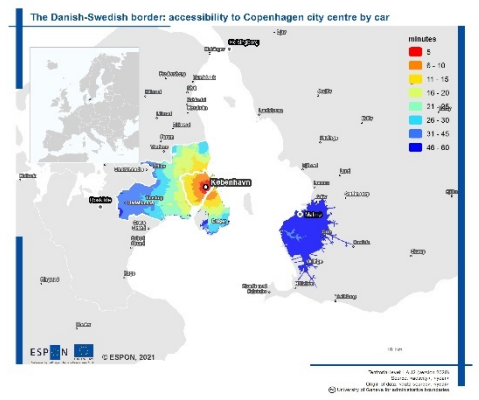
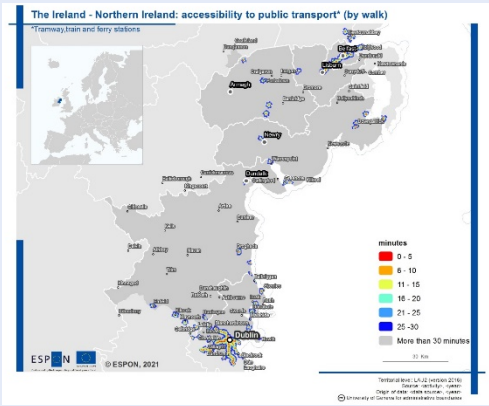
Below, we provide an overview of the harmonised indicators for all case study regions. For a more detailed and comprehensive table of harmonised indicators, please refer to Annex 1: Technical Guidance Document.

INDICATOR	TYPE	FRANCE (ANNECY)	SWITZERLAND	DENMARK	SWEDEN	IRELAND	NORTHERN IRELAND	AUSTRIA	SLOVAKIA	FRANCE (HENDAYE)	SPAIN	BULGARIA	ROMANIA
Number of offers	Sale multifamily	8.152	1.925	4.672	2.292	2.042	227	9.250	7.665	2.153	2.758	666	71
	Sale single-family	2.985	1.411	2.712	960	4.857	1.180	1.016	2.688	598	392	30	66
	Rent multifamily	3.160	2.812	1.367	889	1.815	707	18.377	7.690	110	571	576	26
	Rent single-family	201	309	45	224	788	934	314	512	30	7	0	6
Average Surface (sqm)	Sale multifamily	75,1	144,3	82,3	66,4	-	-	80,1	122,9	62,2	91,6	77,8	744,2
	Sale single-family	155,4	257,1	133,5	137,6	-	-	144,2	164,3	163,1	370,4	139,0	463,2
	Rent multifamily	57,1	81,5	82,7	58,3	-	-	65,3	63,2	55,8	82,9	60,4	51,9
	Rent single-family	113,5	205,7	118,0	124,8	-	-	177,0	192,6	239,4	302,0	-	116,3
Average Number of Rooms	Sale multifamily	2,3	5,0	2,8	3,7	1,9	1,9	-	-	1,8	2,7	1,3	-
	Sale single-family	3,8	7,7	4,7	5,1	3,2	3,2	-	-	3,9	5,1	-	-
	Rent multifamily	1,7	3,6	2,6	2,2	1,9	2,1	-	-	2,2	2,3	1,2	-
	Rent single-family	3,6	6,7	4,0	4,4	3,0	3,5	-	-	5,0	4,1	-	-
Average Advertised Price per sqm (€)	Sale multifamily	4.623,8	13.146,8	7.100,8	3.504,7	-	-	6.732,0	3.552,4	6.476,3	4.104,6	908,3	769,0
	Sale single-family	4.339,4	13.716,5	6.508,4	3.694,3	-	-	6.143,9	2.597,2	6.094,9	2.869,5	839,8	549,2
	Rent multifamily	17,2	35,0	25,7	17,2	-	-	17,1	11,0	14,4	15,3	6,5	20,2
	Rent single-family	17,6	31,0	17,8	14,7	-	-	17,0	10,8	17,0	8,5	-	8,7
Average Advertised Price per room (€)	Sale multifamily	-	-	-	-	172.097,4	85.009,5	-	-	-	-	-	-
	Sale single-family	-	-	-	-	146.536,8	73.237,9	-	-	-	-	-	-
	Rent multifamily	-	-	-	-	1.286,0	502,4	-	-	-	-	-	-
	Rent single-family	-	-	-	-	899,4	355,4	-	-	-	-	-	-
Rental Profitability	Rent multifamily	269,3	376,1	276,1	203,3	133,8	169,2	393,5	324,2	451,3	268,0	139,1	38,0
	Rent single-family	247,0	442,2	366,7	251,1	162,9	206,1	360,6	240,2	359,3	338,4	-	63,1

Table 2: Overview of Harmonised Indicators

4.1 Case Study Overview and Characteristics

Before delving into the statistics, we situate ourselves within each case study by providing brief contexts of each border region:

Case Study Region & Zoom In	*Key Characteristics & Specificities*	*Accessibility Mappings*
Austria-Slovakia: Bratislava & Vienna Twin City Region	This functional cross-border region is characterised by the two capital cities of Austria and Slovakia being located within 55kms of each other. This impacts the rural border region as growing commuter belts and corridor development urbanises and intensifies land use. This in turn places a higher demand on housing resources. In terms of accessibility, this region is highly connected and well-integrated across its border. In terms of the cross-border housing dynamics, the Austrian border communities have experienced demand from Slovakian households.	
Denmark-Sweden: Greater Copenhagen – Copenhagen and Malmö	This functional cross-border region is characterised by a large globally significant capital city extending its influence over other large nearby agglomerations. It encompasses the major metropolitan centres of Copenhagen and Malmö. Due to Copenhagen's large and rich labour market, cross-border flows emerge across the Oresund Strait between Denmark and Malmö, Sweden. In terms of accessibility, this region is connected by the Oresund Bridge and this critical piece of infrastructure integrates and joins the two countries physically. A key consideration in this case study was the major trend of Danish households moving to Malmö to make use of differences in costs of housing.	
Ireland-Northern Ireland: Dublin-Belfast Economic Corridor – Newry and Dundalk	This functional cross-border region is similar to the Austria-Slovakia case study as two capital cities extend their influence over a rural border region to generate extensive commuter belts while corridor development urbanises and intensifies land use between Belfast and Dublin. With rapid new economic growth, housing demand is outpacing supply and prices are increasing. In terms of accessibility, this region is well connected in terms of road infrastructure and the private vehicle but poorly integrated in terms of public transport and sustainable transport means. In this case study, a key trend has been the development of border towns as residential exclaves of both the Dublin and Belfast labour market.	

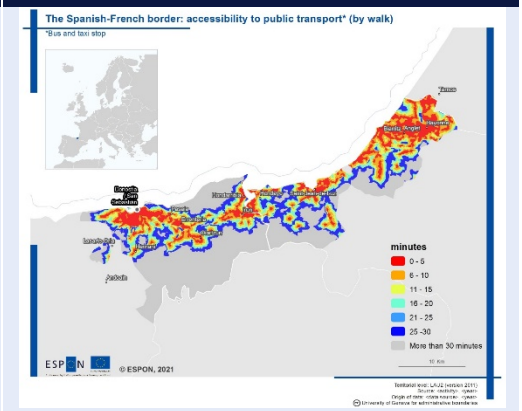
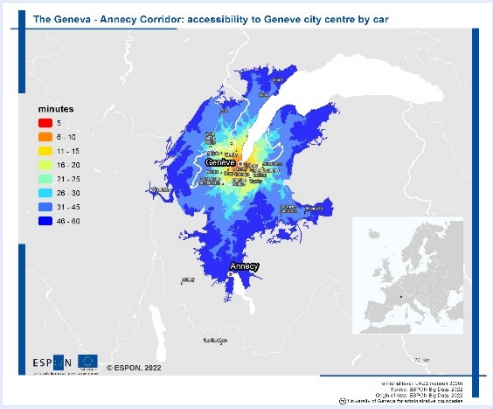
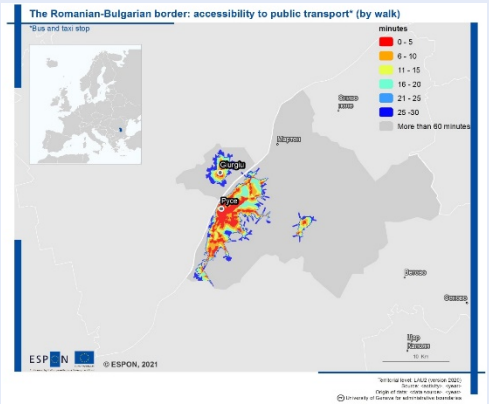
Case Study Region & Zoom In	*Key Characteristics & Specificities*	*Accessibility Mappings*
Spain-France: Basque Eurocity – Txigundi-Bidasoa Eurodistrict	This functional cross-border region is characterised by extensive cross-border collaborations and governance levels driven by Europeanisation. This is turn has caused for extensive corridor development between the agglomerations of San Sebastian and Bayonne as a large commuting belt coupled with high tourism demands drives further housing needs. In terms of accessibility, this region is highly connected and well-integrated across its border. Aspects determining the cross-border housing market is the contiguous built environment between three different border municipalities as well as the influence of tourism on housing supply.	
Switzerland-France: Greater Geneva – Geneva and Annemasse	This functional cross-border region is similar to Denmark-Sweden in that a large globally significant city extends its influence over a border and even pulls from other large agglomerations (Annecy). Hence, this case study is characterised by major metropolitan centres which are constrained in land-use geographically as mountains and farms limit new residential development to existing urban centres. In terms of accessibility, Greater Geneva is highly connected and well-integrated across its border. Within this case study, Swiss salaries create price differentials which drives up the cost of housing across the border.	
Bulgaria-Romania: Ruse-Giurgiu Twin City Region	This cross-border region is mostly characterised by its rural environment. Ruse acts as a regional hub for commerce and business. Moreover, twin city collaborations do exist between Ruse and Giurgiu. In terms of accessibility though, the region is poorly connected and is not well integrated across the Danube. For this case study, a key concern is to identify whether there is scope for developing a cross-border housing market.	

Table 3: Case Study Overviews and Characteristics

By detailing some of the specificities of each case study as well as identifying how accessible and integrated each border region is, we are equipped to better understand how the statistics and findings interrelate to each other. This is especially useful when we consider how the extent of cross-border integration and collaboration that already exist between neighbouring regions can potentially impact housing demand.

4.2 Offerings and Prices

This section reviews and compares the number of offerings across case studies, and it investigates and analyses differences in prices across the border.

4.2.1 Offerings

Table 4 provides an overview of the total offerings that were scraped during the data collection process. The table verifies many of our initial expectations on what the web scraping would statistically collect. Regions with the largest cities like Vienna, Copenhagen and Dublin had some of the highest offerings collected. Conversely, regions that serve as more of a commuting/residential purpose also had high listings such as in France (Haut Savoie). As expected, the more rural regions had the smallest offerings collected as in Romania and Bulgaria. Many of the mid-sized city-regions had between 1000-4000 offerings collected which matches their relegation across the interregional population dynamics. One interesting caveat which exemplifies the inelastic supply of the Genevan market is how few offerings were ultimately collected from Switzerland. Given how Geneva is a large and major urban centre, we would have expected it to have more offerings, but instead its offerings were significantly lower than other similar regions like Ireland and Austria. This matches interview findings detailing how Geneva has a severely inelastic market and a major supply crisis.

The web scraping process also consistently collected more offers for purchase than offers for rent. The only exceptions were in Austria which has a large and significant rental market where we expected its rental sector to outperform its owner-occupied sector, and in Northern Ireland where its rental sector only slightly outperformed the owner-occupied sector. Regarding the case studies collectively, Austria and Slovakia had the most offerings collected which corresponds with a housing offering of two capital cities while Romania and Bulgaria had the least offerings collected which corresponds with its position as a more rural cross-border region.

Region:	***Purchasing:***				***Renting:***			***Offerings:***
	Multi-family	Single-family	Sub-Total		Multi-family	Single-family	Sub-Total	
Austria	7886	840	8726		12673	210	12883	21609
Slovakia	5136	1603	6739		6076	378	6454	13193
Bulgaria	580	28	608		394	0	394	1002
Romania	56	61	117		21	5	26	143
Denmark	3721	2263	5984		880	38	918	6902
Sweden	1451	557	2008		592	162	754	2762
Switzerland	1462	1060	2522		2040	218	2258	4780
France (Haut Savoie)	3068	1444	4512		1971	113	2084	6596
Spain	2069	260	2329		410	5	415	2744
France (Pyrénées-Atlantiques)	1231	352	1583		137	13	150	1733
Ireland	1642	3718	5360		1241	593	1834	7194
Northern Ireland	149	824	973		480	597	1077	2050
TOTAL:	28302	12186	40488		26435	1735	28170	68658

Table 4: Total Offerings

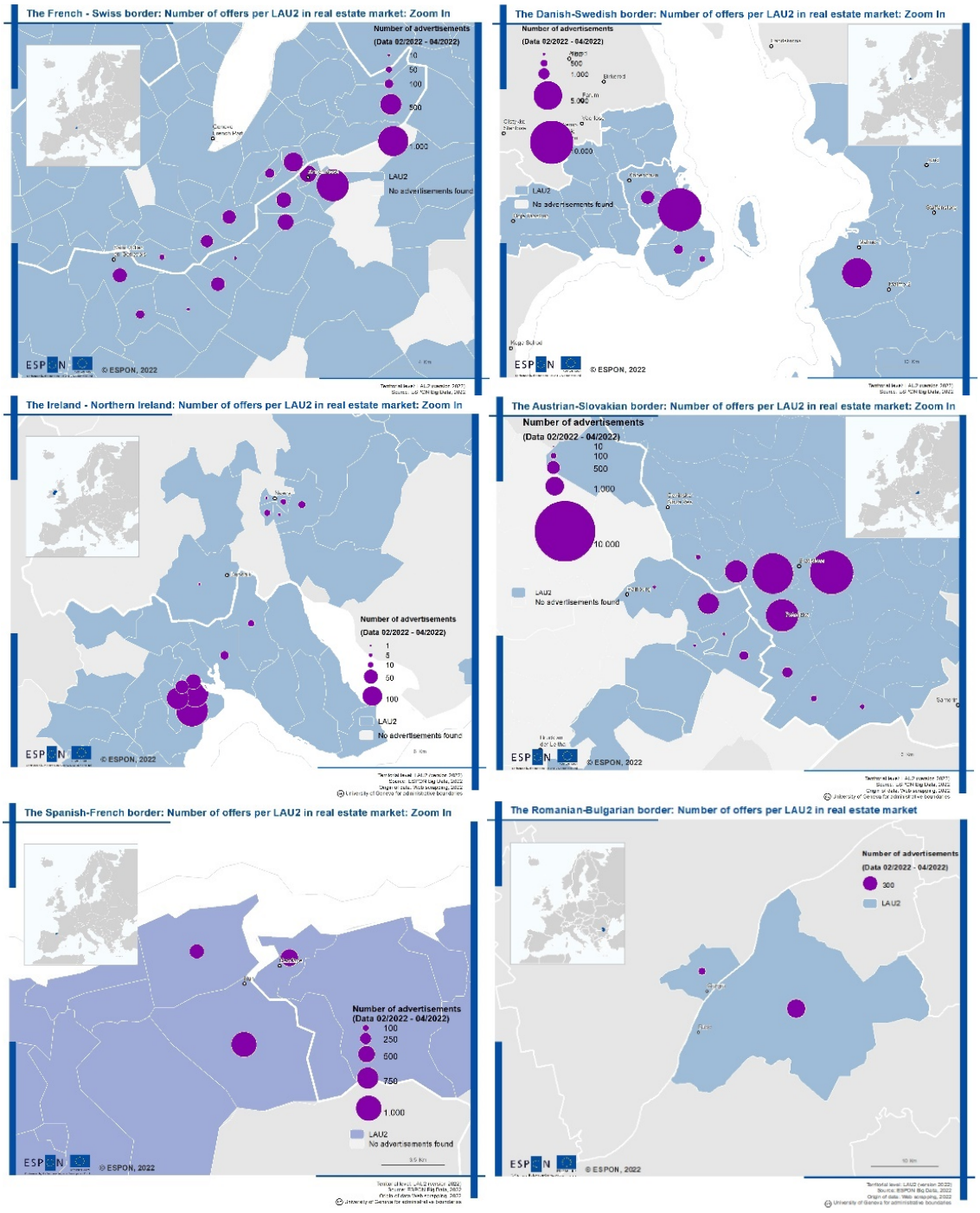


Figure 3: Zoom-Ins of Owner-occupied Offerings

Again, the zoom-ins of Figure 3 illustrate what we expected to collect from the web scraping process as observed in Table 4. In terms of border effect, we see that the side of the border with the larger town or city consistently outperforms the neighbouring market. Copenhagen, Bratislava, Irun/Hondarribia and Ruse all had a larger offering on the market than their smaller neighbouring border regions. There are two exceptions to this trend though: In the Greater Geneva case study, we observe how Annemasse has a larger offering than neighbouring suburban Genevan communes which correlates to the inelastic residential supply of Geneva. In the Irish case study, Dundalk has a significantly larger offer than Newry despite the similar size of both border towns. This finding though also corresponds with interview findings that Newry has an inelastic supply issue due to geographic limitations of the town being built on a hilly valley. Hence overall, the offerings collected from the web scraping process matched our expectations and displayed a similar trend across the border. In cases where this trend was not observed (Switzerland and Ireland), our interviews provided further context as to why these trends did not materialise in those particular cases.

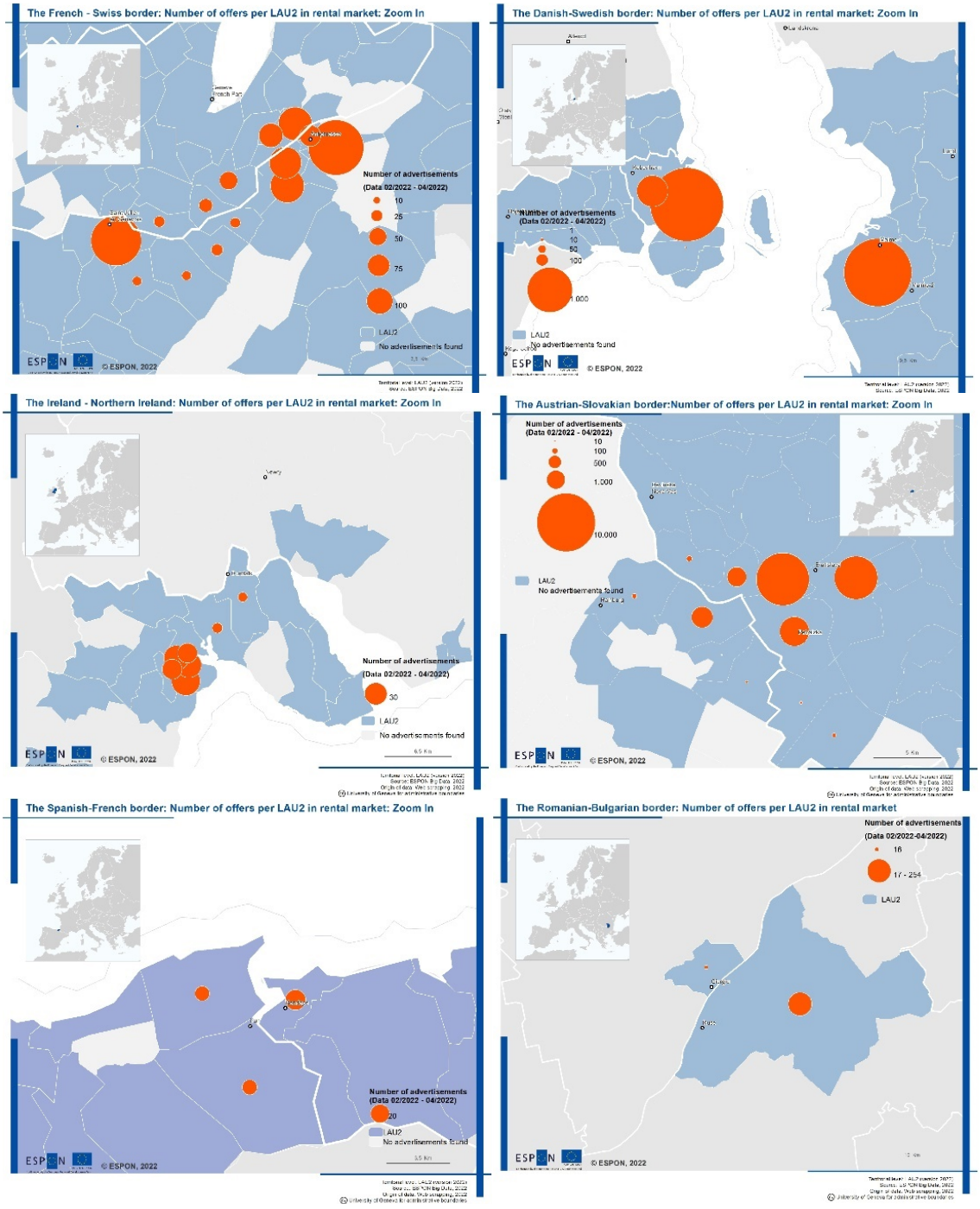


Figure 4: Zoom-Ins of Rental Offerings

Regarding how the offerings from the rental sector were dispersed across the border, some anomalies did emerge from our expectation that larger cities and towns would outperform the neighbouring region. Again, Copenhagen, Bratislava and Ruse had larger offerings than its smaller cross-border counterpart. Moreover, the same trends of inelastic supply emerged in our results in both Geneva and Newry. The only other major exception is in Txingundi-Bidasoa Eurodistrict where Hendaye had more offerings than Irun. This too though corresponds with desktop research findings where France has a larger private rental sector than in Spain where most households live in owner-occupied housing. Additionally, Hendaye serves a more important tourism role within the Eurodistrict as it contains a large beach. The beach and tourism factor can also add to its larger rental offering than the neighbouring industrial community of Irun.

4.2.2 Advertised Prices

A primary aim of our research was to find the average housing prices for these cross-border housing markets and compare them with other such cross-border regions. Overall, we note that the highest number of advertisements can be found in Austria, Slovakia and France, followed by Ireland, Denmark and Switzerland.

By building the box plots in Figure 5, Figure 7, and Figure 8 we are able to visually represent all the data collected across the case studies and compare them with each other.

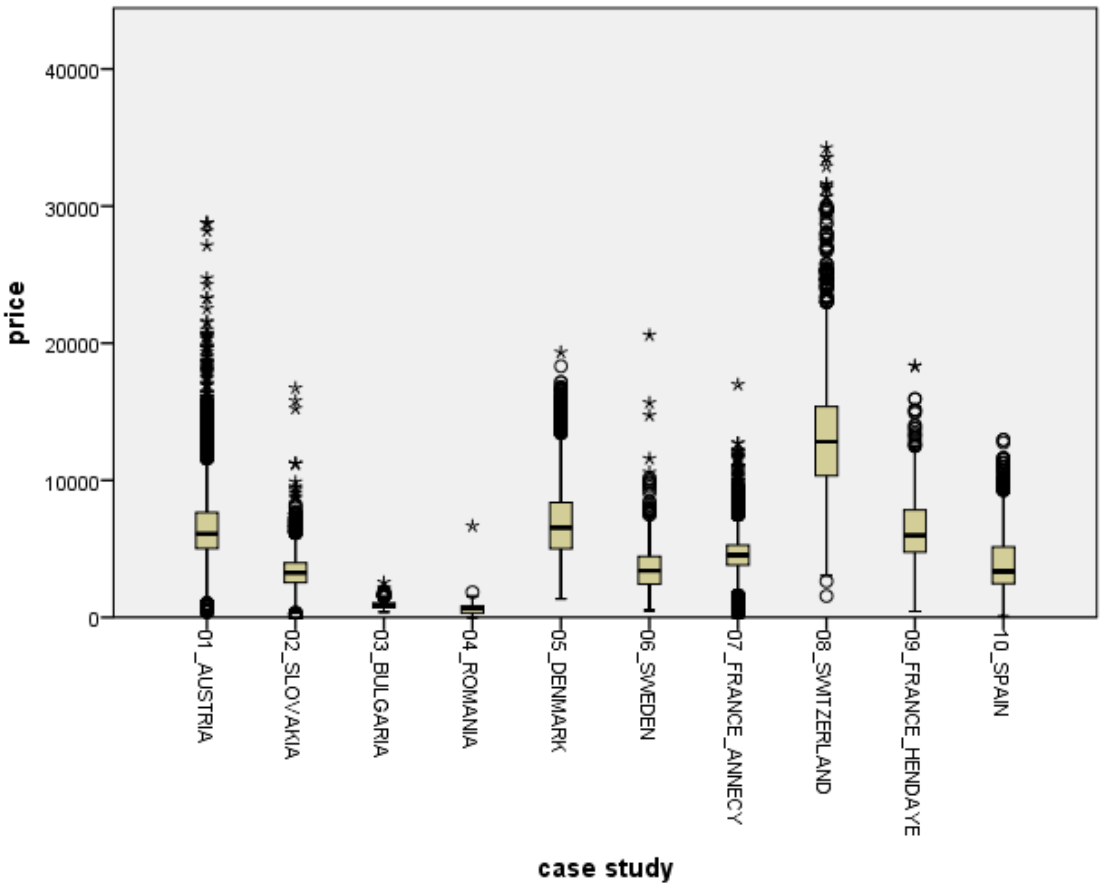


Figure 5: Box Plot of five case study real estate prices

Figure 5 provides an overview of housing prices within the owner-occupied market. The previous chart shows a boxplot of the unit prices for buying property. It displays the valid advertisement prices in €/sqm. Outliers are marked with circles and extreme outliers with asterisks.

The boxplot itself shows the median value with a black horizontal line, and the limits of the box are the quartile 1 (values up to 25% below the median) and the quartile 3 (values up to 75% above the median). The thin vertical black lines indicate the maximum and minimum values that are not considered outliers in the sample.

From the graphic, we see that regions home to large urban agglomerations such as Switzerland with Geneva, Denmark with Copenhagen or Austria with Vienna have the most expensive residential real estate. These also have the highest numbers of outliers and extreme outliers specifically at the higher priced range. Likewise, the smaller, more rural regions had the least expensive residential real estate like in Bulgaria and Romania. The mid-tier cities such as Malmö, Bratislava and San Sebastian all retain similarly moderate prices in relation to their residential real estate. The only region which bucks this trend of agglomeration growth fuelling residential real estate prices in France with Hendaye in the Basque Eurocity corridor. This region functions as an outlier to this pattern as foreign capital, secondary homes and holiday homes from its tourism industry increase demand and raise average prices for residential real estate.

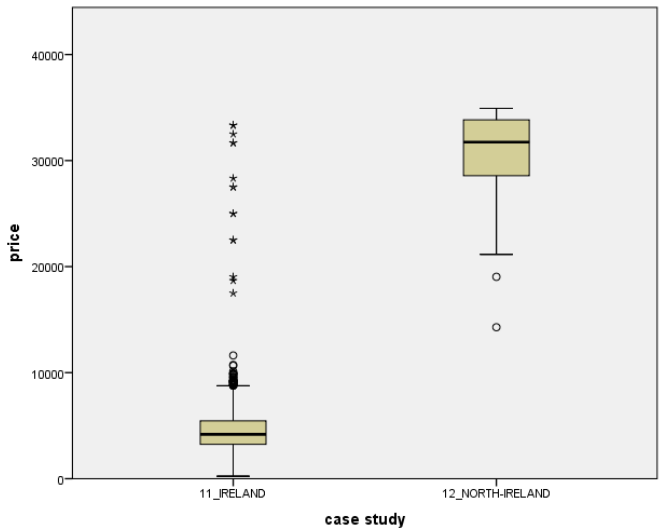


Figure 6: Box Plot of Ireland and Northern Ireland

The Figure 6: Box Plot of Ireland and Northern Ireland chart shows a boxplot of the unit prices for buying property. It displays the valid advertisement prices in €/room for the Ireland-Northern Ireland case study. Outliers are marked with circles and extreme outliers with asterisks.

The boxplot itself shows the median value with a black horizontal line, and the limits of the box are the quartile 1 (values up to 25% below the median) and the quartile 3 (values up to 75% above the median). The thin vertical black lines indicate the maximum and minimum values that are not considered outliers in the sample.

The box plot confirms that Ireland and Northern Ireland have a substantial price difference. As the real estate prices are given per room and not per sqm, they are presented as an individual boxplot.

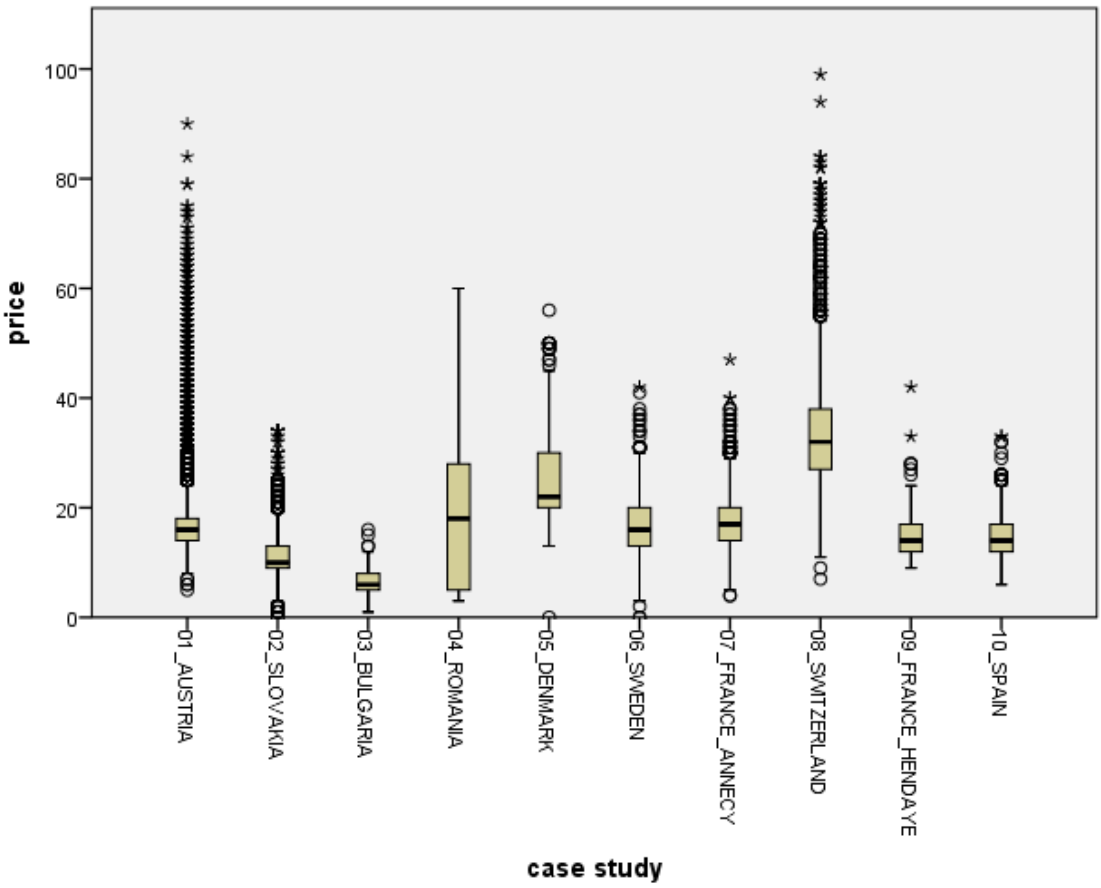


Figure 7: Box plot of five study rental prices

The previous chart shows a boxplot of the unit prices for renting property. It displays the valid advertisement prices in €/sqm. Outliers are marked with circles and extreme outliers with asterisks.

The boxplot itself shows the median value with a black horizontal line, and the limits of the box are the quartile 1 (values up to 25% below the median) and the quartile 3 (values up to 75% above the median). The thin vertical black lines indicate the maximum and minimum values that are not considered outliers in the sample.

Figure 7 sets out that many of the trends proposed in Figure 5 also pertain to the rental sector in cross-border housing markets. Again, we see how rental prices are highest in Switzerland and Denmark where the large agglomerations of Geneva and Copenhagen demand higher rents. Regions with small private rental sectors tend have smaller average rents such as in Bulgaria, Slovakia and Spain. In each of these regions, we see that the market is dominated by owner-occupied tenure. Again, mid-tier cities demand a similar range in prices where Annecy/Annemasse in eastern France, Hendaye/Bayonne in south-western France and Malmö in Sweden all fall within a similar price range. We note that Austria serves as an outlier in the comparison of rental market prices. Given how the renting is the largest form of tenure in Vienna and that the private rental sector must compete against the cost-rental sector and the cooperative sector, rental prices are kept at lower prices than comparable regions due to the strong impact that housing policymaking has played into maintaining rental affordability within this region. Further we note that Switzerland is clearly the highest prices

We also note how Romania is another region which contradicts some of the patterns that we observe. For this region, we note how very little data will have skewed the accuracy of our comparison, at the same time it becomes apparent that the renting market offers higher price ranges than the buying market.

The advertised prices for each case study were obtained by aggregating the sale or rental price per square meter (or per number of rooms in the Irish-Northern Irish case study) per LAU2 unit and computing the

average value for each LAU2 unit. As a result, we get the advertised average sale or rental price at each LAU2 unit which we represent through a choropleth map.

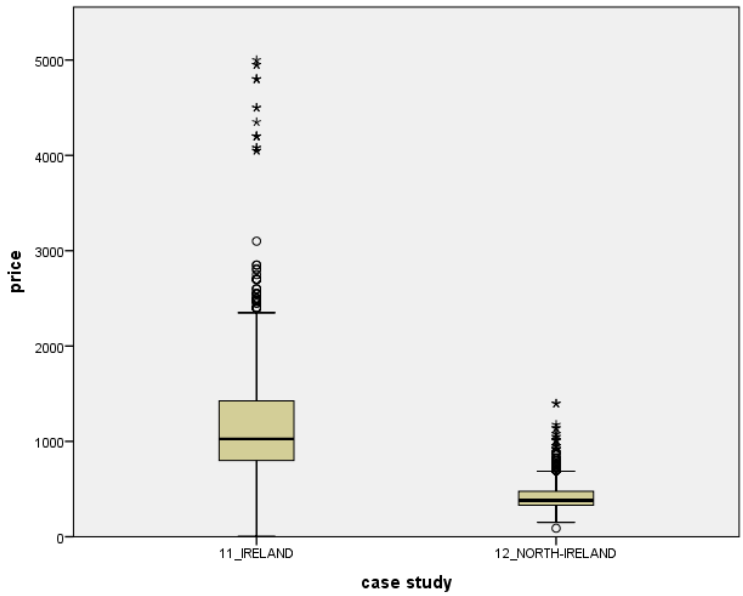


Figure 8: Box plot of Ireland and Northern Ireland Rental Prices

The previous chart shows a boxplot of the unit prices for renting property. It displays the valid advertisement prices in €/room for the Ireland-Northern Ireland case study. Outliers are marked with circles and extreme outliers with asterisks.

The boxplot itself shows the median value with a black horizontal line, and the limits of the box are the quartile 1 (values up to 25% below the median) and the quartile 3 (values up to 75% above the median). The thin vertical black lines indicate the maximum and minimum values that are not considered outliers in the sample.

The average price per room is lower in Northern Ireland than in Ireland, which stands in stark contrast to the median price difference in the buying sector. This might be partly explained with the much higher number of offers in Ireland (9492, total advertisements, versus 2160 I Northern Ireland).

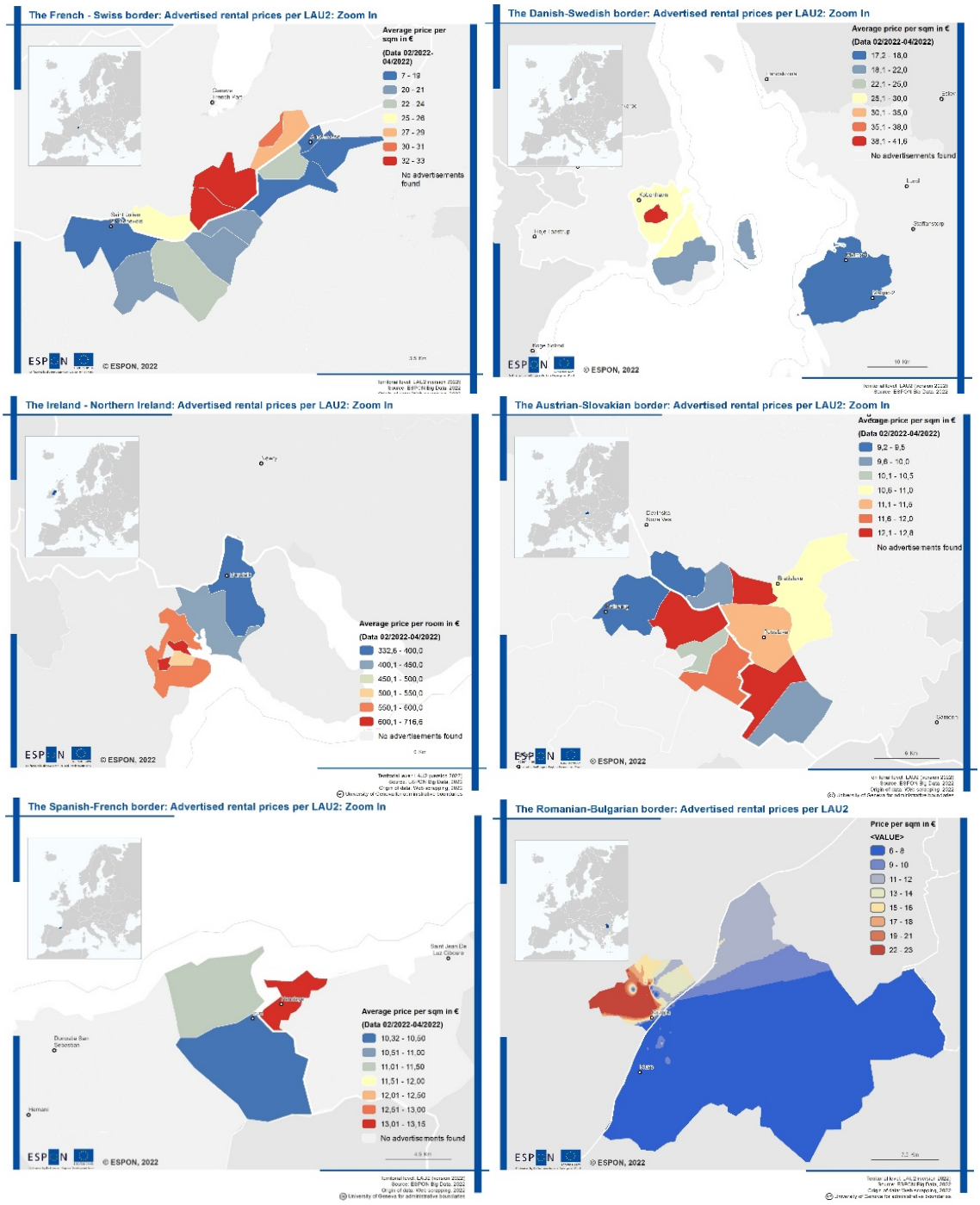


Figure 9: Zoom-ins of Rental Prices

With regard to how the case studies materialised when overlaid with their average rental prices from the web scraping period (see Figure 9), we can see a clear border effect in both Geneva and Copenhagen. In these case studies, we observe how a large urban agglomeration stretches its influence across a border to interconnect nearby rental markets as workers from these rich cities seek the most affordable rental accommodation. Again, like in the previous Ch 4.2.1, we observe the supply inelasticity of Newry as no rentals were found during the entirety of the web scraping period in the border town. We also observe some interesting situations outside Bratislava where Austrian LAU2 units with direct road access to Bratislava city centre have higher average rental prices than the other LAU2 Austrian border communities. This exemplifies the cross-border impact of Slovakian migrants settling in Austrian towns but working still in Bratislava even in the rental sector. The results from Hendaye also runs counter to our overall trends as its rental prices are higher than its Spanish counterparts despite being a smaller town. Its role as the centre of the tourism

industry in the border region and the impact of its beach may play a role in its higher rental prices in addition to a stronger preponderance to live in the private rental sector in France than in Spain.

Hence, our main takeaways from this comparative exercise is that metropolitan areas have a 'big city' effect on cross-border housing markets where large urban agglomerations will extend its influence across the border to impact prices in the border region. A rental market does behave differently from the owner-occupied market, and we can observe some of the caveats of the rental market making a difference in prices in places such as Hendaye with its high tourism capital. Nevertheless, overall, we can observe how cross-border dynamics do have an impact on rental price. The most expensive markets to rent from are in Copenhagen and in Geneva which is coincidentally also where we see our border effect the strongest. Likewise, the highest price difference is observed in these same border regions where urban workers are seeking to migrate across the border to take advantage of the significant price differentials.

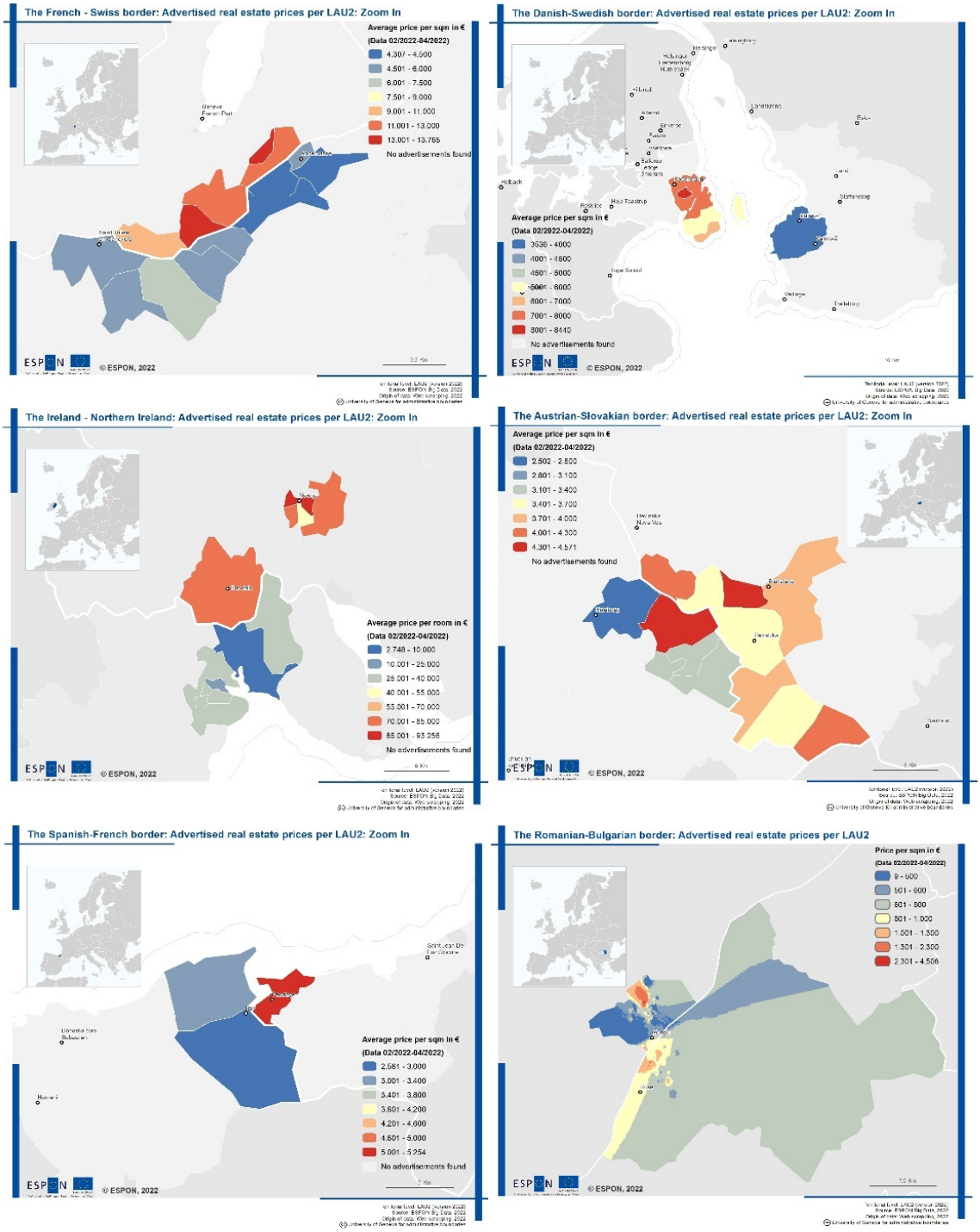


Figure 10: Zoom-Ins of Sales Prices

In terms of understanding how the residential real estate markets behaved in functional cross-border regions, analysis of the advertised sales prices also illustrates a clear border effect in places such as Geneva, Copenhagen and Bratislava (see Figure 10). Here, the larger city places an uneven balance on the neighbouring border region and as a consequence, households take advantage of the disparity in housing price by migrating across the border. An anomaly to this trend is in Ireland where a reverse border effect seems to occur and the higher housing prices are found in Newry in Northern Ireland than its southern counterpart. This in part could be connect to the supply deficit in Newry where the inelasticity of its housing market is driven by the geographic constraints of the town. Another anomaly was observed in the Basque

case study where Hendaye had a higher housing price than its Spanish counterparts. In this case study, we expected to find minimal difference in price across the border due to the nature of the border region being a contiguous built environment across Spanish and French communes. We do note however that there is a stronger tourism industry in Hendaye and its large beach could serve as an important local amenity which boosts local prices.

Hence, our main takeaways from the advertised sale price averages are that again metropolitan areas can place a 'big city' effect on neighbouring border regions to induce a cross-border market effect. We also note how access to a large labour market and a major agglomeration serve as important aspects in a developing cross-border housing market. Overall, we observe how Geneva and Copenhagen have some of the highest housing prices and likewise have some of the largest differentials in price and cost across the border too. Hence, we see the strongest pulls from a cross-border housing market in these regions.

4.3 Affordability and Profitability

4.3.1 Affordability

Affordability is defined as the cost of buying real estate according to the income level. The calculation is done at LAU2 level and requires information on the average sale price per sqm or room in the LAU2 unit and the income level measured as PPP per inhabitant by NUTS3. Given this definition of housing affordability, we are able to find how many months of saving is required to afford housing on either side of the border.

Given how we were dealing with two average household incomes (two PPP statistics) from each side of the border, we designed a quadrant of maps to full display the potential regional differences that income and price can play on each other in a cross-border housing market. Below, we have incorporated the Greater Geneva case study as an example:

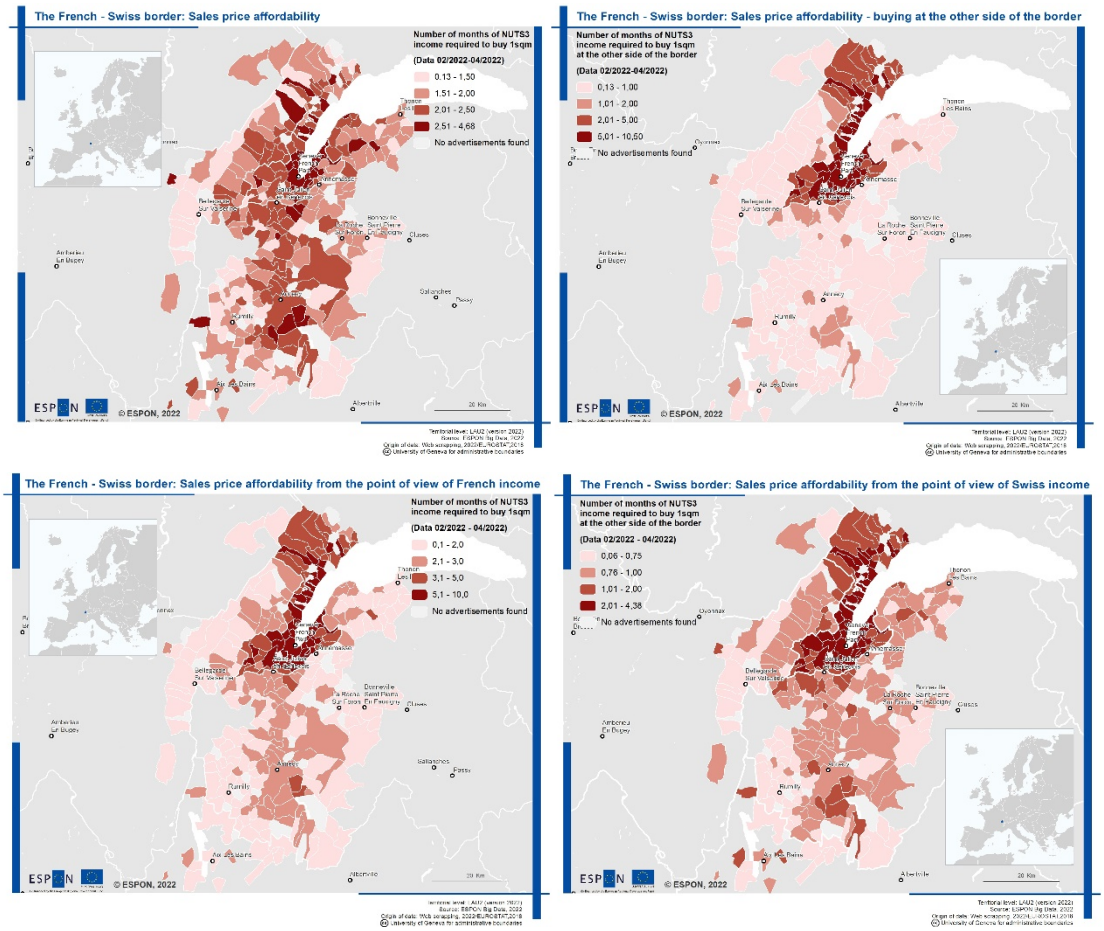


Figure 11: Quadrant displaying how regional incomes impact affordability across the market

In the map in the top left corner, we observe the affordability of each regional income fixed to its home region. For the map in top right corner, we swap this where we observe the affordability of purchasing in the region opposite to where you work. For the map in the bottom left corner, we take a perspective on a French worker seeking to buy property across the entire cross-border housing market while in the map in the bottom right corner, we take the perspective of a Swiss worker.

In mapping these regional imbalances and physically visualising the differences in affordability with relation to income and price between different workers, we can quite clearly see how there are differences in affordability dependent on what your income is and where you live within a border region. Given these imbalances, differences in affordability play out in the market where households with lower incomes are priced out of homeownership while households with higher incomes are able to dominate the cross-border housing market and outcompete other households in order to achieve the greatest value for their money. In terms of social cohesion policymaking as well as in terms of territorial development, these cross-border housing markets with significant imbalances in regional income and affordability can play a major role in undermining policies and destabilising local relations between neighbouring regions.

While the quadrants of Figure 11 served as a useful way to illustrate the differences between housing affordability and local income within a case study region, we also calculated the composite mean difference in affordability across each border region. Table 5 details the comparative differences in sales affordability while Table 6 details the comparative differences in rental affordability.

Buying in...	is ... more affordable	than in...
Austria	15%	Slovakia
Romania	29%	Bulgaria
France	57%	Switzerland
Spain	45%	France
Ireland	63%	Northern Ireland
Sweden	50%	Denmark

Table 5: Mean Differences in Sales Affordability

This table shows the average affordability difference at either side of the border for each case study when buying real estate. The more affordable country is at the left side in all cases. Affordability is measured as the number of months of income necessary to buy 1sqm (or 1 room in the case of IE-NIE). For the purposes of comparative analysis, we refrain from incorporating the Irish case study into our analysis due to its use of a separate unit for measurement.

From this visualisation, we see how the border regions with the greatest difference in sales affordability are in Greater Geneva and Greater Copenhagen. This finding matches our earlier analysis in Ch 4.2.2 where regions with large metropolitan areas and significant urban agglomerations have the greatest impact on cross-border dynamics as the greatest imbalances in income and housing are also located in these regions.

Rental in...	is ... more affordable...	than in...
Slovakia	9%	Austria
Bulgaria	66%	Romania
France	34%	Switzerland
Spain	17%	France
Northern Ireland	16%	Ireland
Sweden	41%	Denmark

Table 6: Mean Differences in Rental Affordability

This table shows the average affordability difference at either side of the border for each case study when renting a dwelling. The more affordable country is at the left side in all cases. Affordability is measured as the number of months of income necessary to rent 1sqm (or 1 room in the case of IE-NIE). For the purposes of comparative analysis, we refrain from incorporating the Irish case study into our analysis due to its use of a separate unit for measurement.

From this visualisation, we see how the rental market does function differently than the owner-occupied market in terms of the composite mean difference in rental affordability. The most significant differences is observed between Bulgaria and Romania which is a region with the least developed private rental sector where the majority of the population live in owner-occupied housing. Greater Geneva and Greater Copenhagen still do have large differences in rental affordability, albeit not as pronounced as in the sales affordability. This shows how the large metropolitan areas with significant urban agglomerations still hold considerable sway in terms of rental affordability within a cross-border housing market but that other factors and needs may also play a part in determining differences in affordability within a rental market specifically.

4.3.2 Profitability

Profitability for this study is defined as the ratio between advertised average sales price and advertised average rental price per LAU2 unit, and it gives an idea as to whether it is more profitable to buy or to rent in a certain area. Hence, for the following mappings, it is important to acknowledge that darker shades of purple indicate that renting is the more economical option while lighter shades of purple indicate that buying is a better choice.

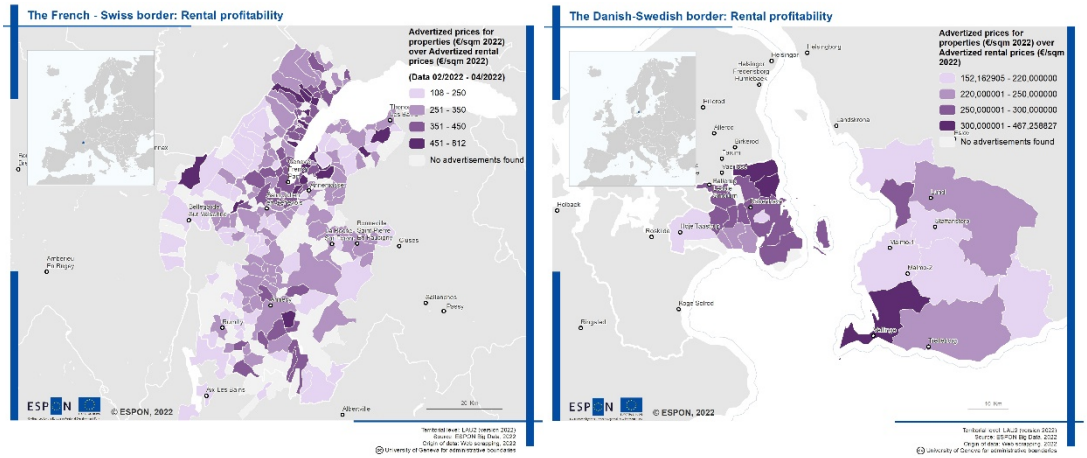


Figure 12: Examples of Profitability Mappings

While a more long-term study with more adverts over a longer period of time would provide a more complete picture as to how differences between renting and buying shape up against each other in local areas, our study of local profitability did provide glimpses of interesting insight in terms of local housing market conditions and social wellbeing. Through the case studies, we did not find one overriding trend which shaped profitability margins in a cross-border housing market. Hence, its utility in studying cross-border housing markets and observing border effects may not be as effective as we initially thought. What we did observe in some instances though were the potential impacts that financialization, housing commodification and strong housing policy can have on renting in core urban areas.

From Figure 12, we observe profitability measurement between Greater Geneva and Greater Copenhagen. In terms of how the cross-border housing market manifested itself in these regions, there are many similarities between these case studies: large metropolitan regions, strong core agglomeration, regional imbalance in cost of living, differences in local income. All of these factors contribute to the evolution of their cross-border housing markets. For profitability though, we see a stark contrast where renting is more economical in Central Geneva whereas buying is more economical in Central Copenhagen and Malmö City Centre. In the past, given the high value of land in core urban areas, buying has been historically more expensive and less profitable in central urban locations. Greater Copenhagen though is clearly bucking this trend where buying has become more economical in the cores of both city regions. As neither the Danish nor Swedish state chooses to regulate, control or protect its private rental sector, we are observing how the commodification of rental housing through the global financialization process is making it wholly undesirable to rent in central urban locations as the introduction of foreign investment and real estate investment trusts into local rental sectors in core urban areas are causing rental prices to skyrocket. Hence, we observe how it has now become more economical to purchase housing in both Central Copenhagen and Malmö despite the high price of land.

Geneva, on the other hand, is representative of a state which heavily regulates and controls its private rental sector. No foreign buyers are allowed to own housing in Geneva while almost all rental housing is subject to state control and regulation. As a consequence, we observe how it is still more economical to rent than to purchase in Central Geneva. The heavy influence of the state's housing policies is able to protect housing from foreign investors and real estate investment trusts for the most part. As a consequence, the Genevan market has been more difficult to commodify and control through the financialization process. In turn, we see that the Genevan housing policies has protected the rental sector from these international housing trends.

So while we may not specifically observe a border effect through the measurement of profitability across cross-border housing markets, we are able to observe how proactive versus reactive housing policies can influence and impact the profitability of housing in large, highly sought-after housing markets. In Geneva, the state plays a proactive role and is able to subdue the impact of financialization on the local rental market while in Greater Copenhagen, we are witnessing how rent has skyrocketed to the point that purchasing land in central urban places is more economical than renting in the private rental sector.

4.4 Advertisement Duration

One novel aspect from the web scraping process has been our ability to capture and measure how long adverts remain on local real estate webpages. We use this measurement as an indicator as to how active and healthy the residential real estate market is in cross-border housing markets. Hence, a market with short advert durations would be exemplative of a healthy market with a fast turnover while a market with long advert durations would be exemplative of a slower market with less turnover and activity.

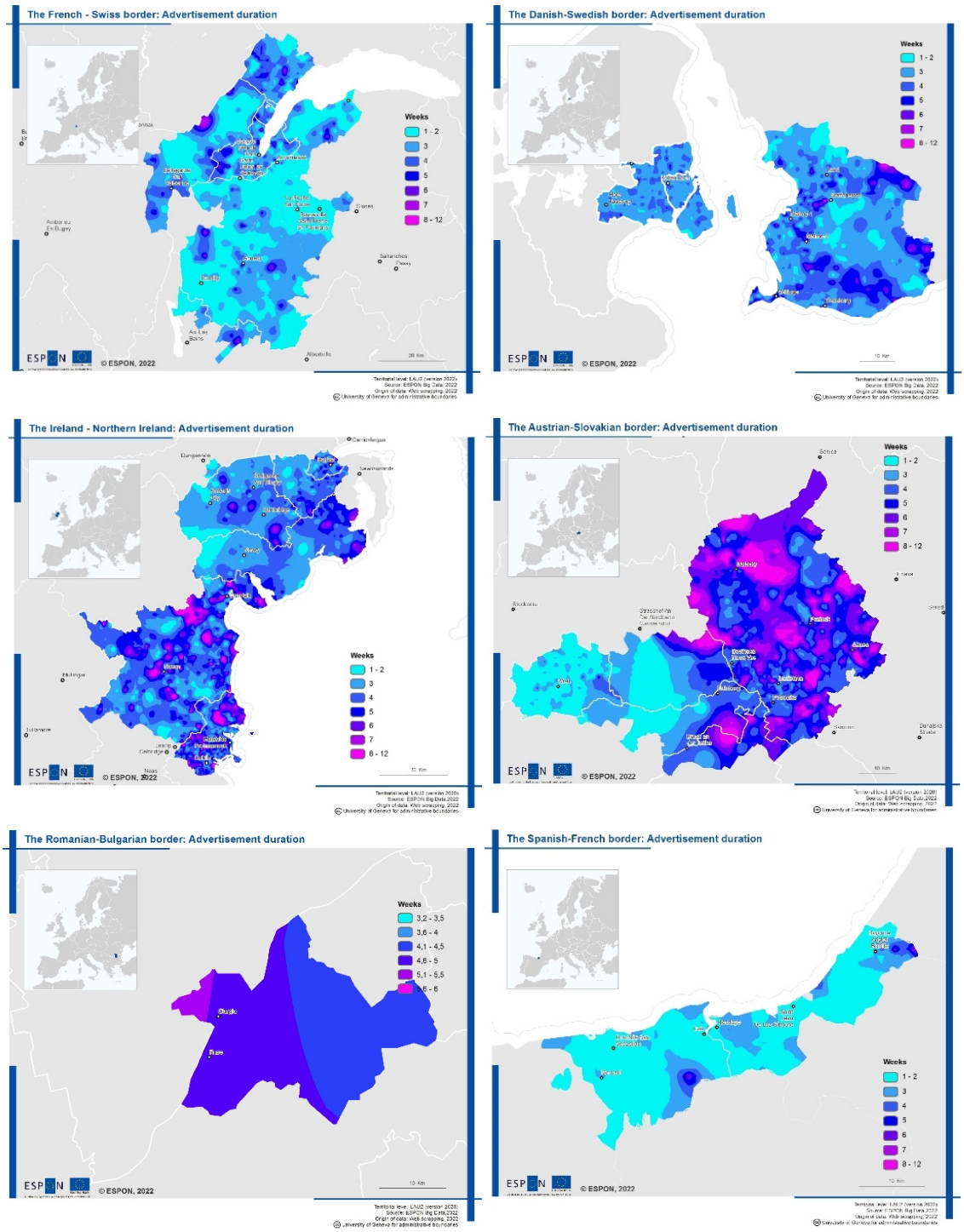


Figure 13: Advertisement Durations

For a healthy and robust cross-border housing market, we expected to find an active market on both sides of the border. Hence, for these figures, we were seeking to see the lack of a border effect as an example that an integrated cross-border housing market exists. What we found is that the Basque Eurocity and Greater Geneva regions had the most active markets on both sides of the border while Greater Copenhagen also had a very active market with a slight border effect across Sweden and Denmark. Hence for these case studies, we can clearly observe a strong market with expedient turnarounds on either side of the border illustrating how the markets have potentially integrated through the level and speed of activity.

On the other hand, we see strong border effects in the Irish and Austrian-Slovakian case studies. Hence in these studies, we observe market differentiation as certain parts of the market on one side of the border operate and function at a separate pace than the market on the other side of the border. This is exemplative of a split market with less integration and is not characteristic of what we would expect to find in a cross-border housing market. It should be noted in the Austrian-Slovakian case study though that the Austrian border region shares more characteristics and similar durations to the Bratislava housing market than with the Viennese market. So, in this way, we do observe the initial evolution of an integrating cross-border housing market.

In relation to our conceptualisation of cross-border housing markets, the use of advertisement durations as an indicator for measuring border effects has illustrated that some of the housing markets with the strongest degree of housing market integration (Greater Geneva and Greater Copenhagen) also share similar activity rates in the market. Hence, we can use advertisement duration of housing markets as another facet to verify the establishment and functioning of a cross-border housing market.

5 Discussion and Conclusions

This project, *Updating and integrating Big Data and Housing datasets,* has taken a multifaceted approach towards the conceptualisation and measurement of cross-border housing markets. In terms of understanding how cross-border housing markets emerge, this study has crossed two streams of literature from housing and cross-border studies in order to develop some of the founding principles by which a cross-border housing market would function. Likewise, in terms of measuring and analysing these evolving markets, this study has combined informal data from web scraping processes with formal data from official sources to interpret a wide variety of outcomes within these markets. These outcomes were then assessed using a form of mixed-method analysis where qualitative findings from desktop research, interviews and grey literature were cross checked with the quantitative results and indicator visualisations to produce a holistic, comparative analysis of cross-border housing markets across six case study regions.

Our initial approach to the project was motivated by a hypothesis that accessibility acts as a key driver for cross-border housing markets. Upon this idea, we framed our initial narratives that these functional cross-border regions have differing levels of integration dependent on their overall accessibility. Following the extensive mapping of different types of accessibility across the six case study regions, we were then able to interconnect prices from web scraping data with accessibility attributes through a regression analysis. What we found as highlighted in Annex 9: Accessibility was that there were no correlations between housing price and level of accessibility throughout each case study region. For our research, this required a shift in perspective as to how we understand cross-border housing markets.

While this meant that the framing of our research was changing, we were able to interrelate these results back to traditional strands of findings from both housing and cross-border literature. For instance in housing studies, we know that a house is a complex product with many unique characteristics that must be considered wholly in order to develop a grasp of how the dynamics of the market function. In other words, aspects such as location, schools, local language, nearby amenities and services, government policies and financial prognosis all play a part in impacting housing price and market dynamics. Hence, we acknowledge that the initial framing of cross-border housing markets as markets primarily impacted by accessibility did not take into account the vast array of other aspects which impact housing prices regardless of if the market is located in a cross-border region or not.

Likewise, we found that many aspects critical to cross-border studies did play out in our study of potential cross-border housing markets. Regional imbalances in cost of living and household income, an integrated labour market, the removal (or reintroduction) of border controls and the existence of a border impacting policymaking and governance all factor into how a cross-border housing market can emerge and evolve in these functional cross-border regions. We found that monetary reasons were a primary motivation in migrating across a border as regional difference in housing affordability and general economic asymmetries allow for some households to economise their situation through a cross-border lifestyle. Within each region which had a strong case for having a cross-border housing market, we note how workers with a higher income on one side of the border can attain substantially more housing at a lower price by migrating across the border to where real estate and rental prices are lower. When backed checked with interview findings and desktop research, we can physically describe how and why a cross-border housing market is emerging in those case studies.

Hence by moving away from the idea that measurements of accessibility are a key driver of cross-border housing markets, we found that factors such as price, the affordability of housing, the cost of living, local culture, services and amenities, common lingua franca and much more can all have an impact on driving dynamics within a cross-border housing market. In merging findings from housing studies with findings from cross-border studies, we were able to piece together a new narrative which illustrates the complexity and multifunctional attributes involved in a cross-border housing market.

Given this discussion, we were able to draw some main takeaways from the research. One of the primary factors driving the development of a cross-border housing market was how **regional differences in income were driving cross-border movements** as in a cross-border comparison wealthier households looked further afield from the home country in order to take advantage of economic asymmetries which were present within the housing market. For this factor, differences in cost of living pushed households to move while their higher, more dominant income allowed these migrating households to take an economically superior position over the local population within the housing market specifically. Hence, economic asymmetries developed

as a consequence of cross-border movements serve as a lynchpin in the development of cross-border housing markets.

Another critical factor to considering how cross-border housing markets emerge was how the topic of **housing affordability remains a key challenge** across European territory. In cross-border housing markets, housing affordability plays a dynamic role as very often issues in housing affordability in one part of the cross-border region are outsourced and have a domino effect in decreasing affordability to other parts of the cross-border region. For instance, if one side of the border is home to an extremely unaffordable housing market, then households struggling to afford accommodation within this market will look just outside the home region to find more affordable accommodation within close proximity to their jobs. This in turn impacts housing affordability of the neighbouring market as they are subject to new, outside demand which drives up prices. Local inhabitants are then consequently priced out as the cross-border workers who migrated as a consequence of housing unaffordability within their home region have now simply transferred the issues of housing affordability to their neighbouring region.

A serious issue remains within this domino scenario as the local, outpriced inhabitants have nowhere to migrate to. Instead, the local inhabitants are either forced to accept poorer, smaller accommodation, or they must turn to the state for social housing and housing benefits. With regard to European policymaking and social cohesion, **the topic of housing affordability within cross-border housing markets having a knock-on negative effect on neighbouring communities supports calls for greater cross-border collaboration and coordination within the housing sector.** New cross-border governance structures and further collaboration can ensure that housing in border regions is reviewed and approached as a cross-border issue. If not, governments in border regions will continue to treat housing as a local issue and some of the root causes for growing housing unaffordability will not be tackled as housing is not viewed as a cross-border issue.

Some of the negative externalities generated from cross-border housing markets are the local displacement of inhabitants unable to afford housing, the exploitation of regional economic inequities and changing dynamics to the cost of living. Hence, **cross-border housing markets can have a significant impact on social wellbeing** as some households stand to lose more of their wealth due to the economic asymmetries caused by the border effect.

While **accessibility has been proven not be a significant factor in the dynamics of price within a cross-border housing market**, we believe that there is still further scope for future research on how different levels of accessibility can impact housing decision making within a cross-border housing market. Hence, further research on cross-border housing markets should investigate the interconnection between how access to foreign job markets can impact local property prices within a border region.

Given the extent of our research and the many new and topical areas of research it touched upon, we have developed a chapter dedicated to how this research can spur further research within conceptual limitations of a cross-border housing market. The following chapter will tough upon these ideas in further detail.

6 Future Research Avenues

This *ESPON 2020 Updating and integrating Big Data and Housing datasets Project*

- developed a conceptualisation of cross-border housing markets based on a thorough literature review from both housing studies and border studies
- analysed housing policies, markets and planning policies in relation to housing in 11 European countries, outlining the relationship between spatial planning and different types of housing policies
- collected and analysed conventional indicators relevant for housing
- developed 11 phyton scripts to web scrap housing data from real estate platforms showing the opportunities as well as limits for a harmonised analysis
- developed new cross-border indicators that allow to analyse the price differentials and profitability, as well as affordability from different sides of a border to live at the other side of a border. In other words, the project analysed the affordability with the income from one side of a border to live on the other side of the border in comparison to living in the country where wages are earned.
- analysed the data and discussed the developed via case study as well as across case studies, thus allowing an identification which border regions in the EU show the highest differences or are integrated the most.
- analysed the accessibility in the border regions and analysed the interdependency with housing prices.
- reflected on the results and suggests further research avenues on a conceptual level as well as in view of further opportunities to analyse the data in more depth as well as in view further integration with other data sources.

Based on this experience, the project suggests a number of promising research avenues, for both the next ESPON programme period as well as in more general. The innovative approach of the project in combining qualitative and quantitative data of different nature in a cross-border context has revealed great potential for a substantial understanding of the nature of cross-border housing markets. Including a detailed analysis of the policy and political backgrounds allows for a detailed interpretation of the data. This includes

- the opportunity to identify the most sought for segments of the housing markets, such as houses with gardens or apartments for couples with a balcony
- identification of legal barriers for cross-border commuting and residencies (Grenzgänger) in view of housing provision
- the impacts of different welfare states systems on the rental and housing sector, and the subsequent profitability and affordability
- the identification of small pockets of high-priced real estate areas
- a better understanding of the factors and thresholds when cross-border commuting
- proof that a general understanding of the functionally integrated border regions can be achieved through by modelling cross-border accessibility.

Yet, we observed that in order to derive to more robust recommendations, the period of web scraping activities would need to be extended. This would for example allow to identify which market segments are displaying very short advertisement periods, and thus represent the sought for part of the market. Additional factors such as age distribution and more socio-economic. One could even consider to develop a longitudinal study and regularly scrap data, Overall, the project proofed that the specific combination of data allows for a very indepth understanding of the determinants of housing prices as well as decision-making for commuters.

A key suggestion by the project team is to attempt to develop a European wide overview of the functioning of housing markets in general for all European countries. Due to the cross-border nature of this project, the project started to describe, explain and analysis all the different aspects of policies, politics and polity that

contribute to the supply and demand of housing in specific areas, and specifically in view of different types of dwellings and price ranges. Creating this overview of 11 country and region profiles allows the project team to well situate the data in the national context and provide more grounded explanations of the patterns observed. This includes both price ranges, affordability as well as the divergence between segments of the market in the selling and renting fields.

In view of cross-border regions one could further explore the qualitative impacts that rising unaffordability is having on cross-border regions and social wellbeing – overall, research still feels detached from 'humanity' with overemphasis on quantitative data in view of market dynamics without enough interconnection to how this is played out on-the-ground. At the same time web scrapping can include further information, ie. Whether listings and advertisements have a garden.

The literature review of the project clearly shows the increased attention towards affordability questions in an era of financialization of housing and urban growth, which effects different people differently. As such, the project team suggests future research to differentiate affordability further for example in view of the age of individuals, their life situation, the changes of access to mortgages, etc. To give an example, income is spread differently over age groups, at the same time, the rising house prices allow fewer and fewer people set a foot on the property market. A better understanding of affordability across different income and age groups thus is important.

Another opportunity lies in linking the existing data with additional data sources as well as to make use of more of the information from the scraped listings. This can include the age of the buildings (as an example for additional data), the number of rooms available or the floor level (as examples for information from the web-scraping). In looking as well into the segment of the market that is very fast taken of the market, one can estimate which segments of the market are underrepresented in view of the demand. Further the impact of different amenities such as green areas could be analysed and hedonistic price models be applied in comparison of different cities across Europe. One could also connect cross-border housing markets to integrated labour markets through the interconnected use of commercial data and housing data, add AirBnB data and 'medium-term rental' component to rental sector research, interconnect modal points such as train stations and motorway junctions to its function within a cross-border housing market (beyond just potentially impacting price), or analyse how the COVID-19 pandemic will in the long-term impact cross-border housing markets. Further consideration should be given to migration dynamics.

In short, the opportunities for further analysis are manifold. Based on this projects experience, the team deams it important to consider both a case study focus including a thorough understanding of the political, administrative as well as financial background, as well as to build on a more quantitative, comparative focus in order to be able take account of the local nitty-gritty aspects of how these markets are functioning in real life and how they might be impacting people in their day-to-day life.

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