MOBI-TWIN

TWIN TRANSITION AND CHANGING PATTERNS OF SPATIAL MOBILITY: A REGIONAL APPROACH

MOBI-TWIN D1.1 STATE-OF-THE-ART REPORT ON THE DRIVERS, FORMS AND EFFECTS OF SPATIAL MOBILITY ON EU REGIONS

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Abstract	The report will provide an extended literature exercise focusing on current theoretical frameworks and latest empirical studies concerning spatial mobility, its drivers and its impact on regional inequality, rural development and sustainability, as well as the definition and geography of demographically declining and left-behind areas as they are currently formed by spatial mobility outcomes.
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EXECUTIVE SUMMARY

The report presents a comprehensive state-of-the-art overview regarding existing forms of spatial mobility and the key factors affecting them. More specifically, it starts by setting the scene and the main definitions for mobility that will be used throughout the MOBI-TWIN project, offering a comprehensive framework under which the future analysis of the project will be performed.

After an introduction (Section 1), Section 2 presents the key definition for long-term, short-term and circular mobility, along with specific examples that will be further explored during the MOBI-TWIN project. Long-term mobility is defined as the temporary change in place of residence of individuals from one region to another with a permanent perspective for at least 12 months. This encompasses movements related to migration for work, education, and family reunification. Moreover, we define short-term mobility as the temporary movement of individuals from one region to another with limited duration – at least 3 months but less than 12 months. This form of mobility involves relatively brief stays in the new location being characterized by a specific purpose or objective, such as digital nomads, internships, and work-related stays. Finally, the case of circular mobility is characterized by repetitiveness in movements between regions. Given is more complex nature, we choose to decompose it into two different components: long-term and short-term circular mobility. The first case refers to back-and-forth movements between regions with a long-time perspective (more than 12 months in each movement), such as return migration, whilst the short-term approach encompasses circular movements with a shorter duration (at least one week, but less than 3 months). The latter case refers to, but it is not limited to, movements related to second homes and (bi)weekly long-distance commuting.

Following this, Section 3 provides a detailed description of the factors affecting the different forms of spatial mobility, focusing on traditional drivers that have previously investigated, such as population density, wage disparities, labour market structure and complexity, whilst in enriches those factors with aspects related to the quality of life and social networks. Moreover, a specific focus in placed on transition processes that have affected spatial mobility, including the digital and the green transition (twin transition), COVID-19 and Brexit. Section 4 provides literature review regarding the effects of spatial mobility on three key areas of development – (1) regional and (2) rural development, as well as (3) sustainability – through keyword co-occurrences network using Scopus data. This will help identify the key trends related to spatial mobility and development, which is essential for the assessment of its effects in the following activities of the project. Section 5 focuses on the demographically declining and left-behind areas, providing a brief description of the definitions available in the literature and the key factors relating spatial mobility to their emergence. Finally, conclusions are provided at the end of this report (Section 6) highlighting the key outcomes that can be used for further analysis in the following tasks of the MOBI-TWIN project.

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LIST OF TERMS AND ABBREVIATIONS

EU	European Union
EEG	Evolutionary Economic Geography
IoT	Internet of Things
NEG	New Economic Geography
RW	Remote Working
TOD	Transit-Oriented Development
TT	Twin Transition

1 INTRODUCTION

The EU-funded MOBI-TWIN project aims to establish the notion that major global transition processes, such as the green and digital transition, necessitate a continuous redefinition of regional attractiveness in order to understand shifts in the drivers and outcomes of spatial mobility. Based on its objectives, the project defines spatial mobility as the changes in place of residence from various temporal scales. So, the terms spatial mobility and residential mobility are being used interchangeably within the text. The project is based on the belief that the twin transition influences regional attractiveness and the factors that drive human mobility. This presents an opportunity for underdeveloped areas to attract new populations based on favourable living and environmental conditions, as well as improved job accessibility. MOBI-TWIN asserts that this leads to the emergence of new spatial mobility patterns, which in turn create new equilibria between different forms of mobility (permanent, circular, and temporary). These patterns impact both the "old" and "new" regions involved in sending and receiving populations. MOBI-TWIN employs big data and agent-based modelling to analyse the effects of these evolving spatial mobility patterns on EU regions and proposes policies to mitigate their consequences on demographics, society, welfare systems, and the labour market.

The MOBI-TWIN project has several main objectives within its scope. Firstly, it aims to analyse the changing drivers of spatial mobility by studying changes in place of residence from various temporal scales and considering the structural changes brought about by the twin transition in defining regional attractiveness. Secondly, it seeks to examine the emerging balance between the three different mobility forms and their effects on EU regions, taking into account the evolving nature of regional attractiveness. Thirdly, the project aims to create a new regional typology based on the twin transition approach to identify areas that are currently experiencing demographic decline or being left behind. Additionally, the project utilizes agent-based modelling to capture and evaluate the impact of changing patterns of residential mobility between EU regions, focusing on demographics, society, the welfare system, and the labour market. Moreover, the project actively involves and empowers regional policymakers in envisioning place-based policies that leverage the positive outcomes of the twin transition, with a specific focus on major disruptions to changes in place of residence like Brexit and the Covid-19 pandemic. Lastly, the project emphasizes the dissemination and communication of its results to a wide audience, establishing collaborations with relevant initiatives and ensuring the practical application of the findings.

To achieve the objectives, Deliverable 1.1 concentrates on establishing the foundational theoretical framework that will underpin the subsequent actions of the project. The deliverable's structure unfolds as follows: Section 2 offers a comprehensive overview of existing definitions of mobility, encompassing various types and forms delineated in the literature. Emphasis is placed on short- and long-term mobility, as well as recognized circular forms. Section 3 delves into a detailed exposition of the theoretical frameworks

pertaining to mobility, aiming to identify the key drivers and barriers that shape its dynamics. It also tries to connect the notion of mobility to the current policy framework of twin transition. Subsequently, Section 4 examines the repercussions of mobility on regional inequality, rural development, and sustainability, elucidating the primary data sources employed by relevant studies. Building on prior inputs, Section 5 explores the concept of demographically declining and left-behind areas, extracting insightful information concerning the conventional factors influencing their formation and evolution. Lastly, the report culminates in the Conclusions section, encapsulating the principal insights derived from the analysis.

2 GENERAL CONTEXTS OF MOBILITY

Spatial mobility pertains to the movement of individuals, commodities, and concepts across distinct geographical locations, exerting a vital influence on socio-economic dynamics, demographic trends, and urban development [1, 2]. Nevertheless, the definition of spatial mobility encompasses diverse perspectives and facets. Geographically, it encompasses the physical displacement of people and goods within and between countries, regions, or even cities, encompassing activities such as commuting, migration, and trade flows. In the realm of transportation, spatial mobility concentrates on the capacity to travel and access various destinations efficiently, considering transportation modalities, infrastructure networks, and travel behaviour. From a sociological standpoint, spatial mobility encompasses social processes that entail alterations in residency, workplace, or daily activity patterns, thus highlighting the social, cultural, and economic factors that form mobility choices. Moreover, spatial mobility can be examined through the prism of information and communication technologies, whereby digital advancements facilitate virtual mobility and remote interactions. In essence, spatial mobility embraces an array of dimensions, underscoring the multifaceted nature of human movement and its profound implications for society, economy, and the built environment.

Spatial mobility is also inherently temporal regarding existing rhythms (daily, weekly, monthly) and longitudinal changes and trends [3]. Specifically, diurnal movements refer to daily travel behaviour, encompassing home-work mobility (e.g. commuting) as key activities, whereas weekly mobility patterns capture differences between workdays and weekends, such as work-related and leisure movements. At the same time, monthly mobility captures seasonality aspects related to special working conditions, variations between regular travel behaviour and holidays, but also linked to second-home visits. In addition, when investigating the temporal dimension of mobility, longitudinal changes and trends should be considered referring to residential and workplace change and migration. Thus, patterns of mobility change over time and can differ between countries and across borders [4].

In general, there have been various definitions for mobility covering multiple dimensions, such as reasons, lifecycles, temporal periodicity and frequency and distance. Starting from the reasons for mobility, these may contain a multitude of driving forces, including

movements related to leisure, work, and education, family or forced mobility (e.g. refugee) [2]. Second, different lifecycle stages are also an additional variable that should be considered when exploring the various mobility types, encompassing aspects related to diversified drivers affecting early-, middle- and mature-age movements such as education, working career, family formations, and retirement [5]. For example, young persons are often linked to student mobility and their choices may be affected by factors related to quality of education and university availability in an area. Moreover, early middle-aged individuals' choices are frequently affected by factors referring to job availability and wages, as their movements relate to career mobility choices. At the same time, the presence of cultural amenities and weather conditions may constitute significant drivers of mobility in cases of movements related to persons in retirement.

Third, the temporal dimension of mobility in terms of periodicity and frequency also characterises the various forms of mobility, indicating some critical points in the time spectrum for differentiating between them [5]. Starting with the 24 hours or overnight stay away from home, we can diversify between short trips and longer travel forms of mobility, such as daily commuting and travel for business purposes. In addition, there is a 6 to 12 months period window, depending on the country, that can act as a turning point for distinguishing travel and migration movements.

Finally, distance is a crucial parameter when classifying the various types of mobility, triggering multiple discussions. For example, distance is a critical factor in distinguishing between "commuting", usually taking place on a daily basis, and "long-term commuting" which may refer to weekly movements due to its longer distance character. At the same time, distance also matters when it comes to moving place of residence from one place to another, indicating different forms of mobility. For instance, moving between short distances within the same local area usually refers to residential mobility/change. However, moving between longer distances between regions, but within the same country, usually refers to internal/regional/domestic migration, whereas moving between longer distances from one country to another signifies international migration phenomena (e.g., internal EU mobility). So, although this division of spatial mobility is based on administrative levels, it is strongly linked to distance.

This report focuses on the investigation of **regional mobility flows derived from changing the place of residence at the European level**. It seeks to investigate the key drivers and barriers related to different types of mobility in relation to **work, education, lifestyle, and/or family reasons**, and their connection to **different life stages**. Regarding the temporal dimension (periodicity and frequency), the report identifies three broad types of spatial mobility: **long-term, short-term, and circular mobility**, which are defined and discussed in the following sections. MOBI-TWIN builds on these three types of mobility and explores their effects on EU regions considering their potential differences and specificities, while defining regions at the NUTS2 level of analysis in this project.

LONG-TERM MOBILITY

Long-term mobility is related to permanent change of residence by people. Long-term mobility can be considered as a residential change within a city, a domestic migration between regions of a country or an international migration between countries depending on the distance of a long-term mobility and administrative division.

Outflows of human capital from a country or a region to another refer to changing population phenomena in search of better living and working conditions, affecting to a large extend the economic and educational foundations of the country of origin [6]. It is interesting to notice that permanent movements have a significant impact on regional growth and reflect the ability of each community to respond to changing structures and opportunities [7, 8]. For example, the brain drain phenomenon is related to highly skilled human capital movements that affect the existing regional capabilities for development.

According to UN Recommendations on Statistics of International Migration [9] a long-term migrant is a person who moves to a country other than that of his or her usual residence for a period of at least a year (12 months), so that the country of destination effectively becomes his or her new country of usual residence[1].

The MOBI-TWIN project adopts the UN definition and fits it into its main premises for following a territorial approach. Hence, MOBI-TWIN will approach **long-term mobility** as:

> *""a permanent movement of individuals changing their place of residence from one region to another with the intention of establishing a more enduring residence or livelihood. This type of mobility involves a prolonged or permanent change of location (for at least 12 months) and may encompass factors such as migration for work, education, family reunification, or other purposes that involve a substantial commitment to the new location".*

As it is stated above, long-term spatial mobility entails enduring relocations, such as permanent migration for the purposes of employment or settlement. It entails substantial changes in residence and often refers to the establishment of a new sociocultural and economic context. Some indicative examples of long-term mobility are the following:

1. Interregional Work Migration: Skilled professionals or blue-collar workers, who relocate to another region for an extended period to pursue better job opportunities and career advancement.

[1] In the European case, it is essential to highlight the concept of "freedom of movement" underpinning movements of EU citizens between the EU member states, as well as Iceland, Liechtenstein and Norway. This refers to the unrestricted mobility of persons (freedom of movement) as a fundamental principle, leading to a wide range of potential regions to migrate based on their needs and preferences without being limited by any administrative barriers.

2. Study Abroad: Students who move to other regions for higher education, such as attending universities or colleges, often staying for the duration of their degree programs.
3. Family Reunification: Individuals who immigrate to join their family members who are already settled in another region, with the intention of staying long-term.
4. Retirement Migration: Seniors who move to a different region to spend their retirement years due to factors like a lower cost of living, pleasant climate, or improved healthcare services. This also includes returning back to where they were originally from.
5. Forced migration: Asylum Seekers and refugees who are forced to flee their home countries due to conflict, persecution, or violence, seeking protection in another country for an extended period until conditions improve.

These examples demonstrate the diverse range of situations and purposes that can lead to long-term mobility, involving significant changes in residence and lifestyle over extended periods of time.

SHORT-TERM MOBILITY

Compared to the long-term mobility, *short-term mobility* is considered in several cases as temporary change of residence mainly linked to changing place of work or study. For example, due to short-term economic activity (e.g., seasonal labour), student exchange, recreational travel combined with working (e.g., digital nomads) or due to natural disasters. However, there are cases where short-term mobility can result in generating long-term movements and vice versa, indicating that these effects are closely intertwined [10].

Following the definition provided by the UN Recommendations on Statistics of International Migration [9], a short-term migrant is a person who moves to a country other than that of his or her usual residence for a period of at least 3 months but less than a year (12 months) except in cases where the movement to that country is for purposes of recreation, holiday, visits to friends and relatives, business, medical treatment or religious pilgrimage.

Stemming from given definition, the MOBI-TWIN project redefines **short-term mobility** as:

> "a *temporary movement of individuals changing their place of residence from one region to another, typically for a limited duration (at least 3 months but less than 12 months), involving relatively brief stays in the new location and being characterized by a specific purpose or objective that requires presence in that location for a short period of time*".

In this regard, short-term mobility involves temporary or seasonal displacements, frequently driven by specific intents like student exchange, business travel, or seasonal employment. This form of mobility allows individuals to experience different locations without permanent resettlement. Examples of short-term mobility, highlighting the diverse range of situations and reasons that lead it, are the following:

1. Short-Term Work Assignments: Employees who are sent to another region by their employer (e.g., posted workers) or self-employed freelancer carrying out for a specific project or task, with the intention of returning once the work is completed, such as consultants and trainers. Seasonal workers can also be considered as part of this mobility type.
2. Digital nomadism: Individuals who leverage technology to work and live a location-independent lifestyle, allowing them to travel and explore the world while maintaining their careers or businesses online.
3. Internships/Traineeships: Young professionals who move temporarily to other regions for gaining work experience, often as part of their education or career development.
4. Student exchanges: Students who travel to different institutions based on other regions to study for a specific period. This type of exchange offers a chance to immerse oneself in a new culture, academic environment, and gain valuable international experience.

These examples indicate the close connection of short-term mobility to different life-cycle events, covering a wide scope of events. The MOBI-TWIN project will focus on short-term mobility between regions related to specific life events including work, education and social life.

CIRCULAR MOBILITY

Circular mobility refers to a pattern of movement in which individuals or groups periodically travel between different locations, often with a planned return to their original place of residence [11, 12]. More specifically, circular mobility is closely linked to the concept where migrants who go to developed regions eventually return to their home region after a certain period in those developed destinations [7]. This circular movement idea implies that the home regions will not permanently lose their skilled individuals, as these migrants are expected to come back after some time, bringing back new skills and remittances that can contribute to their home region's long-term benefits. An illustration of circular mobility can be seen in the back-and-forth movements between rural and urban regions within a country. In such instances, there is a movement of individuals from villages to cities that leads to temporary reversals, resulting in a circular type of mobility between where they come from and where they are going [13].

Circular mobility can encompass a range of activities, such as work, study, family visits, or business endeavours, involving a continuous back-and-forth movement between places over time. Numerous studies characterize circular migration as an organic form of movement that is not strictly regulated, as it originates from migrants themselves [13, 14]. However, according to a post-Fordist perspective, Venturini [15] emphasizes that circular migration arises as a response to the dynamics of both labour market demand and supply in a globalized world, where job opportunities might be of a temporary nature. Therefore,

circular migration patterns are most likely to be triggered due to employment purposes [16].

In addition, circular mobility, and especially short-term circular movements, is closely connected to the increasing mobility of people and to the notion of multilocality. Multilocality is defined as "*the practice of carrying out active everyday life in multiple places. This generally implies access to, but not necessarily ownership of, more than one residence*" [17]. It stands between the terms of migration and mobility, as its patterns are unlikely to adhere strictly to a daily routine, and unlike migration, it doesn't entail a lasting relocation but instead establishes an enduring link between two or more (residential) locations [18].

Hence, circular mobility involves **recurrent** cycles of departure and return, typically driven by specific needs, purposes, or opportunities in both the home and destination locations [19]. According to the European Migration Network (EMN) Glossary [20], there is a difference between temporary and circular mobility. In the first case, temporary mobility is defined as "*migration for a specific motivation and/or purpose with the intention that, afterwards, there will be a return to country of origin or onward movement*"; whereas, in the latter case, circular migration is defined as "*a repetition of legal migration by the same person between two or more countries*", Some indicative examples include persons working in a specific EU region and wishing to start an activity in their region of origin, as well as doctors, professors or other professionals willing to support their region of origin by conducting part of their professional activity there.

The MOBI-TWIN project builds on the official UN definition of circular migration stating that "*circular migrant is a person who has crossed the national borders of the reporting country at least 3 times over the past 10 years, each time with duration of stay (abroad or in the country) of at least 12 months*" [16]. Given its territorial perspective, MOBI-TWIN will focus on movements between regions. To capture circular mobility phenomena in a more comprehensive way, we choose to define **two levels of circular mobility**. The first level refers to a **low-frequency circular mobility** approach and our definition is in line with the UN definition presented above, as follows:

> *"the recurring movements of individuals between two or more regions, occurring a minimum of 3 times within the past 5 years, each time for a duration of stay (abroad or in the region) of at least 3 months but no more than 12 months*".

Low-frequency circular mobility is closely connected to the idea of return migration, where persons living abroad for a long time either retain string ties with their origin region and are able to make frequent return trips, or they decide to return in their home region and perform regular visits to their former countries of destination [21]. At the same time, low frequency circular movements also encompass seasonal workers who move temporarily to work in fields or farms during planting and harvest seasons, often crossing borders to meet the demand for labour. Their movements usually happen once or twice a year.

The second level focuses on a high-frequency approach to circular mobility where movements between regions may be more frequent and related to multilocality. In this latter case, we define **high-frequency circular mobility** as:

> *"the recurring movements of individuals between two or more regions, occurring a minimum of 3 times within the past year, each time for a duration of at least 1 week but no more than 3 months, either abroad or within the country*".

Given that high-frequency circular mobility refers to repeated movements between multiple locations, regular long-distance commuting between a home and a workplace, as well as frequent trips for trade, education, or other activities constitute some indicative expressions. Unlike short-term mobility, its repetitive patterns are associated to specific places with which the person has specific connections, such as work or study, and unlike long-term mobility, it doesn't entail a permanent relocation but rather a continuous association with two or more places [18, 22]. In this regard, some examples of high-frequency circular mobility that relate to specific life events are the following:

1. Multilocal living: Individuals who maintain two separate residences (e.g., second homes), often in different regions, and split their time concurrently between them over time. This could be due to work, family, or lifestyle preferences.
2. Interregional Family ties: Families where members live in different regions due to work or other reasons, and they maintain connections through regular visits and communication.
3. Long-distance commuting: Mobile (e.g., construction, forestry) workers whose physical worksites change over time and or work with longer time shifts away from permanent residence. Also, executives or entrepreneurs who have business interests in multiple regions and frequently travel between their headquarters, branch offices, and other business-related destinations. Long-distance commuting can take place within and between countries.

These examples demonstrate how individuals and families can maintain multiple connections with different places, whether for work, lifestyle, family, or other reasons, creating a lifestyle of circular mobility (or multilocality).

To better understand the variations between the different types of mobility mentioned in this section, Table 1 presents a set of indicative examples of mobility within a 5-year period. more specifically, if a person stays in region A throughout the whole period, this refers to immobility (case 1), whereas a single movement less than a year between regions A and B can be considered as an example of short-term mobility (case 2). At the same time, circular mobility derives as an outcome of back-and-forth movements between regions A and B for at least 3 times during the 5-year period (cases 3 and 4). Finally, cases 5 and 6 show two examples of long-term mobility, with the first one referring to return migration, as the person after a period of 3 years living abroad (in region B) returns to his/her origin region (region A), without performing any intermediate movement. In this case, given that the

duration of the movement is longer than 12 months, we consider it as a case of long-term mobility.

Table 1: Examples of different types of mobility applied within a 5-year period.

Case	Year 1	Year 2	Year 3	Year 4	Year 5	Type of mobility
1	A	A	A	A	A	Immobility
2	A	B	A	A	A	Short-term mobility
3	A	B	A	B	A	Low-frequency circular mobility
4	A-B	A-B	A-B	A-B	A-B	High-frequency circular mobility
5	A	B	B	B	A	Long-term mobility
6	A	B	B	B	B	Long-term mobility

Following the definitions presented in this section, Table 2 provides a grouping of the selected spatial mobility types that will be investigated during the project lifetime based on their temporal characteristic and reason for mobility. Return migration has been placed in all three columns as it can be related to all the different reasons (work, family/lifestyle, study) included in the table. MOBI-TWIN will use this categorisation for the analysis in the following tasks. Specifically, T1.3 has already identified potential secondary data sources that can be used for the analysis of some of the included mobility types (interregional migration, studying abroad, short-term work assignments, student/youth education exchanges, seasonal working, long-distance commuting). At the same time, T1.2 has been developed based on the idea that its outputs will be used for analysing the remaining mobility types on Table 2, for which no available secondary data sources have been identified.

Table 2: Spatial mobility types that the MOBI-TWIN project will focus on.

	Work	Family / Lifestyle	Study
Long-term mobility	Interregional Migration	Family Reunification Retirement migration	Studying abroad
Short-term mobility	Business travel Short-Term Work Assignments	Digital nomadism	Student/Youth education exchanges
Circular mobility (low frequency)	Return migration	Return migration	Return migration

	Seasonal working		
Circular mobility (high frequency)	Long-distance commuting	Multilocal living Interregional families	

3 FACTORS AFFECTING SPATIAL MOBILITY

3.1 TRADITIONAL DRIVERS OF SPATIAL MOBILITY

Spatial mobility, the movement of individuals, goods, and ideas across geographical spaces, has been shaped by various traditional drivers that have profoundly influenced human mobility patterns throughout time. These drivers encompass a multitude of factors spanning economic, social, political, and environmental dimensions [23]. Economically, job opportunities and better living standards have historically motivated people to migrate from rural to urban areas and across regions and country borders in search of improved prospects. Social drivers, such as family reunification or the desire for cultural exchange, have also played pivotal roles in shaping migration patterns. Political factors, such as conflict, persecution, or government policies, have forced people to seek refuge or relocate to safer regions. Environmental factors, including natural disasters or climate change impacts, have likewise been instrumental in driving spatial mobility, compelling populations to move away from disaster-prone areas or regions facing environmental challenges. Understanding these traditional drivers of spatial mobility is essential for comprehending the dynamics and complexities of human movement and developing policies that address the implications for societies and economies.

The following paragraphs will try to shed light on the traditional drivers of spatial mobility, focusing mostly on aspects related to economic structure and regional specificities, such as economic structure, labour market, living conditions, as well as social dimensions linked to family and other social networks that mobilise individuals to move.

ECONOMIC STRUCTURE AND LABOUR MARKET

In general, the determination of spatial mobility drivers emanates from the predominant theoretical framework concerning migration that has evolved over the course of numerous years. The inception of this framework can be traced back to Ravenstein's seminal work in 1885 the "Laws of Migration" [24] which introduced the push-pull model for comprehending migration patterns within the United Kingdom. This model highlighted the significance of **regional population size and density** as explanatory factors for migration. Greenwood (1975) emphasised the widespread adoption of gravity-type models for evaluating aggregate migration movements, explaining the process through which these models are refined to attain behavioural significance. The "gravity-type" nomenclature stems from the premise that migration, and spatial mobility in general, is intrinsically affected by the magnitudes of source and destination regions and inversely associated

with geographical distance. Greenwood also points out that additional variables employed in these models act as proxies for individual utility functions [25, 26].

According to neoclassical theory, the decision to migrate is equivalent to an investment choice (Greenwood, 1975; Sjaastad, 1962). Consequently, **wage disparities** play a pivotal role in prompting and perpetuating migration streams, representing the anticipated gains or losses from migration [27–29]. As stressed by Borjas [30], the **economic activity** within each region significantly influences the size and composition of migration flows, given its integral role in wage determination. In addition, the significance of **unemployment rates** within this theoretical framework is highlighted by Todaro [29], who asserts that the income prospects for prospective migrants hinge not solely on available wages, but also on the likelihood of securing said wages in the destination region.

In a comprehensive study spanning the years 1980 to 2005, Ortega and Peri [31] identified substantial income disparities between origin and destination countries as a potential driver of international migration. This finding was also supported by the work of Clark, Hatton, and Williamson [32] considering migration flows to the United States. The extensive cross-country dataset analysed by Czaika and Hobolth [33] further underscores the pivotal role of income opportunities at the destination in propelling migration, even in cases of irregular international movement. In addition to income disparities, differences in the living costs is another parameter that has also been investigated as a mobility driver, especially in cross-border regions [34].

At the same time, the intricate relationship between **economic cycles**, demonstrated by the fluctuations in business growth, and migration trends in Europe is vividly highlighted by De Haas and Vezzoli [35]. This notable correlation underscores the paramount influence of **labour demand** as the principal force shaping migration dynamics, a significance further heightened by the frequently observed connection between labour and family migration. In essence, labour demand within the destination country stands as the key player among migration determinants, a fact reinforced by the tendency of family migration to cascade from initial labour-driven movements. Simultaneously, **labour market structure** emerges as a secondary yet pivotal mechanism that propels migration, even in scenarios devoid of wage disparities or during periods of elevated unemployment [35].

This reveals the intricate interplay of factors beyond mere economic incentives. Looking through this analytical lens, the very structure of labour demand within host regions takes centre stage as a prime catalyst for spatial mobility. In the global landscape, labour migration predominantly arises from the structural requirements of advanced economies, encompassing both high- and low-skilled roles to fulfil a spectrum of production tasks and service-oriented functions. In the case of Europe, increased **labour market complexity** combined with **educational and occupational specialization**, acts as an amplifier for spatial mobility, especially in the form of commuting [36, 37].

The literature also highlights the role of **human capital** in influencing migration propensity and regional attractiveness. By integrating human capital through education into migration models, a novel set of parameters can be introduced on both ends of the spatial mobility

spectrum. Numerous studies corroborate and often validate the overarching hypothesis that higher levels of education are correlated with an increased likelihood of migration [38–40]. This can be rationalized through neoclassical theory by asserting that highly skilled individuals, having invested significantly in education, seek elevated returns through their wages, thereby augmenting the probability of migrating to regions with higher average salaries.

At the same time, spatial mismatches between human capital and jobs result in increased factor mobility flows towards bridging spatial gaps between productivity and income [41, 42]. These factor flows shape and are shaped by spatial characteristics indicating a concentration trend, triggering patterns of uneven regional development and territorial divergence [43, 44]. This is clearly reflected in new industrialised economies, where urban areas have gradually started to play a significant role in the developmental paths of their regions acting as poles for human capital concentration [45]. Recent findings indicate a rising proportion of individuals possessing university-level education who reside and engage in employment within urban centres [46]. Furthermore, this ratio of university-educated workforce is intricately connected to the pre-existing reservoir of human capital [46], and both factors exhibit correlation with the expansion of the city itself [47, 48]. This continuously increasing concentration of labour market opportunities in cities resulted in an uneven development process, where less-populated regions have not managed to sustain an adequate level of human capital, resulting in a downward spiral in terms of productivity, innovation potential and developmental opportunities [49].

Finally, the **gender dimension** has been very often highlighted as a significant factor for triggering spatial mobility variations [50]. More specifically, gender disparities within the labour market, characterized by wage gaps, occupational segregation, and uneven access to economic opportunities, can directly shape an individual's spatial mobility choices. Women often face limitations in economic empowerment, which may prompt them to seek better prospects in other regions. In some cases, women's mobility between regions is driven by the pursuit of employment opportunities that align with their skills and aspirations. However, women can also face unique challenges, such as the need to balance career aspirations with caregiving responsibilities, which can affect their willingness and ability to migrate [51].

QUALITY OF LIFE

Recently, new theories have surfaced, pivoting the focus towards quality of life and living conditions. Hence, the process of utility maximization in migration decision-making becomes more intricate, encompassing factors beyond economic aspects that pertain to regional attractiveness. Variables such as the presence of universities [46, 52], amenities [48, 53–56], and low barriers to integration within a community [57, 58] emerge as pivotal influencers of the magnetism exerted on highly skilled individuals by a locale.

When it comes to the role of amenities, Roback [59] expanded upon the traditional neoclassical model of migration, primarily considering wage differentials and land rent, by

introducing the dimension of **quality-of-life amenities**. At the same time, Glaeser et al. [54] identified a trend where consumer-oriented and personal service industries, such as dining establishments, theatres, and cultural amenities, tend to cluster in specific geographical areas, emphasizing the significance of proximity between producers and consumers. This geographical clustering underscores the pivotal role of physical closeness in these sectors. Both Lloyd and Clark [55] as well as Florida [60] emphasize the profound impact of lifestyle factors, encompassing entertainment options, nightlife experiences, and cultural offerings, in attracting and retaining educated and skilled populations. In a more quantitative approach, Florida [58] quantified amenities using the "bohemian index", derived from observed preferences of creators and providers of artistic and cultural amenities, revealing a strong connection with the concentration of human capital and innovation. Florida [58] also considers the role of tolerance, by means of a gay index, as a key source of attractiveness of the creative class. Furthermore, Shapiro's [48] in-depth exploration into regional productivity growth sheds light on the multifaceted contribution of college graduates to employment growth. It becomes apparent that approximately 60 percent of the employment growth attributed to college graduates can be attributed to an increase in productivity, with the remaining portion arising from the improvement in the overall quality of life within the region.

The work of Faggian and Royuela [61] provides an in-depth analysis regarding the effects of subjective quality-of-life indicators on inter-provincial migration taking the example of the Barcelona metropolitan region. More specifically, their findings suggest some notable quality-of-life elements encompassing sports, cultural amenities, educational resources, efficient public transportation, and reduced congestion. They also highlight that the identification of quality-of-life aspects that exhibit diverse spatial distribution patterns, consequently wielding a greater influence on migration patterns, could aid in strategic planning to enhance the provisioning of amenities in specific regions, thereby contributing to a more promising future [61].

SOCIAL NETWORKS

Historically, researchers have treated social networks and spatial mobility as distinct subjects within separate realms of scientific exploration. Nevertheless, certain studies, originating from fields as diverse as sociology, urban planning, and transportation, have converged to shed light on the intricate interrelationship between these two phenomena [62]. Personal social networks possess a distinct spatial embeddedness characterized by robust spatial limitations [63]. In these networks, most interactions and activities predominantly transpire over relatively short distances, primarily cantered around pivotal locales such as residences and workplaces [64, 65]. This inclination is driven by the predominant everyday routines, which find individuals spending most of their time in these routine locales [3]. These spatial and temporal constraints, often referred to as space-time constraints, significantly influence the geographical distribution of activities, the individuals engaged in these interactions, and the duration of these engagements [66]. Although Information and Communication Technologies (ICTs) have to some extent enabled remote

reach and interaction, many interactions still materialize with individuals who are in closer physical proximity [67].

The augmentation of spatial mobility, however, correlates with networks exhibiting a more expansive spatial distribution as information costs decrease to the members of the network. This holds particularly true in the context of residential mobility, leading to increased distances between individuals [68, 69]. Changes in daily activity locations and time allocation may precipitate changes in the composition of personal networks, as the time required to connect with network members plays a role [70]. While core networks tend to maintain stability due to their enduring nature [71], weaker connections, such as those with colleagues, classmates, or neighbours, exhibit less resilience, often perturbed by physical relocations. With the passage of time in new activity locations, these fragile ties are often supplanted by fresh local relationships [72, 73]. The sustenance of these relationships is closely intertwined with the nature of mobility, with permanent residential relocations leading to the establishment of more localized networks. Conversely, short-term movements tend to uphold networks originally formed in an individual's place of origin, thereby rendering networks more spatially dispersed [74].

There are various factors affecting the configuration of personal social networks and spatial mobility. This relationship is notably underscored by **life stages** and **pivotal life cycle events**, often accompanied by residential shifts or alterations in activity locales. Such transitions strongly delineate the significance of distinct activities and relationships in alignment with individual necessities and societal roles [72, 75]. More specifically, throughout an individual's lifespan, family network sizes might exhibit relative stability, but additional roles emerge during specific life stages. Adolescents and children typically cultivate more friendships that cater to individual information-seeking objectives, whilst with the onset of adulthood, individuals become more inclined to invest in closer relationships and pursue emotional fulfilment [76]. The middle-aged cohort often emerges as the most mobile demographic [77], associated with diverse activity spaces [78]. Conversely, older individuals often face a heightened risk of social isolation, rendering their personal social networks crucial contributors to their overall quality of life [79].

Moreover, **colleagues** hold a significant position within personal networks [80], particularly among individuals aged 30 to 40 years [76]. Working professionals, often falling within the age range mentioned, generally engage in a more dispersed range of activities due to the geographical separation between their residences and workplaces [77] or due to job-related travel obligations [81]. Individuals who possess higher occupational, educational, and economic privileges typically exhibit greater spatial mobility [68, 80], leading them to establish networks characterized by a broader spectrum of role-based connections, which may span a wider geographical distribution [82].

At the same time, individuals' network dynamics are notably influenced by their **relationship status**. Unattached individuals generally cultivate more friendships [80], whereas couples tend to gravitate towards befriending other couples [83]. The transition to parenthood, often coinciding with active participation in the labour market, typically leads to a shift in social interactions towards a local context, involving connections with

family, friends, and other families with children [68, 82]. This transition can introduce complexities in terms of spatial mobility, as it involves allocating time to parental responsibilities. Moreover, the need to accommodate the activities and mobility requirements of close family members may lead to increased spatial mobility [84, 85].

Spatial mobility is also affected by the **migration background** (e.g., ethnicity) and **cultural ties** (e.g., language), and eventually the level of integration to a society [86, 87]. People with migration background tend to be more limited by their short-term mobility (e.g., multilocality) between regions in a country partly due to more concentrated social network by ethnicity, linguistic and cultural ties, but also depending on the overall level of integrating to a society [86]. This aspect reflects further to short-term mobility across country borders regarding long-distance commuting and multilocality [87].

Gender disparities further contribute to the configuration of parental networks due to the greater childcare responsibilities typically assumed by women [51]. Women's personal networks tend to exhibit a higher proportion and wider array of kin relationships than those of men [88], and women often reside in closer proximity to members of their networks compared to men [82]. This gender discrepancy is also evident within mobility studies: women generally display reduced spatial mobility and employ cars to a lesser extent than men [84].

Table 3 below summarises some relevant studies/knowledge producers for the case of Europe in relation to spatial mobility and the main factors affecting it, pointing out the key indicators and the data sources that have been used in each case.

Table 3: Existing studies and data sources being used for exploring traditional drivers of spatial mobility in the European context focusing on long-term mobility.

Authors	Main indicators	Data sources
Faggian et al. [44] & Faggian and McCann [89]	Graduates, patents, unemployment, wage, crime rate, jobs, research quality of local universities	HESA (Higher Education Statistics Agency) student leavers' questionnaire providing data on 187,474 university graduates for the year 2000
Williams et al. [90]	Demographics, life satisfaction, employment, education, lifestyle, personality	Large-scale online panel survey, specially commissioned from a major market research organisation, GfK Significance (Belgium). Data collection took place between November 2015 and January 2016, in nine European countries (Germany, Ireland, Italy, Latvia, Romania, Slovakia, Spain, Sweden and UK).

		N = 20,473 non-student respondents aged 16-35.
Bartolini et al. [91]	Demographics education, unemployment, quality of life	Data collected through a quantitative survey on Highly Skilled Migration in Times of Crisis. 6750 valid responses of people who had already emigrated at the time of responding.
Van Mol [92]	Demographics, education, employment, previous international experience abroad, urbanisation level, unemployment rate, GDP, AIC, EU-membership duration	Representative sample of young people aged 16–30 in all member states of the EU, using secondary data from Flash Eurobarometer 395. A multistage random (probabilistic) sample was drawn in each member stat of some 500 individuals who were surveyed through Computer Assisted Telephone Interviews (CATI) in 2014. All EU member states N = 13,078
Otrachshenko & Popova [93]	Demographics, life satisfaction, education, perceived financial situation, employment, past experience, GDP, Gini, unemployment	Eurobarometer Survey for 2008 27 Central and Eastern European (CEE) and Western European (non-CEE) countries, N = 24,232
Van Mol & Timmerman [94]	Family SES, Parent(s) lived abroad, Sibling(s) on exchange abroad, Migration background, international friends in home country, Friends on exchange abroad, Gap year abroad, Live abroad during youth, Independent travels	An iterative and sequential approach, with a quantitative data collection composed of three online surveys, conducted in 2009, 2010, and 2011, and a qualitative data collection (in-depth interviews and focus groups) conducted in 2009–2010, whereby every data collection informed the subsequent ones. 6 EU countries (Austria, Belgium, Italy, Norway, Poland, UK) N = 5654 for online survey and N = 71 for the interviews/focus groups.

Rodríguez-Pose & Ketterer [95]	Regional wealth, living standards, wages, unemployment, social welfare payments, age- and education-structure, natural amenities (temperature, cloudiness, rainfall), cultural amenities	Migration data for 133 European regions during the period 1990-2006. The analysis is based on a combination of NUTS1 and NUTS2 regions. Table 1 for details on data sources and exact definitions of the variables. In order to analyse the attractiveness of European regions for prospective migrants, we estimate static and dynamic panel data models with Hausman-Taylor and heteroscedasticity robust fixed effects techniques
Tranos et al. [96]	GDP, Education, population aged 15-29, language, distance	Online database for the International Migration Statistics (IMS) / data on yearly immigration flows between 32 OECD countries for the period 2000-2009
Hadler [97]	Demographics, education, household size and income, previous moves, occupation type, motives, Size of community, GDP Country, GDP-Gap of Region	Eurobarometer Survey for 2001 15 European countries, 196 NUTS2, N = 7000
Constant & Zimmermann [98]	Age, sex, education, Years Since Migration, employment and marital status, Remit to Home Country, Feel German, citizenship, Number of Years out of Germany	German Socioeconomic Panel (GSOEP) 14 waves from 1984 - 1997 of migrants from the guestworker generation who were not in the military, were over 16 years of age and were successfully interviewed in a given year. The final sample contains 4,613 migrants.
Hönekopp & Mattila [99]	Household economic status, occupational status before migration	Eurostat, United Nations, national studies Centre for Urban and Regional Sociology (CURS) survey 2003, 2005

3.2 EFFECTS OF MAJOR TRANSITIONS ON SPATIAL MOBILITY

The effects of major transitions on spatial mobility have become a focal point of research and analysis, as societies grapple with transformative shifts such as the COVID-19 pandemic, Brexit, and the twin transition involving green and digital transformations. These major transitions have brought about significant disruptions to existing spatial mobility patterns, leading to changes in commuting behaviours, travel preferences, and migration dynamics. The COVID-19 pandemic, with its widespread impact on public transportation and remote work adoption, has reshaped urban mobility and prompted a re-evaluation of transportation systems. Brexit has introduced new complexities to the movement of people and goods between regions, necessitating adjustments in mobility strategies. Meanwhile, the twin transition towards sustainability and digitalization has implications for job accessibility, living conditions, and environmental considerations, influencing the attractiveness and mobility patterns of different regions. Understanding the multifaceted effects of these major transitions on spatial mobility is crucial for policymakers, urban planners, and stakeholders to adapt to new challenges and seize potential opportunities for creating more sustainable and resilient mobility systems.

TWIN TRANSITION

The twin transition, characterized by concurrent green and digital transformations, assumes a pivotal role in shaping the intricate dynamics of spatial mobility. It necessitates a comprehensive reassessment of the interrelationship between regional attractiveness and spatial mobility patterns. The twin transition significantly impacts the drivers and outcomes of spatial mobility, engendering both challenges and prospects for diverse regions. Notably, it presents an opportunity for previously marginalized areas to attract new populations by virtue of favourable living conditions, environmental considerations, and enhanced job accessibility. These shifts in attractiveness and mobility patterns contribute to the emergence of novel equilibria among various forms of mobility, including permanent, circular, and temporary movements. Furthermore, the twin transition exerts profound influences on both "old" and "new" sending and receiving regions, engendering repercussions on demographic patterns, societal dynamics, welfare systems, and the labour market. The exploration of the role of the twin transition in spatial mobility, employing rigorous methodologies, facilitates a comprehensive understanding of the intricate interplay between these transformative processes and regional development.

Starting from the **digital transition** component referring to the adoption of digital means of communication, networking and implementation, changes in how people move, which encompass long, short, and circular movements, play a crucial role in influencing the mobility of assets in a given area. These spatial mobility patterns can be transformed by the adoption of advanced digital communication, management, and collaboration tools, facilitating remote work practices. More specifically, emerging digital platforms have influenced individual decisions concerning work-related mobility due to the fresh possibilities they present for accessing an extended labour market triggering a wide range

of digital externalities [100, 101]. The advancement of technology has played a pivotal role in disconnecting work opportunities from physical locations. This has been facilitated by the rise of remote work tools, which strive to enhance the capabilities of organizations and boost productivity. Consequently, these developments have brought about shifts in patterns of mobility, including the increase of multilocality – a circular mobility behaviour between several places [17]. These changes are evident not only at the urban or metropolitan scale but also on an inter-regional level [102], underscoring how technology can significantly shape the distribution of human capital across different geographical areas, thereby impacting opportunities for development.

An example relevant to the effects of digital transition to spatial mobility is the phenomenon known as "digital nomads." Coined by Makimoto and Manners [103], the term digital nomad underscores the impact of technology in shaping a novel lifestyle where individuals are no longer bound by the constraints of time and place. Consequently, digital nomads are individuals who operate beyond traditional work structures, having the freedom to select their work location, provided they have their laptop and reliable internet access [104]. The tools and methodologies employed by digital nomads commonly centre around effectively prioritizing tasks and managing time, particularly for coordinating meetings across various time zones and arranging synchronous gatherings that involve broad participation [105, 106].

It becomes evident that digital nomadism -and digital transition in general- has ushered in new forms of mobility, primarily cantered around short-term and circular movements. These emerge from the fusion of technological progress across diverse work environments [107]. Schlagwein and Jarrahi [108] highlight four interconnected types of mobility stemming from digital work, including: (i) administrative mobility, arising from working independently; (ii) spatial mobility, involving the choice of work location; (iii) temporal mobility, determining work timings; and (iv) content mobility, driven by the freedom to define work nature and content.

At the same time, the ongoing **green transition**, driven by a global need to mitigate climate change and promote sustainability, holds profound implications for the availability and quality of environmental amenities. Within the European context, the green transition can be understood as a shift towards economically sustainable growth model based on low consumption of natural resources and low-carbon solutions that promote the circular economy and biodiversity[2]. Hence, as societies move towards cleaner and more environmentally friendly practices, the emphasis on renewable energy, efficient resource management, and reduced carbon emissions contributes to the preservation and enhancement of natural ecosystems. This, in turn, plays a pivotal role in safeguarding vital

[2] https://reform-support.ec.europa.eu/what-we-do/green-transition_en

environmental amenities such as clean air, water resources, green spaces, and biodiversity.

As policies and technologies align with the green transition, a potential arises for a harmonious relationship between human activities, spatial mobility, and the environment. Evidence suggests that bottom-up behavioural shifts have the possibility to result to more rapid and widespread adoption of green technologies [109]. This indicates that the green transition can be considered -apart from being strictly a policy framework- as a structural change in individuals' behaviour towards the environment. These green behavioural shifts are closely linked to changing aspects attracting individuals in their location choices, which in many cases include the presence of environmental amenities. Therefore, the green transition aims at addressing pressing environmental concerns not only through the green technologies' perspective, but also through the creation of healthier, more liveable urban and rural environments. This offers communities with an enhanced access to environmental amenities a comparative advantage in terms of attracting individuals with increased green behaviour, which is essential for achieving a broader green transition goal.

In this context, environmental amenities are pivotal in influencing dynamics like urban sprawl and migration shifts [107]. Recent literature trying to shed light on the interaction between residents' mobility responses and local environmental and climate assessments, suggests that a diversified arrangement of land use elements has the potential to encourage longer cycling distances [108, 109], whilst evidence indicates that high levels of green amenities are also related to increased leisure mobility [107]. In their study, Osland et al. [110] identify six distinct amenity variables – ocean view, natural reserves, parks, lakes, retail, and recreational facilities – considering them as intrinsic to nature and green spaces, which are increasingly recognized as significant drivers of urban and rural spatial development patterns.

Following the above, we can say that the green transition intersects with spatial mobility patterns through the channels of sustainable urban planning and improved transportation systems, given that both facilitate easier access to green spaces and promote eco-friendly modes of spatial mobility. Therefore, differences between regions in terms of existing environmental amenities may result in economic disparities within both communities and landscapes, leading affluent households to reside in regions boasting higher levels of environmental amenities and superior public services [111]. More precisely, the increase in per capita income aligns with a heightened desire for larger housing accommodations, which are often scarce and costly in central urban areas.

Additionally, there's a growing preference for environmental amenities situated in less congested and more natural surroundings [110]. Advancements in transportation and communication technologies have diminished the relevance of proximity to workplaces as a determining factor in residential choices. The proliferation of automobiles and substantial investments in road and public transport infrastructure have facilitated extended commutes [112]. The environment holds pivotal significance in this context, as it is both a driving force and an outcome. On one hand, the demand for environmental amenities in

residential zones is steadily increasing. Conversely, as urban expansion encroaches upon these areas, the availability of such amenities becomes compromised.

When exploring the **twin transition** context, we should embed aspects related to both digital and green transitions. More specifically, it is important to investigate the role of ICTs in the formation of migration flows, whilst at the same time, focus should be placed on the ways in which enhanced job access through remote working will affect individual decisions and preferences in relation to spatial mobility choices considering the importance of location-based environmental amenities. Up to the authors' knowledge, there is still no previous study that investigates the role of both digital and green transition on spatial mobility choices.

COVID-19

The outbreak of the COVID-19 pandemic has brought about unprecedented disruptions to spatial mobility patterns worldwide as it reshaped the way we live, work, and move. As governments and health authorities responded with measures to contain the spread of the virus, various restrictions on movement, travel bans, and social distancing protocols were implemented. These measures significantly impacted both domestic and international spatial mobility, affecting commuting, tourism, business travel, and migration. With the widespread adoption of remote work and virtual interactions, there was a notable shift in spatial mobility patterns, leading to reduced commuter flows, changes in urban mobility, and altered urban-suburban dynamics. Moreover, the pandemic-induced economic downturn influenced mobility choices, with many people refraining from long-distance travel and opting for local or regional destinations.

Starting from the urban level, the COVID-19 pandemic had a profound impact on mobility, with significant changes observed across various modes of transportation [110]. **Public transportation** experienced a sharp decline in usage as lockdown measures and teleworking became widespread, and people avoided mass transit due to infection fears. Operators faced the challenge of implementing new hygiene protocols and adjusting operations to regain passengers' trust [111]. In response to the reduced demand and financial distress, services and available routes were curtailed, leading people to explore **alternative mobility options**, including the use of private cars, shared mobility services, and active mobility such as cycling and walking [112]. However, not everyone had the opportunity to shift to sustainable modes, and this shift could potentially marginalize individuals in economically disadvantaged areas who rely on public transportation for essential commutes to jobs that cannot be performed remotely [113].

Conversely, the pandemic also witnessed a **rise in sustainable individual mobility modes**, such as walking and cycling, with significant increases in bicycle sales and usage reported in various regions [114]. Governments and policymakers have accelerated their focus on sustainability, exemplified by initiatives like the European Green Deal. However, uncertainties remain about the long-term sustainability of these trends and their environmental impact. Some countries have provided incentives for purchasing hybrid and

electric cars to support the automotive industry, while certain regions in the US have relaxed parking enforcement penalties to encourage car usage [110].

Moreover, another significant shift caused due to the pandemic has been the rise of remote working (RW) as a primary working arrangement for many employees, necessitated by the closure of workplaces during the pandemic [115]. Data from Sostero et al. [115] reveals the prevalence of RW in European countries both before and during the pandemic, with striking disparities. In countries like Sweden, Finland, and the Netherlands, over 25% of the workforce frequently or occasionally worked from home in 2019, whereas Greece, Cyprus, and Italy recorded figures lower than 10%. However, the pandemic brought a dramatic change as RW surged across the board, with over 30% of employees working from home in all EU member states, reaching 40% in Italy. These variations were influenced by factors such as firm size, industry specialization, occupation, and worker skills.

The effects of RW go beyond changing work arrangements. It has made suburban and peripheral locations more desirable as they allow people to adhere to social distancing guidelines and reduce the need for commuting to major metropolitan areas. The question of whether the trend of leaving major cities will persist in the short, medium, or long term is a subject of extensive debate. Studies from various sources [116–119] explore the evolving dynamics in cities such as San Francisco, New York, Los Angeles, Milan, Lombardy, and Spain, revealing both the increase in remote work and shifting migration patterns.

Gokan et al. [120] underscore two major implications of RW for cities: it creates a divide between skilled and unskilled workers and allows skilled workers to relocate to suburbs or smaller cities where housing is more affordable. Ramani and Bloom [121] quantify the impact of COVID-19 on migratory trends and local real estate markets, leading to a "Donut Effect" with a migration of activity from city centres to suburban rings. Althoff et al. [116] find that workers in business service-dominant areas during the pandemic moved to less densely populated regions. Willberg et al. [122] showcased in Finland that people moving from cities to rural regions was linked to multilocal living as they relocated to second homes during the pandemic.

Delventhal et al. [117] analyse the Los Angeles metropolitan region, where jobs moved to the city centre while residents relocated to peripheral areas, causing decreased traffic congestion, shorter commutes, and shifting real estate prices. The study by Gurrutxaga [123] in Spain reveals a reverse trend, with a rise in rural residents and their share in the overall population. The studies by Mariotti et al. [119] and Gorrini et al. [118] highlight how the attractiveness of Milan neighbourhoods shifted during the pandemic, with daytime visitors decreasing in the city centre but increasing in peripheral districts.

Di Matteo et al. [124] investigate the propensity for remote working and identify factors like gender, relationship status, education level, and employment type influencing the decision to work from a different location. Nonetheless, the literature consistently emphasizes that while remote work has transformed spatial mobility, it is unlikely to halt

the ongoing urbanization and the economic importance of cities. The concentration of human capital, resources, and the dynamic atmosphere of cities remain vital drivers of innovation, creativity, and economic growth, especially for knowledge-intensive occupations.

BREXIT

The departure of the United Kingdom from the European Union, known as Brexit, has had significant effects on spatial mobility, reshaping patterns of movement and migration between the UK and EU member states. As a result of the new regulations and trade agreements, there have been notable changes in the freedom of movement for people and goods. The end of the free movement of people has implications for both EU citizens wishing to live and work in the UK and UK citizens seeking opportunities in EU countries. These changes have impacted various sectors, including tourism, business travel, and academic exchanges, and have introduced complexities in cross-border mobility. Additionally, trade disruptions and changes in customs procedures have influenced the movement of goods, affecting supply chains and logistics. Understanding the effects of Brexit on spatial mobility is essential for assessing its implications on regional development, labour markets, and overall economic activity. Policymakers and stakeholders must navigate these new dynamics to effectively address the challenges and opportunities arising from the post-Brexit mobility landscape.

4 IMPACT OF MOBILITY ON REGIONAL DEVELOPMENT, RURAL DEVELOPMENT AND SUSTAINABILITY

This section aims at providing a more in-depth analysis regarding the potential impacts of spatial mobility on three critical dimensions of development, namely regional development/inequality, rural development and sustainability, as they have been identified through existing literature.

4.1 IMPACT OF MOBILITY ON REGIONAL DEVELOPMENT

Spatial mobility has a significant and wide-ranging impact on regional development, exerting influence over various facets including socio-economic dynamics, demographic trends, and the overall trajectory of regional growth. The movement of individuals, goods, and ideas across different geographical areas facilitates the exchange of knowledge, resources, and cultural diversity, thereby fostering innovation and bolstering economic vitality. Notably, spatial mobility plays an important role by introducing new skills, labour, and entrepreneurial talent to regions, thereby enhancing workforce diversity and boosting overall productivity [44]. This influx of fresh perspectives and expertise not only enriches the pool of human capital but also contributes to a dynamic exchange of ideas and innovation within the local economy. As migrants bring their unique experiences and knowledge, they foster a cross-fertilisation of cultures and practices that can lead to novel approaches to problem-solving and business development [125, 126]. The injection of diverse skill sets often addresses labour shortages in specific sectors, fostering growth and specialization [127, 128]. This synergy of talents and capabilities not only accelerates economic progress but also contributes to the resilience and adaptability of regions, enabling them to thrive in an increasingly interconnected and competitive global landscape [129].

At the same time, spatial mobility enables the efficient flow of goods and services, **fostering trade and promoting regional economic integration**. By facilitating the movement of products across geographical boundaries, spatial mobility enhances market access for businesses, encourages specialization, and expands the reach of industries beyond their immediate locality [130]. This interconnectedness leads to the creation of economic networks that transcend local limitations, strengthening economic ties between regions [131]. Moreover, as spatial mobility improves transportation infrastructure and logistics, it reduces barriers to trade, lowers transaction costs, and bolsters the competitiveness of industries in global markets [132]. The seamless movement of goods not only drives economic growth but also encourages collaboration and knowledge exchange among diverse regions. This convergence of economic activities fosters the sharing of best practices, technological advancements, and innovative ideas, creating a virtuous cycle of development that benefits participating regions [133].

By facilitating access to markets, employment opportunities, and specialized services, spatial mobility significantly **shapes patterns of urbanization** and **influences the spatial**

distribution of economic activities. The ease with which individuals and goods can move within and between regions drives the formation and expansion of urban centres, as people are drawn to areas offering diverse economic prospects and improved quality of life. This urban agglomeration is further intensified by the concentration of businesses, industries, and services that benefit from the proximity to skilled labour, potential customers, and essential resources [134, 135]. As a result, spatial mobility serves as a catalyst for the development of vibrant urban hubs that drive economic growth and innovation. Moreover, spatial mobility has an impact on the allocation of economic activities across a region. Accessibility to transportation networks and the ability to swiftly transport goods lead to the establishment of specialized economic clusters in specific locales [136, 137]. This phenomenon is exemplified by industrial parks, technology districts, and commercial zones that emerge around well-connected transportation nodes. Conversely, regions with limited mobility infrastructure may experience a dispersion of economic activities, resulting in a more scattered pattern of development.

Nonetheless, it is crucial to acknowledge that the impact of spatial mobility on regional development is not homogeneous, as it may **accentuate regional disparities** and pose challenges such as overcrowding, imbalances on infrastructure, and potential strain on social cohesion [138]. While spatial mobility can contribute to the growth of prosperous urban centres, it also has the potential to exacerbate inequalities between regions. As individuals and businesses move towards areas with better accessibility and opportunities, this migration of resources can lead to a concentration of wealth and economic activity in certain places, leaving other regions comparatively disadvantaged [49]. Furthermore, the intensified movement of people and goods can lead to issues such as urban congestion and the overburdening of transportation networks, resulting in environmental degradation and decreased quality of life [139, 140]. Lack of infrastructure, including roads, public transportation, and utilities, can hinder sustainable development and impede the equitable distribution of benefits across regions. Moreover, the rapid influx of people due to spatial mobility can challenge social cohesion and community dynamics. Newcomers may face difficulties integrating into established communities, potentially giving rise to cultural clashes or social tensions [141].

The temporal character of spatial mobility constitutes a determinant in shaping the influence of such mobility on regional disparities. Long-term mobility, exemplified by brain drain, signifies a lasting depletion of highly skilled human capital from a region [142]. This phenomenon imposes constraints on, and in the context of left-behind areas, imperils developmental prospects due to the indispensable role played by knowledge-driven economies [6, 143]. Conversely, short-term and circular forms of mobility, encompassing periodic assignments, weekly and daily commuting, have the potential to confer positive effects upon the area of origin. These forms tend to stimulate information dissemination, network expansion, and innovative endeavours between geographical entities [144].

Overall, we can see that spatial mobility acts as a dynamic force that shapes the evolution of regional landscapes and economic patterns. It propels the rise of thriving urban centres while influencing the concentration and dispersion of industries, thus playing a pivotal role

in the overall socio-economic transformation of regions. However, even though spatial mobility brings opportunities for economic growth and development, a well-rounded approach is needed to manage its potential negative consequences. By promoting balanced regional development, investing in sustainable infrastructure, and fostering social inclusivity, regions can harness the benefits of spatial mobility while mitigating its potential drawbacks. To address these challenges, effective urban and regional planning, investment in infrastructure, and social integration initiatives are essential. Thus, comprehending and effectively managing the multifaceted implications of spatial mobility are essential to promoting inclusive and sustainable regional development.

Figure 1 shows a keyword co-occurrences network using Scopus data deriving from the search terms "mobility" AND "regional development". The network analysis has been performed using the *bibliometrix* tool in R[3]. As we can see, the two search terms are closely related to aspects such as accessibility, regional inequality, convergence, human capital and transport infrastructure. Keywords referring to labour mobility, urbanisation, resilience and sustainable development are also included in this network and seem to be connected to the interplay between spatial mobility and regional development.

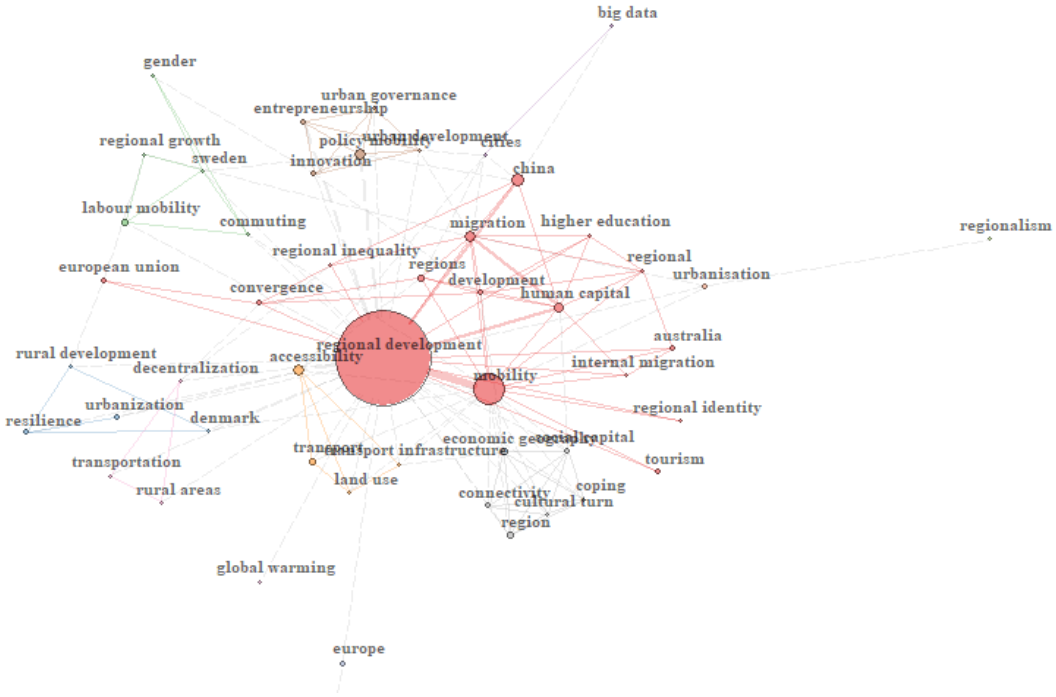

Figure 1: Keyword co-occurrences network using Scopus data deriving from the search terms "mobility" AND "regional development" (N = 490 documents). Source: Authors' elaboration

[3] https://www.bibliometrix.org/vignettes/Introduction_to_bibliometrix.html

Table 4 below presents some relevant studies for Europe focusing on exploring the impacts of spatial mobility on regional development.

Table 4: Existing studies and data sources being used for exploring the impact of spatial mobility on regional development in Europe.

Authors	Main indicators	Data sources
Crescenzi & Rodríguez-Pose [145]	Infrastructure endowment and investment, R&D, GDP per capita, structural regional characteristics, human capital mobility	EUROSTAT NUTS1 regions for Belgium, Germany6 and the United Kingdom and NUTS2 for Austria, Finland, France, Italy, the Netherlands, Portugal, Spain and Sweden.
Boschma & Fritsch [146]	Employment growth, creativity, education, type of profession, population density	Data have been collected during the EU project "Technology, Talent and Tolerance in European Cities: A Comparative Analysis." Data were collected by eight European teams in the 2004- 2006 period based on national data sources that were made comparable between the eight participating countries. For most of the countries, the data are at the level of NUTS III–regions
Haapanen & Karhunen [147]	Age, gender, family status, nationality, spouse's education, income, working conditions, parents' region, unemployment rate	Longitudinal Census Files and the Longitudinal Employment Statistics File constructed by Statistics Finland. Annually updated from the registers and contain a large set of variables spanning 1987 to 2006. A 7% random sample of individuals who were Finnish residents in 2001

4.2 IMPACT OF MOBILITY ON RURAL DEVELOPMENT

When it comes to rural development, spatial mobility holds a considerable role, exerting profound influences on the social, economic, and demographic dynamics of rural areas. The movement of individuals, goods, and ideas into and out of rural regions significantly shapes the trajectories of their development. In terms of population, spatial mobility in rural areas can lead to both inflows and outflows of people.

In the first case, **inflows of individuals**, such as migrants or retirees seeking a rural lifestyle, bring forth fresh skills, labour, and entrepreneurial activities, revitalizing local economies and fostering job creation [148]. The arrival of new residents injects diversity into rural communities, infusing them with innovative ideas and expertise that can contribute to the development of new businesses and the expansion of existing ones. Additionally, the presence of newcomers can stimulate demand for various goods and services, leading to the establishment of markets and enterprises that cater to evolving preferences and needs [149]. Moreover, the migration of retirees to rural areas can have multiple positive effects. Retirees often possess valuable experience and knowledge gained from their previous careers, which they can share through mentorship and engagement in local projects [150]. This intergenerational exchange of insights can lead to skill transfers and the cultivation of a learning environment within rural communities. Despite of its temporal nature, urban dwellers with a multilocal lifestyle residing temporally in rural areas can bring economic, cultural and technological boost to the region [151]. However, it's important to recognize that while inflows of people can bring considerable benefits, they may also introduce challenges related to local culture and customs, land use, housing availability, and strains on existing infrastructure.

At the same time, **outflows of people** from rural areas can have varying consequences, often posing challenges to the sustainable development and vitality of these regions [152]. The departure of young individuals seeking better educational and employment opportunities in urban centres can lead to a significant loss of human capital within rural communities. This brain drain can hinder the growth of local industries, limit innovation, and impede the diversification of economic activities [153, 154]. Furthermore, the decreasing population in rural areas can exert pressure on local infrastructure and services, potentially leading to the closure of schools, healthcare facilities, and other essential amenities. This decline in services can create a vicious cycle, further deterring residents and businesses from staying or settling in these regions [155]. In addition, the outmigration of younger generations can contribute to an aging population in rural areas. This demographic shift can pose challenges to social support systems and limit intergenerational interactions, potentially impacting community cohesion and well-being [63]. However, it's essential to recognize that not all outflows result in negative consequences. Some individuals who leave rural areas for urban centres may gain valuable skills and experiences, which they could potentially bring back to their communities in the future through circular migration [156, 157]. Moreover, in cases where

outflows are managed through strategic planning and policies, they can help alleviate population pressure and facilitate the regeneration of rural landscapes [153].

In addition, spatial mobility plays a pivotal role in influencing economic development by facilitating the **flow of goods and services**, improving market access for rural producers, and enabling participation in regional and global value chains [63]. By reducing transportation barriers, spatial mobility enhances the reach of rural products to broader markets, expanding income opportunities for producers and bolstering their economic resilience. Furthermore, enabling rural communities to engage in regional and global value chains, is essential for their products to be integrated into larger supply networks. This integration not only exposes producers to diverse markets but also exposes them to technological advancements, best practices, and knowledge-sharing that can enhance the quality and competitiveness of their goods [63].

However, challenges such as inadequate transportation infrastructure, connectivity gaps, and transportation costs can hinder the potential benefits of spatial mobility for rural areas. Strategic investments in rural transportation networks, coupled with policies that support equitable access and sustainable mobility solutions, are crucial to ensuring that spatial mobility becomes a driving force for balanced and inclusive economic development across regions [153]. Understanding the nuanced impact of outflows from rural areas is crucial for designing effective policies that address the challenges while harnessing the potential benefits [153]. Encouraging a balance between rural and urban opportunities, retaining local talent, and fostering sustainable economic growth are key considerations in shaping the outcomes of spatial mobility from rural regions.

Figure 2 shows a keyword co-occurrences network using Scopus data deriving from the search terms “mobility” AND “rural development”. The network analysis has been performed using the *bibliometrix* tool in R[4]. As we can see, the two search terms are closely related to aspects such as sustainability, resilience, social capital, governance and second home. There is also a significant strand of literature related to e-mobility and electric vehicles that relates to these two terms, indicating the close interaction between transport infrastructure and rural development, that has been previously highlighted.

[4] https://www.bibliometrix.org/vignettes/Introduction_to_bibliometrix.html

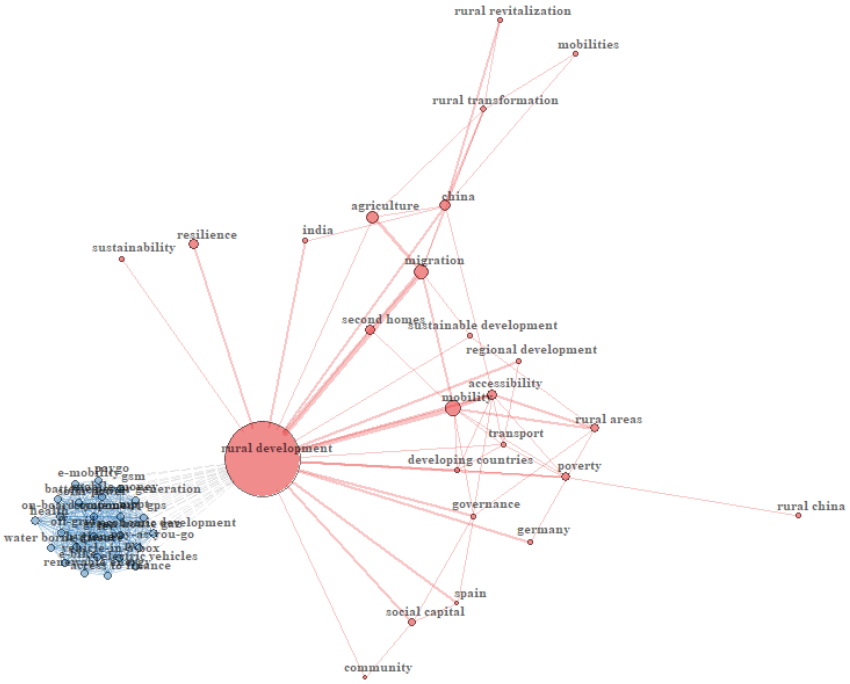

Figure 2: Keyword co-occurrences network using Scopus data deriving from the search terms "mobility" AND "rural development" (N = 362 documents). Source: Authors' elaboration

Table 5 below presents some relevant studies in Europe focusing on exploring the impacts of spatial mobility on rural development.

Table 5: Existing studies and data sources being used for exploring the impact of spatial mobility on rural development.

Authors	Main indicators	Data sources
McGarry et al. [157]	Age, sex, civil status before migration, education, employment before migration, occupational status before migration, motivation related variables (economic/education/family), Country of birth, type of region before migration, type of country of current residence,	Data collection for a large-scale online survey took place between November 2015 and March 2016, in nine European countries (receiving countries: the United Kingdom, Sweden and Germany; sending countries: Latvia, Romania, Slovakia and countries of both emigration and immigration: Ireland, Italy and Spain) N = 30,012 respondents, aged 16–35 H2020 YMOBILITY project

Venhorst et al. [154]	Age, sex, graduation grade, born in another EU country or outside EU, sector of studies, regional economic growth, unemployment rate HE, number of higher and scientific jobs	Data from the 2003–08 waves of the HBO- and WO-Monitor, a representative micro dataset on recent Dutch graduates (over the period 2003–08).
Bijker & Haartsen [158]	Age, types of rural areas, Landscape characteristics, Type of agriculture, Accessibility, Employment in recreation-related services, Sociocultural characteristics, Socio-economic characteristic	Housing Research of the Netherlands (WoON 2009)
Rye & Slettebak [159]	Type of industry, unemployment, higher education, Norwegian-born net migration, Birth surplus, refugees, population	Norwegian register data at municipality levels 426 Norwegian municipalities

4.3 IMPACT OF MOBILITY ON OTHER ASPECTS OF SUSTAINABILITY

In relation to other aspects of sustainability, the impact of spatial mobility assumes paramount importance, as it involves the intricate interplay between human mobility patterns and the environmental, social, and economic dimensions of well-being. Given that in the previous sections of this report we focused on exploring the links between spatial mobility and regional and rural development, which can be perceived as key aspects of sustainable development, in this section we choose to focus on a more transportation-oriented approach on sustainability, which is another essential part of this broad term.

Spatial mobility, encompassing migration, commuting, and trade flows, bears implications for resource efficiency, land management, and the carbon footprint associated with transportation [160, 161]. A sustainable approach to spatial mobility necessitates the **promotion of transportation modes that minimize environmental degradation**, including the encouragement of public transportation, cycling, and pedestrianism, while mitigating reliance on private vehicles [161]. By prioritizing these eco-friendly alternatives, we can reduce air pollution, ease traffic congestion, and lower carbon emissions, contributing to cleaner and healthier urban environments. Embracing public transportation networks, cycling infrastructure, and pedestrian-friendly urban planning not only

enhances mobility but also fosters a sense of community, reduces energy consumption, and improves public health [162]. Embracing technological advancements in transportation to reduce emissions and resource consumption is crucial in this case [163].

At the same time, sustainable spatial mobility underscores the significance of **compact urban planning** to curb urban sprawl, optimize land usage, and preserve natural habitats and agricultural areas. By designing cities with a focus on compactness, more walkable neighbourhoods can be created, reducing the need for extensive transportation networks, and limiting the encroachment on vital green spaces [164]. Compact urban planning not only minimizes the environmental footprint of our cities but also enhances the efficiency of transportation systems, making sustainable modes of mobility like public transit and cycling more accessible and attractive. Furthermore, it fosters a sense of community and connection among residents, promoting a higher quality of life and a healthier balance between urban development and the preservation of natural resources [164, 165].

In relation to the planning perspective, **Transit-Oriented Development** (TOD) offers an additional way in which mobility patterns interact with the sustainability approach. TOD can be defined as a form of urban planning that prioritizes the convenience and desirability of sustainable transportation methods while optimizing the efficiency of transport services through the concentration of urban development around transit stations [166]. TOD is a concept in urban planning that advocates for the establishment of vibrant, sustainable, and attractive communities cantered around public transportation systems, often consisting of bus and rail networks. Its primary objective is to diminish the dependence on private cars, alleviate traffic congestion, improve accessibility, and foster a sense of community and environmental sustainability. TOD contributes to environmental sustainability by reducing greenhouse gas emissions, air pollution, and urban sprawl. It minimizes the necessity for lengthy car commutes, which can result in decreased traffic congestion and a smaller carbon footprint [166].

Moreover, a sustainable mobility approach seeks to **ensure equitable access** to vital services, amenities, and employment opportunities across regions, fostering social inclusivity and reducing regional disparities [167]. When transportation systems are designed with a regional perspective, they become powerful tools for enhancing the lives of individuals residing in various areas. Improved connectivity between urban centres and rural communities serves to bridge geographical divides that often separate regions from crucial resources and economic prospects [168]. This approach not only lessens the financial burden of long-distance transportation on individuals and communities, but also strengthens regional bonds by facilitating the exchange of goods, services, and knowledge, ultimately fostering economic growth and a more equitable distribution of resources. In this way, spatial mobility acts as a catalyst for a sustainable regional development and social progress, striving for a fairer and more interconnected society where each region can prosper.

In addition to the previous aspects, there is a close multifaceted relationship between spatial mobility and sustainability through the notion of **teleworking**, which has been widely enhanced during the last few years with far-reaching implications. Teleworking,

which enables individuals to perform their jobs remotely, has the potential to significantly reduce the need for daily commuting and thus mitigate the environmental impact associated with traditional transportation modes [169]. By allowing employees to work from home or in closer proximity to their residences, teleworking can ease congestion, lower carbon emissions, and lessen the strain on transportation infrastructure. This, in turn, contributes to more sustainable spatial mobility patterns, as the reliance on private vehicles decreases [169, 170]. Furthermore, teleworking promotes a flexible work environment, which can lead to a reduction in the demand for office space and, in some cases, contribute to the development of decentralized work hubs, thus fostering a more balanced distribution of economic activity across regions [170, 171]. However, it's essential to strike a balance that ensures that teleworking is accessible to all, avoids potential negative social consequences, and addresses challenges related to the digital divide, as they have been previously described.

Figure 3 shows a keyword co-occurrences network using Scopus data deriving from the search terms "mobility" AND "sustainability". The network analysis has been performed using the *bibliometrix* tool in R[5]. As we can see, the two search terms are closely related to aspects such as urban mobility, public transport, climate change, urban planning, and smart cities. Keywords referring to accessibility, travel behaviour, shared mobility and electric vehicles are also included in this network and seem to be connected to the interplay between spatial mobility and sustainability. Table 6 below presents some relevant studies in Europe focusing on exploring the impacts of spatial mobility on rural development.

Table 6: Existing studies and data sources being used for exploring the impact of spatial mobility on sustainability in Europe.

Authors	Main indicators	Data sources
Elldér [170]	Telework full day, Telework part day, binary indicator of whether or not the respondent reported one or more trips, total number of trips, total distance travelled, total distance travelled by car, mode of travel, Rush-hour, age, gender, income, education	micro-data from the recurrent Swedish National Travel Survey (RVU), which has studied a randomized and representative cross-section of the Swedish population

[5] https://www.bibliometrix.org/vignettes/Introduction_to_bibliometrix.html

Melo and de Abreu e Silva [172] de Abreu e Silva and Melo [173]	Ordinal (home-based telework frequency) Separate analysis for one- and two-worker households, Travel distance and number of weekly trips by car, active modes, and transit	UK National Travel Survey (2005–2012)
de Vos et al. [174]	Binary (telecommuter or not), ordinal (telecommuting days per month), and continuous (average weekly hours working from home), Commute time	Dutch Labour Supply Panel (2002–2014)

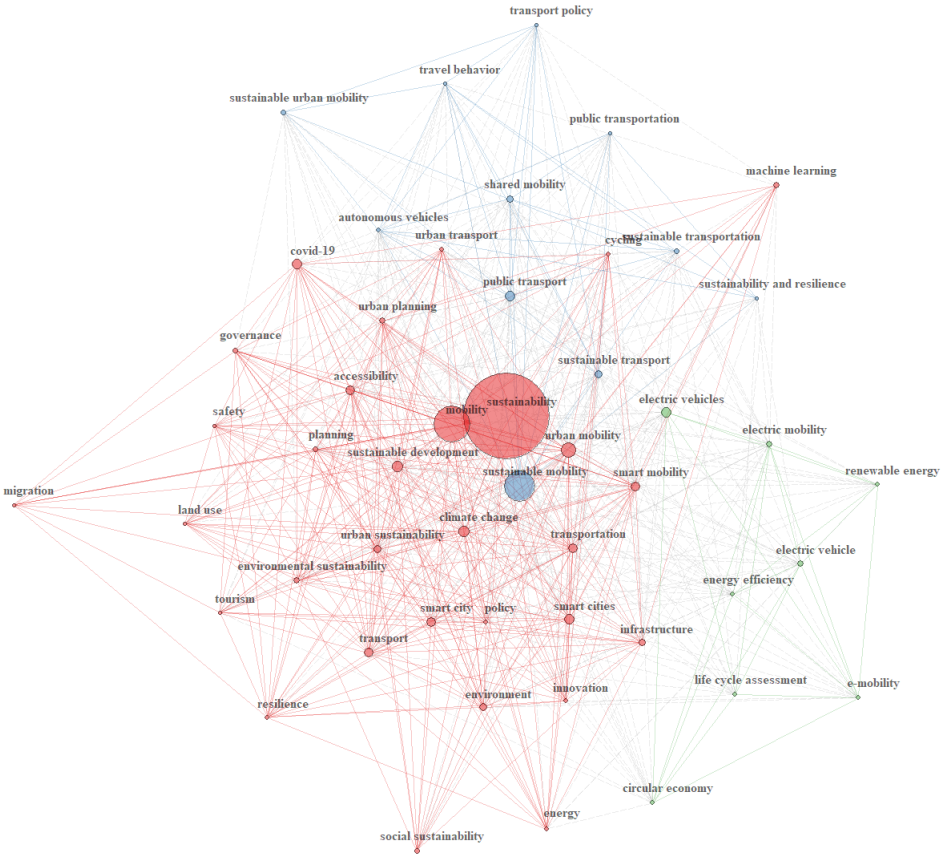

Figure 3: Keyword co-occurrences network using Scopus data deriving from the search terms "mobility" AND "sustainability" (N = 6,138 documents). Source: Authors' elaboration

5 DEMOGRAPHICALLY DECLINING AND LEFT-BEHIND AREAS

5.1 GENERAL CONTEXT

Beginning from economically disadvantaged and declining regions, these locales have garnered minimal attention within urban and regional studies in recent decades [175, 176]. While rooted in distinct intellectual lineages and marked by differing conceptual orientations and economic comprehension, prominent theoretical paradigms like the New Economic Geography (NEG), urban economics, and Evolutionary Economic Geography (EEG) have predominantly cultivated narrow, growth-centric interpretations of the economy and economic strategies. These perspectives accentuate facets such as growth, competition, agglomeration, and innovation [177–179], often favouring regions characterized by heightened competitiveness, dynamism, and superior levels of innovation and productivity. Consequently, these theories tend to divert theoretical focus from areas grappling with economic lag and decline [176, 180]. Nonetheless, research with empirical and policy implications concerning regions facing economic decline, particularly former industrial hubs, endures [181–183]. This persistence underscores their sustained relevance as targets of spatial policies, endorsed by subnational, national, and supranational entities, that generally aim to stimulate amplified growth, innovation, and entrepreneurial endeavours [184], often guided by overarching concepts like 'smart specialization' and frequently shaped by the experiences of more prosperous regions [185]. However, the limitations of the 'growth turn' in policy and the inadequacies of current approaches for 'left behind' regions highlight the urgency for a fresh policy framework that affords a more robust foundation for comprehending and addressing the challenges encountered by these territories [186].

The term 'left behind' regions has gained prominence as a component of the geography of discontent [187]. It has been utilized by various stakeholders to characterize economically lagging and deteriorating areas, especially former industrial and rural regions, which have articulated sentiments of marginalization and neglect through increased support for populist parties and movements [176, 188]. The emergence of these regions as focal points of dissatisfaction reflects the accentuation of social and spatial disparities in the decade succeeding the global financial crisis, particularly evident in the United States and the United Kingdom [180, 189]. A convergence of economic uncertainties, declining living standards, concerns regarding future prosperity, and cultural grievances has culminated in a populist reaction against elites and mainstream establishments, particularly emanating from 'left behind' individuals and locales [190, 191]. The term 'left behind' conveniently encapsulates and resonates with academics, politicians, and policymakers worldwide, due to its economic and political significance [175].

Essentially, 'left behind' regions signify a modern manifestation of long-standing patterns of uneven geographic development [192]. This construct builds upon historical

terminologies that have expressed such uneven development using terms like 'disparities,' 'divides,' 'gaps,' and 'imbalances' [193, 194]. Policy reactions to address the challenges faced by these regions encompass concepts like 'no place left behind' in the US [195] and the narrative of 'levelling up' in the UK [196]. These articulations are also part of a broader historical context of regional policies aimed at objectives such as mitigating geographical disparities, bridging divides, pursuing catch-up mechanisms to eliminate gaps, and spatial rebalancing [197, 198].

However, the concept and analytical framework of 'left behind' regions are susceptible to inherent ambiguities in its definition. Frequently, the entities or locations that are 'left behind', and more importantly, what they are being 'left behind' in, remain imprecise. A multitude of dimensions are highlighted, encompassing economic hardship, restricted employment prospects, social and cultural isolation, political disregard, reductions in public amenities, and infrastructural investments [190]. Depending on the national context, the spatial scales at which 'left behind' regions manifest can span various units such as regions, towns, and neighbourhoods [199]. The duration and timeframes across which 'left behind' regions are assessed and articulated also exhibit diversity. The agents or factors contributing to the condition of 'leaving behind' these regions are not consistently articulated beyond vague powerful entities and institutions, along with a blend of interrelated causes encompassing globalization, technological shifts, and the expansion of metropolitan areas [175]. Often, the emergence of 'left behind' regions is conceived within the framework of relational processes involving metropolitanisation, marked by the concentration of businesses and workforce within major cities, and peripheralization facilitated by mechanisms such as emigration, disconnection from infrastructure and knowledge networks, reliance on larger cities for resources and services, and discursive marginalization [200]. Consequently, it becomes imperative to explore the ramifications that unfold when the forces of metropolitanisation and peripheralization intersect with the regions that have been left behind.

Both research and policy frequently portray migration as akin to an escalator [201], a path that inherently transports individuals towards economically thriving urban centres or regions abundant with job prospects [202, 203]. Despite recent attention to the "less-popular" rural locales [204, 205] that underscore alternatives to the conventional narrative of counter-urbanization [206], the narratives concealed within migrant trajectories that might seemingly depict a socio-economic "downshift" remain rarely recounted and even less probed for insights into the intricate interplay of class and socio-economic disparities. Prevailing depictions of migration destinations and motivations have been challenged by research exploring counter-urbanization [207], lifestyle migration [208], and emerging immigration hubs for international migrants [209]. Especially noteworthy is the lifestyle migration literature's spotlight on non-economic motives for relocation, aligned with counter-urbanization scholars' exploration of the "rural idyll" [207]. In these studies, the mobility of the middle class is both enacted [210] and manifested [211]. Nonetheless, these inquiries have often cantered around desirable destinations, with the spatial inequalities behind these movements (and facilitating them) remaining largely unaddressed, aside

from acknowledging that migrant lifestyles are sustained by earnings earned elsewhere. In contrast, nascent investigations into "new" immigration destinations have contemplated "frequently improbable places ... [and] unfamiliar patterns of movement" [212], accentuating "less-popular" locales. However, these inquiries have yet to grapple with the lifestyles catalysed by migration to such regions.

When considering a regional perspective, 'left behind' regions should be recognized as a focal point within the research agenda of a redefined field of urban and regional studies, emphasizing regional fairness [180]. While its analytical precision might be lacking, the term encapsulates a pivotal facet of contemporary spatial inequalities [175, 176]. It signifies locations grappling with economic stagnation or regression, particularly erstwhile industrial regions and rural zones marginalized due to the concentration of skilled knowledge-based jobs in urban centres [184, 189]. The notion of 'left behind' regions is multi-dimensional, encompassing more than just economic dimensions and extending to social, demographic, political, and cultural concerns. Noteworthy defining attributes encompass: relative economic underperformance and decline, manifested through below-average wages, employment, and productivity; diminished educational qualifications and skills; elevated levels of poverty and disadvantage in comparison to national averages; population out-migration, aging, and demographic contraction; subpar health indicators; inadequate connectivity and investment in social and economic infrastructure; reduced provision of services; political disengagement, negligence, and dissatisfaction; as well as a dearth of community amenities and civic assets [196, 213, 214]. Although not all these characteristics will be universally evident in every 'left behind' region, it is the amalgamation of economic hardship, reduced living standards, population attrition, limited infrastructure, political negligence, and disengagement that collectively define a region as 'left behind'.

5.2 FACTORS RELATING SPATIAL MOBILITY TO DEMOGRAPHICALLY DECLINING AND LEFT-BEHIND AREAS

A multitude of significant factors underpin the interplay between spatial mobility and demographically declining and left-behind areas, providing insights into the underlying dynamics and challenges faced by these regions. Primarily, the patterns of spatial mobility exert a pivotal influence on population dynamics, as the outmigration of younger individuals seeking enhanced educational and employment prospects elsewhere contributes to population decline within these areas, resulting in an aging demographic structure and a contracting labour force. Additionally, the limited availability of job opportunities and economic prospects acts as a deterrent to attracting new residents and businesses, perpetuating the cycle of decline. Furthermore, spatial disparities and inequalities in accessing vital services, such as healthcare, education, and transportation, erect obstacles to mobility and impede the socio-economic advancement of these regions. Moreover, the concentration of poverty and social deprivation in specific localities engenders a sense of marginalization and curtails social mobility for the inhabitants. A comprehensive understanding of these factors is vital for formulating targeted policies and

interventions that can effectively reverse population decline, foster economic growth, and enhance the overall well-being of demographically declining and left-behind areas.

MacKinnon et al. [186] in their analysis identify a set of conventional and alternative factors that can be used as a baseline for defining left behind places, focusing both on economic and social aspects. Traditional economic factors related to GDP/GVA growth, increased productivity, technological innovation and hard infrastructure can be replaced by variables inspired by post-growth and livelihoods approaches, as well as social economy aspects. Moreover, common social factors for identifying left behind areas, such as employment/employability, ability to spread the benefits of technological innovation and amenities, can be replaced by elements related to wellbeing and belonging, social innovation and reproduction, as well as community deployment. In this way, their approach on left behind areas follows a multi-level perspective encompassing the foundational economy, factors related to income and livelihoods, social infrastructure and inclusive innovation [186].

At the same time, Goodwin-Hawkins and Dafydd Jones [215] follow a migration-based approach to reveal aspects related to left-behindedness. In their analysis, the use qualitative methods to reveal factors that drive middle-class migrants (defined by economic, social, and cultural capital) towards peripheral regions to envisage and enact their aspirations. After performing a set of interviews, they identified factors related to migration in less popular regions based on three dimensions: material, relational, subjective. Their findings suggest that affordability in left behind areas is a key element that enables an improved middle-class lifestyle, compared to more popular regions, mostly expressed through lower costs of living, larger properties, shorter commuting and more free time for leisure.

To the authors' knowledge, no studies have considered the twin transition dimension under the context of spatial mobility in left-behind areas. However, efforts have been made towards connecting the concept of the twin transition to more equitable growth considering its potential effects on the left-behind areas. More specifically, Evrard and Schmitt [216] explore the links between the Just and Green European policy frameworks under the Territorial Agenda 2030, highlighting the need for a balanced and sustainable development especially for the left-behind areas. At the same time, Bez and Virgillito [217] highlight the lack of labour reallocation towards greener jobs in left-behind places that hinders the ability of those areas to experience a meaningful twin transition process, triggering out-mobility effects.

6 CONCLUSIONS

The report presented an extended literature review covering the key theoretical elements of the MOBI-TWIN project. More specifically, it sets the baseline for defining the three main **spatial mobility forms** that will be investigated through the project activities: long-term, short-term and circular mobility. Following a territorial perspective, it defines long-term mobility as the movement between regions focusing on establishing a permanent change in residence for at least 12 months. Key life-events related to this type of mobility are international work migration, study abroad, family reunification, retirement migration, asylum seekers and refugees. Moreover, short-term mobility is defined as a temporary movement between regions for limited time (between 3 and 12 months), closely related to specific purpose or objective, such as business travel, short-term work assignments, digital nomadism, internships or traineeships, and sabbatical or academic research. Third, in the case of circular mobility, given its more complex nature, we decided to split it into two key types: the low-frequency circular mobility, referring mostly to return mobility and seasonal working phenomena, and the high-frequency circular mobility, covering short recurring movements between regions happening for a minimum of 3 times within the past year. Life events related to this type of spatial mobility include second homes, international families, long-distance commuting, and cross-border students.

The report also presented a thorough analysis of the **factors acting as push and pull forces of spatial mobility** to and from a region, Specifically, we focused on a three-level perspective of these factors. First, the literature review investigated factors related to the regional economic structure and labour market, exploring the role of regional population size and density, wage disparities, economic activity, unemployment rates, economic cycles, labour market structure, specialisation and complexity. Human capital was also put in the centre of attention because of its essential role in the development of spatial mobility flows. Second, factors related to the quality of life were also identified as triggers of spatial mobility movements, focusing on regional amenities as well as subjective quality-of-life indicators. Third, the role of social networks as triggers of spatial mobility was highlighted, indicating a close connection to the life stages and pivotal life cycle events on their formation. The role of colleagues, relationship status and gender disparities has also been pointed out.

When exploring the **effects of major transitions on spatial mobility**, specific focus has been placed on the twin transition effects, alongside the COVID-19 experience and Brexit. In the former case, the review examined the role of the digital transition to the evolution of spatial mobility flows, due to its ability to influence work practices and the development of networks. At the same time, green transition has triggered factors related to climate mitigation and environmental amenities to act as push and pull factors for spatial mobility. the intersection of these two categories forms the effects of the twin transition on spatial mobility. In the case of COVID-19, aspects related to public transportation, alternative mobility options and the rise in sustainable individual mobility modes are critical factors for increasing attractiveness of a place for newcomers. Brexit effects seem to have reshaped patterns of movement and migration between the UK and EU member states, due to free

movements limitations posed afterwards that have introduced complexities in cross-border mobility.

This report also points out the **potential effects of spatial mobility on regional and rural development**, and broader aspects of **sustainability**, such as transportation. In the case of regional development, spatial mobility effects include aspects of trade, regional economic integration, patterns of urbanization and the spatial distribution of economic activities. In many cases, these impacts indicate imbalances across space resulting in the emergence of regional disparities that pose challenges in infrastructure and social cohesion. Moreover, in the case of rural areas the main effects of spatial mobility include revitalization of local economies through new skills and previous experiences and new job creation. However, outflows of people in these areas are also associated with significant loss of human capital and exert pressure on local infrastructure and services, such as schools, healthcare facilities, and other essential amenities. Thirdly, in the case of sustainability when considered under the transportation perspective, spatial mobility affects the use of transportation modes that minimize environmental degradation, compact urban planning, Transit-Oriented Development, social inclusivity and regional disparities through equitable access to vital services, amenities, and employment opportunities. Finally, spatial mobility effects are closely related to teleworking which provides the potential to significantly reduce the need for daily commuting, mitigating the environmental impact associated with traditional transportation modes.

Finally, a specific focus has been placed on the definition of **left-behind and demographically declining areas** pointing out the importance of effectively embedding them into policy development processes. In this framework, spatial mobility offers a dynamic process forming regional capabilities, especially in terms of human capital and knowledge flows, which is essential to consider in the case of these types of areas. Aspects relating to regional fairness and equitable growth derive as important outcomes of imbalanced spatial mobility flows, relating to population dynamics, labour market opportunities and socio-economic deprivation aspects. When considering the role of the twin transition in the developmental perspectives of left-behind areas, only few studies have been implemented showing the need for an efficient integration of the "just" dimension in the European territorial Agenda 2030, to sustain a balanced growth between EU regions.

Overall, based on the findings of this report **the MOBI-TWIN project will focus on analysing the effects resulting from the various types (long-term, short-term and circular) of spatial mobility on territorial development processes.** A comprehensive approach will be applied when identifying factors that affect spatial mobility flows encompassing economic structure, labour market, quality of life and social networks, alongside considering the effects of major transitions, such as the twin transition and COVID-19. Assessing the effects of spatial mobility should cover aspects related to regional, rural and sustainable development, whereas a specific focus should be placed on left-behind and demographically declining areas by essentially embedding them in policy development processes.

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TWIN TRANSITION AND CHANGING PATTERNS OF SPATIAL MOBILITY: A REGIONAL APPROACH

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