

JĀNIS ZĀLĪTE

Residential restructuring in the age of
digital transition: understanding intra-urban,
metropolitan and counter-urban change



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LIST OF PUBLICATIONS

This thesis is based on four publications, referred to in the thesis by Roman numerals:

- I Tammaru, T., Kalm, K., García Estévez, R., **Zālīte, J.**, & Ubarevičienė, R. (forthcoming). Urban inequalities in the digital age: Labour and housing market restructuring in European capital cities. In K. Kalm, S. Marcińczak, & T. Tammaru (Eds.), *A Modern Guide to Urban Inequality and Segregation in Europe*. Edward Elgar Publishing.
- II **Zālīte, J.**, Kalm, K., Leetmaa, K., & Tammaru, T. (2026). The role of tech workers in ethnicity- and class-based urban segregation. *Nature Cities*, 3(4), 371–379. <https://doi.org/10.1038/s44284-026-00420-4>
- III Tammaru, T., Kliimask, J., Kalm, K., & **Zālīte, J.** (2023). Did the pandemic bring new features to counter-urbanisation? Evidence from Estonia. *Journal of Rural Studies*, 97, 345–355. <https://doi.org/10.1016/j.jrurstud.2022.12.012>
- IV **Zālīte, J.**, Ubarevičienė, R., Bērziņš, M., Kalm, K., Leetmaa, K., Krišjāne, Z., & Tammaru, T. (submitted). Digital transition and settlement system change: Tech workers, life course, and residential differentiation.

Author’s contribution to the publications denoted by: * minor contribution; ** moderate contribution; *** major contribution

	Publication			
	I	II	III	IV
Original idea	*	***	*	***
Study design	*	***	*	***
Data processing and analysis	**	***	**	***
Interpretation	**	***	*	***
Writing the manuscript	**	***	**	***

1. INTRODUCTION

The digital transition is one of the most significant contemporary societal and economic transformations. In its wider definition, the digital transition can be understood as the increasing prevalence of digital solutions across multiple dimensions of life. Through the economic dimension, the far-reaching implications of the digital transition become notable when witnessing the growth of the digital or tech sector. This growth is part of the new economic restructuring, which is characterized by broader labour market trends and changing occupational structures, with professionalisation, or the growth of the managerial and professional class, being recognized as the main global trend (van Ham et al., 2021).

In the context of the digital transition, tech workers employed in the information and communication technology (ICT) sector have emerged as likely frontrunners of digital transition-induced occupational change. They represent a group of highly skilled workers who can benefit most directly from the new opportunities associated with digital transition. Two characteristics of tech workers stand out when compared to other occupational groups, including highly skilled workers in other sectors. First, tech workers earn particularly high incomes driven by the rapid rates of growth of the ICT sector. Second, they possess the highest capacity for remote work (Luca et al., 2025) – a structural shift in the arrangement of work that intensified in the aftermath of the Covid-19 pandemic. The interaction of these two characteristics makes tech workers a particularly relevant group for understanding the socio-spatial effects of the digital transition.

From the occupational perspective, the spatial embeddedness of economic restructuring in the age of digital transition continues to favour urban areas. Cities are the economic engines for high-productivity sectors, such as tech sector, and the agglomeration benefits provided by urban economies further embed tech sector companies in cities. The Covid-19 pandemic recently called into question the lasting power of urban economic cores was more recently questioned by the Covid-19 pandemic, although cities are expected to remain at the forefront of economic development (Florida et al., 2023). Thus, urban labour markets would continue to attract and keep tech workers in cities.

However, the impacts of the digital transition and the associated occupational change are less clear in the residential sphere. Periods of major societal transitions, such as the digital transition, have been considered to affect inter-regional dynamics of population distribution (Bathelt et al., 2024). The digital transition can thus lead to changes in residential mobility, with some arguing for its decrease due to digital opportunities available from home (Cooke & Shuttleworth, 2018), while others suggest that residential relocations would become more widespread as an outcome of reduced commuting constraints (Hostettler Macias et al., 2022). More specifically, the digital transition expands socioeconomic opportunities for tech workers, influencing their residential decision-making – both towards moving and staying. The combined outcomes of residential mobility and in situ

changes can lead to residential restructuring, or fundamental changes in residential geography. Importantly, residential restructuring should be considered across multiple spatial scales. Residential patterns may change within cities, as tech workers realign themselves in the residential space according to their housing and neighbourhood preferences, thus also reshaping urban segregation. Residential restructuring can alter the relationship between cities and suburbs by shifting commuting patterns, worsening urban housing unaffordability and changing the availability of single-family homes. Finally, if remote work sufficiently relaxes the typical constraints linking homes and workplaces, residential restructuring may shift beyond metropolitan regions. This restructuring can occur in two ways: first, through counter-urban residential mobility, with people moving from cities to smaller settlements outside of metropolitan regions (Champion, 2001); and second, through a general decline in new residents moving into urban centres. Furthermore, the intra-urban, metropolitan and counter-urban dimensions of residential restructuring are deeply interconnected, requiring a comprehensive analysis to fully capture their complexity.

Therefore, the fundamental aim of this thesis is to contribute to the understanding of the contemporary residential restructuring process and outcomes by exploring the links between occupational and residential change in the context of the digital transition, with a focus on tech workers. This is considered across multiple spatial scales: urban, metropolitan and counter-urban.

The specific contributions to this thesis vary across the publications. While **Publication I** contains an empirical component, it is fundamentally conceptual. As an integral part of the thesis, it provides the necessary background context for the empirical core presented in **Publications II, III and IV**.

To achieve the aim of the thesis, four research questions are proposed and addressed in the following publications:

1. Through which mechanisms and occupational dynamics is digital transition associated with residential restructuring? (**Publication I, II, IV**)
2. How does tech workers' residential change affect urban segregation? (**Publication II**)
3. What are the metropolitan residential dynamics and the associated differentiating factors between urban and suburban tech workers? (**Publication II, IV**)
4. To what extent does counter-urbanisation characterise the residential restructuring of the highly skilled population, including tech workers? (**Publication II, III, IV**)

This thesis is centred on the case of Estonia, while also providing a comparative framework – with Latvia and Lithuania (**Publication IV**) and also other European capital cities (**Publication I**). The combination of high levels of digitalisation and the overlap between class- and ethnicity-based segregation makes Estonia a fitting case study for investigating residential restructuring in the age of digital

transition. In Estonia, the digital transition has been the core direction of the country's contemporary development, which has resulted in advanced digital solutions seeping into all levels of governance, a model referred to as e-Estonia (Espinosa & Pino, 2025). On the one hand, such comprehensive digital development may expose ethnic disparities between Estonia's ethnic majority and the substantial Russian-speaking ethnic minority (Björklund, 2016), mirroring high levels of segregation already present through residential and occupational dimensions (Kalm et al., 2024; Saar & Helemäe, 2017). On the other hand, entering the tech sector may serve as a trampoline for ethnic minorities towards integration into local labour markets, eventually translating into residential change and ethnic desegregation. Meanwhile, settlement structure, expressed through the level of population centralisation, affects the scope for residential restructuring beyond the capital city metropolitan region, including counter-urbanisation. In Estonia, the Tallinn metropolitan region has a dominant role in the settlement structure, with close to 50% of Estonia's population residing there. Such relatively high level of population centralisation, with a clear gradient between the capital city and the rest of the settlement system, underlines the suitability of Estonia as a case study for studying counter-urbanisation processes.

However, this thesis is not limited to the study of the Estonian case. Instead, part of the thesis is set in a comparative framework, benefitting from the extensive population data infrastructure development that has taken place in the Baltic States (Estonia, Latvia and Lithuania), with individual-level census data – the most comprehensive population data source – being available for research purposes. Such data access enables fine-grained analysis, while the relatively similar historical development pathways and digital transition levels – contrasted with their different levels of centralisation – makes it possible to better isolate the effects of settlement systems on population restructuring. In addition, this thesis builds upon a large-scale comparative study of European capital metropolitan regions (Ubarevičienė et al., 2026), repurposing it for conceptual exploration of urban inequalities in digital transition.

2. THEORETICAL FRAMEWORK

2.1. Conceptual framework: links between digital transition and residential restructuring

The advent of digital technologies has marked a major shift in the dominant economic structures, to the extent that the **digital transition** has been referred to as the “third industrial revolution” (Bathelt et al., 2024). Significant social restructuring as an outcome of the digital transition was also predicted already several decades ago, with uneven effects across different spatial scales (Graham, 2002). As the digital economy has evolved and expanded its reach, the socio-spatial impact of the digital transition has been recognised, with consequences both for urban (Nijman & Wei, 2020) and regional (Bathelt et al., 2024) inequalities. However, the new social dynamics and its spatial manifestation in the age of digital transition remains insufficiently addressed in academic research (McNeill, 2021). In particular, the **residential restructuring** effects of the digital transition have not been clarified in a comprehensive manner, addressing the interplay between cities, suburbs and non-metropolitan areas.

While the digital transition and residential restructuring emerge as connected macro-level processes, the digital transition does not directly exert its influence over residential space. Instead, it is directed through **professionalisation** – another macro-level process, describing the upgrading of the occupational structure through an increase in professionals and managers (Hamnett, 2021). In this way, the mechanisms leading to residential restructuring are also revealed. The digital transition contributes to professionalisation by offering a pool of tech workers to the labour market, providing them with increased salaries and remote work opportunities. Tech workers can then use these benefits to support their residential choices, either by choosing to move or by having the means to remain in the same place of residence. When aggregating the patterns of individual residential behaviour, changes in local population dynamics, expressed through the demographic and socioeconomic composition of neighbourhoods and localities, result in residential restructuring (Coulter, 2023).

While tech workers may have emerged in a particularly favourable position, not everyone benefits equally from the digital transition and occupational change, highlighting the inequalities behind contemporary residential restructuring (Graham, 2002; Nijman & Wei, 2020; van Dijk, 2005). Therefore, while focusing on tech workers remains highly instructive, the overall process of residential restructuring is best understood in reference to other occupational groups – not only highly skilled workers but also the general workforce. In this way, it can be simultaneously observed to what extent the digital transition selectively expands the residential options for tech workers, and how this relates to broader outcomes of residential restructuring.

For detecting intra-urban residential restructuring, segregation provides a useful framework. **Residential segregation** is a process which both reflects and

reinforces the manifestation of inequalities in cities. It is characterised by the spatial differentiation of and between various population groups, which results from the residential sorting of individuals and households based on their preferences and according to their available resources and housing market conditions. The inequality that feeds residential segregation has its roots in income and wealth disparities, generated by the functioning of the labour market, as well as in ethnic hierarchies (Maloutas & Fujita, 2016). Therefore, residential segregation can be broadly distinguished between socioeconomic and ethnic dimensions.

Urbanisation, or population concentration towards cities, has been the defining direction of population dynamics for many decades. However, capital cities are tightly linked with their suburbs. The uneven balance between urban and suburban labour and housing markets is typically expressed through commuting, forming integrated metropolitan regions (Morrill et al., 1999). It can also lead to **suburbanisation**, understood as reconfiguration of population dynamics from cities towards suburbs. In addition to suburbanisation, there are also signs of increasing **counter-urbanisation**, or population deconcentration, in Europe (Rowe et al., 2019). In its classic definition, counter-urbanisation is characterised by population mobility down the settlement hierarchy, away from major urban areas, thus serving as an opposite population trajectory to urbanisation (Champion, 2001). These processes can be considered to operate interchangeably, with spatial equilibrium reached when the migration flows of urbanisation and counter-urbanisation are in balance (Rees et al., 2017). This is further explained by the differential urbanisation model, where counter-urbanisation defines its final stage, when smaller towns are experiencing positive net migration (Geyer & Kontuly, 1993). The dynamics of urbanisation, suburbanisation and counter-urbanisation are mediated by **settlement structure**, with monocentric countries associated with higher rate of residential moves towards the capital city due to spatially concentrated labour markets, whereas in polycentric contexts, the employment opportunities are more widely distributed, reinforcing more even population distribution (Ubarevičienė et al., 2024).

Residential restructuring as a result of changes in residential mobility and in situ change is not linked solely to occupational status. The specific ways in which residential restructuring shapes socio-spatial dynamics interact with various personal and household characteristics, and they are further influenced by more structural factors, such as housing availability. Two fundamental personal-level factors are **life course stage**, represented most directly by age, and **ethnicity**. While young people are traditionally drawn to urban areas for educational and occupational advancement (Fielding, 1992), the digital transition may redistribute the opportunity set available at the early-career stage, increasing the viability of non-metropolitan areas for residence. Meanwhile, population distribution across neighbourhoods and regions is strongly shaped by ethnicity, with tight links between socioeconomic and ethnic segregation (Costa & De Valk, 2018). Yet, the digital transition may also restructure such established ethnic residential patterns, particularly in urban settings, as ethnic minority tech workers acquire

the necessary financial resources to relocate to more preferable neighbourhoods, thus simultaneously contributing to desegregation.

Figure 1 sets out a conceptual framework to capture this research gap, connecting the digital transition and residential restructuring through occupational change. Macro-level processes along digital, occupational and residential dimensions generate micro-level mechanisms, which lead to varied residential outcomes at intra-urban, metropolitan and counter-urban scales, mediated by personal-level factors and settlement structure. The components constituting the conceptual structure, as well as their interactions, are laid out in the rest of the theoretical framework, starting with digital and occupational change.

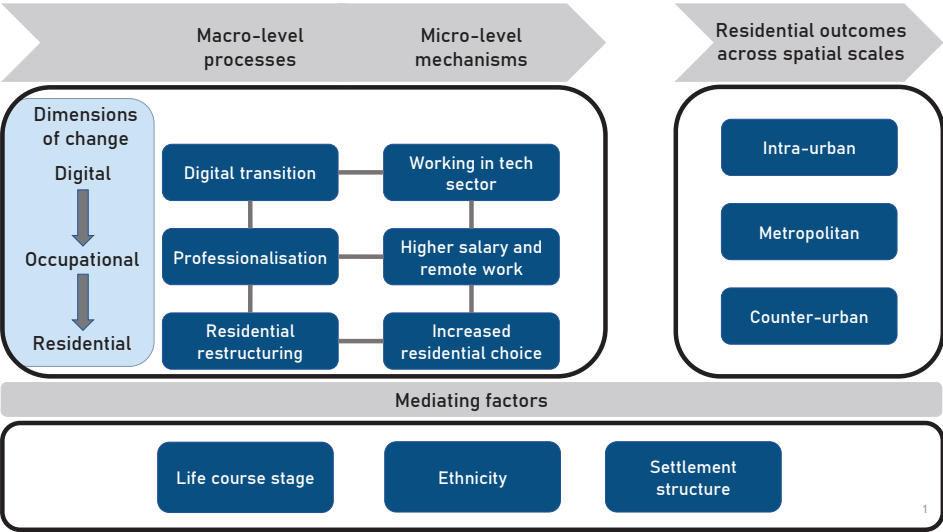


Figure 1. Conceptual framework of the links between digital transition and residential restructuring

2.2. Digital transition and contemporary occupational dynamics

The discourse on contemporary occupational setups and their broader spatial implications largely originates from the global city thesis, proposed by Saskia Sassen (1991). In it, she claims that a dual process of occupational restructuring is taking place in the world's urban economic centres. At the upper level of occupational structure, advanced-producer services generate growth of an elite occupational class of managers and professionals. As a direct outcome of this process, an expansion takes place in the lower-skilled service sector occupations, which are necessary to support the lifestyle needs of the higher-earning residents. Meanwhile, the demand for middle class occupations declines in a post-industrial economy, leading to socioeconomic **polarisation** of the global city.

Since Sassen proposed her thesis, the notion of polarisation of the contemporary occupational structure has been criticised. Hamnett (1994, 2021) has been one of the leading voices in this discussion. His recurring studies show that the shift towards highly skilled occupations is not met by a similar growth in the lower end of occupational structure. Therefore, he contends that the main trend of occupational structure is **professionalisation**, rather than polarisation. This finding is supported by empirical studies across European countries, which find that the most prominent labour market development is the increase in managerial and professional positions (Oesch et al., 2025; Oesch & Piccitto, 2019). While professionalisation has been attributed to global cities, a similar shift in occupational structure is also common in other large European cities (Oesch et al., 2025; Ubarevičienė et al., 2026), where professionals are more connected to local economies (Pratschke & Morlicchio, 2012). Professionalisation in this sense is understood primarily through the occupational lens, yet it also reflects a class dimension, with the upper or cultural middle class representing the main group experiencing growth in cities (Custers & Engbersen, 2022; Oesch et al., 2025). Even though cities are the hotspots of professionalisation, it is a spatially overarching trend, extending even to traditionally agricultural regions of Europe (Morris & Oesch, 2025). Recent scholarship has introduced nuance into the polarisation-professionalisation debate. Specifically, signs of growth of low-skilled occupations has led Hamnett (2024) to term this dual development ‘asymmetric polarisation’, while others describe it as ‘polarised upgrading’ (Oesch et al., 2025). While these studies reaffirm that professionalisation is the prevailing occupational process, they also highlight the inequalities which characterise contemporary labour markets.

Professionalisation of the workforce can be attributed to multiple factors influencing the labour market. In the European context, in addition to the expansion of higher education and increased female labour market participation, technological change as part of the digital transition has a significant role to play (Morris & Oesch, 2025; Oesch & Piccitto, 2019). Digitalisation and growth in ICT-based industries have spurred the demand for highly skilled workers while shrinking the medium-skill occupational groups. However, it remains unclear whether the digital transition directly decreases low-skill employment (Balsmeier & Woerter, 2019), or leaves the lower end of the occupational structure relatively unaffected (Capello et al., 2025; Michaels et al., 2014). The links between the digital transition and professionalisation are most notable in urban labour markets, as digital and innovation industries are particularly sensitive to agglomerative effects (Bathelt et al., 2024; Vas et al., 2024). This is then reflected in the rising share of **tech workers** in cities, particularly in the private sector (Morris & Oesch, 2025; Oesch & Piccitto, 2019; Vas et al., 2024). In fact, professionals in information and communication technology have become one of the largest occupations in the managerial and professional class (Oesch et al., 2025), leading to the distinction of tech workers as a separate class (Dorschel, 2022).

The fact that digitalisation supports growth in the upper segments of the occupational structure suggests that the digital transition contributes to inequalities,

especially in urban areas. The benefits of digitalisation in the form of high salaries are concentrated in the hands of highly skilled workers, and as a result, inequalities between occupational groups are amplified (Capello et al., 2025). Life course and ethnicity considerations give further nuance to the differentiated socioeconomic opportunities arising from digital and occupational change. As shown in the US context, the tech sector is known for its limited ethnic diversity, particularly in managerial level positions (Alegria, 2020; Neely et al., 2023). Although the US ethnic context may not directly translate to Europe – where the internationalisation of labour markets has generated global talent migration – the variety of Europe’s ethnic diversity, which includes long-standing ethnic minority groups, suggests that integration through tech sector employment is equally relevant in the European context. Furthermore, tech workers are exceptionally young (Neely et al., 2023), suggesting that the tech sector offers rapid pathways for career advancement. The life course and ethnic perspectives may also inter-link, as digital transition may be an especially important tool of integration for those ethnic minorities who manage to overcome potential barriers in starting their career in the tech sector.

The urban inequality effects of the digital transition are not limited to the labour market, but extend to the housing market as well. Professionalisation and rising income inequality, driven by tech economy growth, are critical factors fuelling urban housing affordability issues (Quercia et al., 2002; Van Ham et al., 2020). The interlinked labour-housing market opportunities are further differentiated through **remote work**, which selectively increases the importance of the home as a central hub of daily activity, leading to new trends in housing demand (Asadieh & Neisch, 2025; Ilham et al., 2024). Across European countries, the rise in remote work since the onset of the Covid-19 pandemic has to a large extent been captured by professionals in the information and communication sector, and the uptake has been higher in cities (Luca et al., 2025). Overall, the inequality dimension of contemporary occupational change suggests that fully understanding the socio-spatial impacts of the digital transition and professionalisation requires looking beyond highly skilled tech workers to embrace the entire workforce.

2.3. Urban residential segregation and restructuring

The previous section showcases the emergence of a new socioeconomically privileged class – tech workers – as part of a wider professionalisation trend, and the associated rise of inequalities through various mechanisms linking labour and housing markets. Following the main argument of this thesis, an increase in the share of highly skilled tech workers as a mechanism of the digital transition and professionalisation may lead to residential restructuring of and between cities, suburbs and non-metropolitan areas. At the intra-urban scale, tech workers can use their extensive financial resources to align their residential preferences with the most desirable housing and attractive neighbourhoods. Beyond changing tech

workers' residential patterns, urban segregation may also experience reconfiguration.

Income and occupational inequalities provide the structural basis for socioeconomic or class-based residential segregation. As income inequalities induce differentiated housing demand between socioeconomic groups, they drive residential sorting, resulting in economically segregated residential space (Galster & Sharkey, 2017; Reardon & Bischoff, 2011). The primary driving force of socioeconomic segregation is the self-selection of higher-earning households clustering in the most attractive residential neighbourhoods (Kim & Kang, 2024; Pangallo et al., 2019; van Ham et al., 2021). Therefore, high-income groups are more segregated than low-income ones; in other words, segregation by affluence is more pronounced than segregation by poverty (Haandrikman et al., 2023). However, it is not clear to what extent tech workers contribute to class-based segregation with their particularly high incomes, and thus, even less restricted residential choice.

Increasingly, the recognition of segregation's multi-faceted nature has led to calls for integrating both ethnic and class perspectives towards understanding segregation (Hwang & McDaniel, 2022; Kauppinen & Van Ham, 2019). Ethnic and class-based segregation tend to be highly correlated in multiethnic cities, being defined as **'eth-class' segregation**, with ethnic minorities often suffering from disadvantage in labour and housing markets (Andersson & Kährik, 2016). In the labour market, natives tend to occupy higher-status positions, while foreigners make up a larger share of the lower-status workforce (Consolazio et al., 2023). The resulting income disparities between the ethnic majority and the ethnic minority are further reinforced in the housing market, as the financial disadvantage of the ethnic minority leads to constrained residential choices (Goel, 2023). It is such an 'eth-class' conceptualisation which allows us to highlight the 'double sorting' processes behind urban residential sorting and segregation, where high-income natives tend to be over-represented in the most sought-after neighbourhoods, while low-income minorities reside in peripheral, affordable neighbourhoods (Andersson & Kährik, 2016; Zwiers et al., 2018).

The compounding of socioeconomic and ethnic factors suggests that ethnic majority tech workers may perpetuate urban segregation through self-selective residential mobility. However, the digital transition may also serve to decouple ethnic and class segregation. Following the spatial assimilation framework (Massey & Denton, 1985), obtaining a university degree in information and communication technology and securing employment in the tech sector may provide minorities with the financial resources to achieve co-residence with members of the majority population. The expression of these processes varies between established ethnic minority residents and newcomers. The latter may be more flexible in their residential decision-making, immediately choosing ethnic majority-dominated neighbourhoods, and thus removing the condition for gradual spatial assimilation. In either case, such residential restructuring would translate to ethnic desegregation. However, class-based segregation would increase as the rise in income inequalities between ethnic minorities is reflected in residential space

(Jargowsky, 1996). However, there is a certain time lag between changes in income inequality and changes in residential segregation between socioeconomic groups (Tammaru et al., 2020). Therefore, the digital transition of the economy and labour market may still outpace possible shifts in housing market demand and not result in notable changes in class-based segregation.

The digital transition may also have the opposite effect on urban segregation. If ethnic minority tech workers in segregated settings do not change their residential neighbourhoods, ethnic segregation is reinforced. This is especially likely in cases of strong place attachment, which can outweigh other residential decision-making factors, thus explaining the preference of staying in the current place of residence (Clark et al., 2017). At the same time, the increased socioeconomic mixing within the ethnically segregated neighbourhoods would contribute to class-based desegregation. Therefore, the ethnic minority perspective suggests that a decoupling of ethnic and class segregation is a likely outcome of tech-based professionalisation, regardless of actual changes in residential patterns.

Further intra-urban residential restructuring associated with the digital transition can be inferred from the literature on highly skilled workers. In the context of professionalisation, social geography has been found to be more dynamic than segregation, with the increasing shares of highly skilled workers relocating to central neighbourhoods, thus contributing to gentrification and displacing lower-income residents to more peripheral neighbourhoods (Van Ham et al., 2020; van Ham et al., 2021). However, the gentrification process has slowed down as the demand for inner-city housing exceeds the limits of supply, resulting in a certain spillover of managers and professionals to neighbourhoods outside of the inner city core (Ubarevičienė et al., 2026). Ultimately, differences in residential patterns between high- and low-skill occupational groups can be attributed to unequal opportunities, rather than different preferences (Arntz et al., 2023). This supports the notion that residential segregation is embedded in structural inequalities, while also suggesting that growth in the tech sector labour force may serve to break some of the existing patterns of segregation, as an expanded opportunity set allows tech workers to better match their residential preferences and choices.

The urban residential patterns of tech workers have also been directly addressed in the literature. In the Netherlands, tech workers are over-represented in new-build urban neighbourhoods, alongside residents in other high-income occupations (Boterman et al., 2018). However, in terms of neighbourhood's socioeconomic characteristics, tech workers' residential patterns do not indicate a clear alignment towards a particular typology of neighbourhood (Boterman et al., 2021). Similar to the broader group of knowledge workers, tech workers in Madrid tend to cluster together in residential space, which serves to strengthen their social networks, but the tech workers' residential clusters are much more dispersed throughout the city (Sánchez-Moral et al., 2022). These findings offer varied explanations regarding the potential links between tech workers' residential patterns and segregation. Tech workers may be less inclined towards socioeconomic self-segregation, preferring instead to extend their professional

networks to the residential sphere. While such clustering still suggests that tech workers contribute to segregation, simultaneous dispersal might offset this impact – especially if the constraints of limited inner-city housing supply intensify. The presence of tech workers in new-build neighbourhoods further shows that tech worker segregation patterns are closely linked with housing development patterns, reaffirming the tight labour-housing market links in the age of digital transition. These impacts may also reshape ethnic segregation, as ethnic minority migrants in the tech sector search for their first homes in their new country of residence. Thus, intra-urban residential restructuring in the digital transition is strongly linked to both class- and ethnicity-based segregation.

2.4. Metropolitan population dynamics and counter-urbanisation

In addition to intra-urban residential change, cities are focal points of the wider spatial structure and its transformation. This is expressed most eloquently through the key processes of internal migration: urbanisation, suburbanisation and counter-urbanisation – all of which entail links to the city. The combination of these processes, driven by population changes that are closely linked to the digital transition and broader changes in labour markets, is reflected in residential restructuring across the settlement system, changing the dynamics between cities, suburbs and non-metropolitan areas (Tammaru et al., 2026).

The classic factors differentiating suburban residents from city dwellers have been the presence of young children in the household, belonging to the ethnic majority, and higher income (Booi & Boterman, 2020). The increasing issue of urban housing unaffordability has shifted suburbanisation dynamics, as lower-income population groups are displaced outside of the city limits in the search of suitable housing – a process known as suburbanisation of poverty (Hochstenbach & Musterd, 2018). At the same time, suburbs are also experiencing a growth in their highly skilled population, as the digital transition and the associated rise of remote work have improved the position of suburbs as a residential environment (Aasa et al., 2026). As remote work decreases the need for commuting, suburban residents are less likely to relocate, while the feasibility of suburbs as a residential destination increases for others with an opportunity to work remotely, including tech workers. The combination of these factors has led to the development of a ‘doughnut’ metropolitan population structure, where suburban areas are gaining population at the expense of cities, which are becoming relatively emptier (Ramani & Bloom, 2021). Furthermore, residential mobility induced by the digital transition has stretched the definition of the metropolitan region, creating an ‘extended doughnut’ beyond existing metropolitan boundaries (Ahrend et al., 2025).

The leading perspectives in the counter-urban discourse stipulate that counter-urbanisation is driven by economic or lifestyle motives (Šimon, 2014). Similarly to suburbanisation, counter-urbanisation driven by economic motives serves as a

form of displacement under urban housing affordability pressure, increasingly reaching even higher-income households (Karsten, 2020). The lifestyle-driven counter-urbanisation stems from post-productivist notions of the rural environment, with a focus on the consumption of rural amenities (Šimon, 2014). According to this perspective, counter-urbanisation takes the form of highly selective mobility, available primarily to those with higher social and economic capital (Colomb & Gallent, 2022). This is supported by the increased spatial variability of high-paying jobs, which means that higher-skill workers are able to be more residentially mobile than lower-skill workers, especially during economic boom periods (Coulter, 2023). The spatial expansion of digitalisation and the possibility to work remotely have been linked to counter-urban migration among highly-skilled workers, a trend supported by several empirical studies (Eliasson, 2025; Knuepling et al., 2025). The combination of these factors suggests that tech workers are best positioned to use their professional advantages to pursue lifestyle-driven counter-urbanisation.

However, several factors need to be considered which limit the potential of the digital transition to contribute towards counter-urbanisation. In addition to the ‘doughnut’ effect at the metropolitan scale, ‘shadow’ effects of the digital transition are expected at the inter-urban scale, as larger metropolitan areas improve their relative position in the settlement structure over smaller towns (Bond-Smith & McCann, 2025). The ‘shadow’ effect is likely to be especially pronounced in more monocentric countries, where the current population size difference between the largest city and the rest of the urban system is already significant. The spatial variability of highly-skilled jobs is also more pronounced in the public sector, suggesting a more limited impact of the employment opportunity structure for private sector tech workers than otherwise expected (Sandow & Lundholm, 2020). In addition, the prevalence of hybrid work has limited large-scale implementation of long-distance moves, as proximity to the workplace remains necessary (McCollum, 2025; Reuschke & MacLeavy, 2026). While these factors may explain why the ‘urban exodus’ in the aftermath of the Covid-19 pandemic largely did not materialise, the potential for a shift in population dynamics between urban, suburban and non-metropolitan areas remains (Silva et al., 2025). The settlement system directs the residential restructuring processes, with monocentric countries offering more potential for intra-urban and metropolitan residential change, and polycentric countries allowing for population dispersal based on a more even distribution of opportunities.

Beyond employment-related factors, the choice of residential environment is conditioned by life course stage, as people adapt to their needs and preferences. This has been described by the ‘escalator region’ concept, which stipulates that younger people move to cities in search of education and job opportunities, but upon establishing a family, they seek to relocate to suburban or rural areas (Fielding, 1992). Based on the life course dimension, the choice to move away from the city is primarily motivated by the need for more spacious housing and a better residential environment for children (Karsten, 2020). The life course stage interacts with the ethnic dimension, as ethnic minorities tend to be concentrated

in larger urban areas. Thus, ethnic group settlement patterns pre-determine the differentiation of internal migration between ethnic groups over the life course (Coulter, 2023). This can be further explained by residential experience, as people who have previously lived in a rural area are more likely to engage in counter-urban residential mobility later in life (Feijten et al., 2008; Sandow & Lundholm, 2023). Thus, the concentration of ethnic minorities in cities may limit their consideration of a counter-urban move, which suggests that counter-urban residential restructuring would primarily be driven by the ethnic majority population at the family life stage. However, the digital transition may challenge that notion. While ethnic minorities may not expand their residential geography to the same extent as the ethnic majority, for regions with more notable ethnic minority populations, the digital transition and professionalisation may help retain the early-career stage population, as expanded professional opportunities and remote work reduce the need to move to larger metropolitan areas.

This section has built upon the spatial change model presented in Figure 1, highlighting the impact of the digital transition and professionalisation in residential restructuring across multiple spatial scales, with tech workers being the core population group driving the process. First, the internal residential structure of cities is likely to change. As tech workers apply their extensive socioeconomic opportunity set towards residential decision-making, the residential patterns of tech workers increasingly align with their residential preferences, leading to varied urban segregation outcomes along the lines of class and ethnicity. However, digitally-enabled work allows us to conceive residential dispersion of the highly skilled workforce, decoupling place of residence from place of work (McCollum, 2025). Thus, residential restructuring should be considered across the whole settlement system. Depending on the strength of workplace ties, we may envision change at the metropolitan level to be more prominent if the decoupling of home and work is limited, while counter-urbanisation may become more common if remote work establishes itself as a permanent feature.

3. STUDY AREA CONTEXT

This thesis primarily investigates the processes of residential restructuring in Estonia, a country which offers a compelling case to study the interactions between digital, occupational and residential dimensions. However, the research framework of this thesis is fundamentally comparative, which allows us to contextualise the findings made based on the Estonian case. For that purpose, Estonia is directly compared to the other Baltic States – Latvia and Lithuania – in **Publication IV**. Such a comparison is valuable as these neighbouring countries share similar historical and contemporary socioeconomic development pathways, including those of digital transition. A notable socio-spatial difference between these countries lies in the settlement structure, which in this thesis is conceptualised as one of the key mediating factors in the development of the links between the digital transition and residential restructuring. However, the processes of digital transition and professionalisation have been found to have an overarching impact across European countries (Oesch et al., 2025; Vas et al., 2024). Therefore, a broader European context expands the research outlook even further, positioning Estonia and the Baltic States in a comparative framework of urban inequalities and labour-housing market interactions (**Publication I**).

Estonia, just like Latvia and Lithuania, was under the Soviet rule between 1944 and 1991. This historical period was associated with mass immigration from other Soviet republics, resulting in a significant transformation of Estonia's population. The new, mainly Russian-speaking immigrants did not need to learn the Estonian language because the local infrastructure operated in Russian. In addition, the new migrants were mostly relocated to selected settlements, and they were housed in newly-established housing estate neighbourhoods. Therefore, after Estonia regained its independence in 1991, it inherited a dual ethnic society strongly divided along ethnolinguistic lines, which manifested spatially as ethnic segregation (Leetmaa et al., 2015; Tammaru et al., 2016).

After the collapse of the Soviet Union, the re-independent Baltic States rapidly switched to a market-based economy. Increasingly, the ethnic disparities were followed by socioeconomic ones, as income inequality grew. The overlap between ethnic and socioeconomic disparities in Estonia is visible in the occupational dimension. The labour market is characterised by ethnic segmentation and weak integration, with Russians in Tallinn working in positions with lower occupational status, even if they have good Estonian language skills (Lindemann, 2014). Growth in managerial and professional jobs has also been captured primarily by Estonian speakers (Tammaru et al., 2016). However, the situation differs among second- and third-generation young Russian minority residents, who achieve high-status, high-income jobs at similar rates to Estonians (Saar & Helemäe, 2017).

Ethnic inequalities in the occupational dimension have extended to the residential dimension, with socioeconomic segregation growing alongside the already established ethnic segregation, giving rise to eth-class segregation. Every combination of Estonian-Russian class segregation shows a dissimilarity index

above 40 (Tammaru et al., 2016), which can be interpreted as a high level of segregation (Marcinčzak et al., 2015). In the case of Tallinn, the ethnic dimension still appears to be prevalent in shaping the socio-spatial dynamics, as the most segregated eth-class group – Estonian managers – is less segregated from Estonians in elementary occupations than from Russian managers (Tammaru et al., 2016). While intra-urban residential mobility in Tallinn generally aligns with ethnicity – thus reproducing ethnic segregation – the overall residential mobility trends show that ethnic minority residents of Estonia with high occupational status are likely to increase their share of Estonians in their residential destination (Mägi et al., 2016). However, this is the case also for Estonians, who exhibit a notable, although decreasing, preference for co-ethnic neighbours, with limited co-ethnic preference among the ethnic minority population (Leetmaa et al., 2015; Mägi et al., 2016). Therefore, socio-spatial integration is limited primarily by the ethnic majority. Meanwhile, residential segregation of minorities may be driven not only by labour market disadvantages but also by a supportive familiarity with their current residential environment, rather than explicit co-ethnic preference (Leetmaa et al., 2015; Mägi et al., 2016).

Estonia's recent development is rooted in its digital transition, which has been the foundation of the nation's economic and societal restructuring process. As a result, Estonia is recognised as a global leader in digital public services and e-governance, supported by highly developed tech sector (Espinosa & Pino, 2025). Estonia also shows some of the fastest rates of growth in terms of workforce digitalisation in Europe, reaching levels comparable to the Nordic countries (Caravella et al., 2023). This may help to explain the high prevalence of remote work in Estonia (Luca et al., 2025).

While Estonia is considered one of Europe's overall digital leaders, the other two Baltic countries offer a valuable comparative context for digital transition trends. According to the Digital Economy and Society Index 2022, Estonia is the leading Baltic country in terms of digital performance, followed by Lithuania, while Latvia's ranking in the index is slightly below the European Union average (European Commission, 2022). Like Estonia, Lithuania and Latvia score particularly high in the 'digital public services' dimension of the Index, indicating high levels of integration with e-governance. Each country has also chosen a particular approach to direct the digital transition into broader development. Latvia stands out for its active investment into rural digitalisation, reflecting efforts to reduce regional inequalities through digital solutions (Feurich et al., 2024). Meanwhile, Lithuania has specialised in the FinTech sector, with the government actively supporting its growth to position the country as the European Union's financial centre (Raudla et al., 2025).

Despite the shared history of the Baltic States under the Soviet rule, significant differences in their spatial development emerged during that era, largely shaping each country's current position along the monocentricity-polycentricity continuum. Latvia is the most monocentric of the Baltic States, as Soviet industrialisation activities and their workforce centred in Riga. Lithuania is positioned at the other end of the continuum, with polycentric spatial development motivated

both by the significant position of Kaunas and Klaipeda in the first period of independence (Kebza et al., 2019) and by dispersed industrialisation and more systematic regional planning in the Soviet period (Vanagas et al., 2002). In Estonia, Tallinn saw the largest share of industrial activity, but Tartu kept its position as the academic centre of the country, allowing Estonia to maintain an intermediate settlement system structure.

While population dynamics and settlement systems under Soviet rule were largely a product of central planning, the regaining of independence in 1991 gave the populations of the Baltic States the opportunity to express their residential preferences (Ubarevičienė, 2018; Vanagas et al., 2002). Suburbanisation and urban sprawl became the key drivers of population change. This shift was fuelled by the residential mobility of the highly skilled population group, leading to increased monocentricity based on the capital city metropolitan regions, particularly in Lithuania (Burneika et al., 2025; Ubarevičienė, 2018). With the diversification of selective residential mobility pathways, other types of residential mobility have emerged, such as counter-urbanisation, which is the focus of **Publication III** for the case of Estonia.

Estonia and the Baltic States can also be measured against other European countries, as is done in **Publication I**. This study extends the comparative framework by placing 15 European capital city regions – including Tallinn, Riga and Vilnius – at the core of the empirical analysis. Population dynamics in Europe has diverged between Western and Northern Europe, where international migration drives population growth, and Eastern and Southern Europe, where out-migration and population ageing are more pronounced. Despite these diverging trends, capital cities across Europe have strengthened their position as main economic and population centres in their respective countries. However, the global orientation of European capital cities significantly differs, generally correlating with the magnitude of the digital transition. Based on one of the most widely accepted classifications of cities' global positioning – the World Cities report by the Globalization and World Cities Research Network (2024) – the Baltic capitals are found in the lower brackets of the classification, indicating low integration in global city networks when compared to their European counterparts. However, a comparison of digital transition levels based on the Digital Economy and Society Index positions the Baltic capitals relatively higher, indicating that the digital transition has outpaced globalisation in the Baltic region.

This section highlights that the present-day settlement structure and broader socio-spatial context of the Baltic States can be traced back to their socialist history. Since then, market-based socioeconomic development, including the digital transition, has reshaped the socio-spatial dynamics, reinforcing inequality. For Estonia, this has been most pronounced in the form of ethnic segregation across both occupational and residential dimensions. While none of the Baltic capitals can be considered global cities, they all remain the largest cities and the economic, social and cultural centres of their countries. Despite this, each of them plays a different role in its respective settlement structure, shaping broader residential restructuring processes.

4. DATA AND METHODS

4.1. Data

The empirical research constituting this thesis is primarily census-based. Table 1 provides an overview of the datasets, years of analysis, geographic scope and research population of each publication. The choice of national census as the primary data source is an outcome of a long-term effort of developing research access to census datasets in the Baltic States, which in Estonia has been conducted as part of the Infotechnological Mobility Observatory project. The available census datasets are individual-level, ensuring fine-grained detail; harmonised across census years, allowing for a direct comparison in time; and with a broad set of variables, extending the possible dimensions for insights. The specific variables chosen for the publications depend on the particular study design, but they include variables reflecting individual demographic and socioeconomic characteristics, household composition, and housing conditions. In **Publications II and IV**, census datasets from 2011 and 2021 were used; in **Publication III**, the years of analysis were 1989, 2000 and 2011. **Publication III** was complemented by Estonian population register data from 2015 and 2020, which are also harmonised with the census data, and thus suitable for the publication's longitudinal study design.

Publication I, which serves as a conceptual contribution, rather than empirical study, builds upon data sourced from a previous comparative study (Ubarevičienė et al., 2026), namely – national census and register from 2021 (or the nearest available year), as well as Gini index data from 2011. The 10-year difference in the data sources reflects the time lag of spatial changes following changes in income inequality (Tammaru et al., 2020). Two other original data sources were part of **Publication I**. These are Digital Economy and Society Index 2022, compiled by European Commission, as well as Rent Index 2025, accessed from the crowdsourced data platform Numbeo. The Digital Economy and Society Index is a composite metric of European Union and associate country digital competitiveness, while the Rent Index reflects the price of renting a 1- and 3- bedroom apartment within and outside of city centre.

Table 1. Brief overview of data, geographic scope and research population

Publication	Data and its sources	Years of analysis	Geographic scope and analytical units	Research population
I	National census or registers (Ubarevičienė et al., 2026) Gini Index (Ubarevičienė et al., 2026) Digital Economy and Society Index (European Commission 2022) Rent Index (Numbeo 2025)	2011 (Gini index) 2021, or similar (census or registers) 2022 (Digital Economy and Society Index) 2025 (Rent Index)	15 European capital city regions	Working-age population (ages 15–64)
II	Estonian census	2011 and 2021	Neighbourhoods of Tallinn Municipalities of Estonia Nationwide classification	Working population Estonians and Russians Tech workers
III	Estonian census and register	1989, 2000, 2011 (census) 2015 and 2020 (population register)	Settlement system levels Localities	Whole population
IV	Estonian, Latvian and Lithuanian census	2011 and 2021	Settlement system levels Smallest territorial statistical units	Working population (ages 25–64) Tech workers

4.2. Study area and research population

The main study area of the thesis is Estonia, with variations in geographic scope and spatial analytical units between publications (Table 1). The core analytical part of **Publication III** is based on settlement system levels, with three levels of metropolitan areas: capital city, regional city, and county seat, as well as two levels of non-metropolitan areas: small towns and rural areas. Additional map-based analysis was done at the small territorial statistical unit, or locality level. **Publication II** continues the nationwide focus, with the classification of Tallinn, Tallinn suburbs, and the rest of the country, as well as conducting separate analysis at the municipality level. This publication also contains a fine-grained urban analysis that examines Tallinn at the neighbourhood level.

Two of the publications include Estonia as part of an inter-country comparative framework. **Publication IV** focuses on the Baltic States: Estonia, Latvia and Lithuania. Similar to **Publication III**, the main analytical units in **Publication IV** are based on settlement system levels. In this case, it distinguishes between capital city, capital city suburbs, regional centres, and other settlement units. In addition to these units, towns were distinguished in maps, which were based on smallest territorial statistical units available in each country. Variations in settlement systems, defined by level of centralisation, are at the core of the study. Latvia is characterised by monocentric, Lithuania by polycentric, and Estonia by intermediate settlement system structure. This pattern is illustrated by the primacy index, which shows that the population disparity between the largest and the second largest city is greatest in Latvia and least significant in Lithuania.

The broadest study area is featured in **Publication I**, which serves as a conceptual background guiding the empirical analysis of this thesis, providing a European-wide perspective on digital transition and urban inequalities. Unlike the other publications, **Publication I**, which is based on a previous comparative study by Ubarevičienė et al. (2026), focuses exclusively on the urban scale, comparing 15 European city-regions: Athens, Barcelona, Bratislava, Dublin, Helsinki, Lisbon, London, Oslo, Paris, Prague, Riga, Stockholm, Tallinn, Vilnius and Warsaw.

In terms of research population, **Publication III** has the broadest reach, as it captures the whole population of the study area, in this case, Estonia. Additionally, it distinguishes between high-, medium-, and low-skilled workers, based on custom application of the ISCO-08 classification. In this study, high-skilled workers are managers and professionals, low-skilled workers are in elementary occupations, while the rest of the workforce are classified as medium-skilled workers. **Publications II and IV** focus on working population, while **Publication I** – on working-age population. In **Publication IV**, which is centred on the life course dimension, the research population is workers in age group 25–64. Younger working-age residents – in the age of 15 to 24 – were excluded, due to this being the most dynamic life course stage, where occupational and residential dimensions have not yet fully established.

In both **Publications II and IV**, the overall workforce serves as a comparison group to the main research population of interest – tech workers. The definition of tech workers is custom for this thesis and is based on two criteria, combining the International Standard Classification of Occupations ISCO-08 and the statistical classification of economic activities in the European Community, or NACE. If the person is in the ISCO occupational group 1 or 2 (managers and professionals), and works in NACE 62 industry (programming, consultancy and related activities), they are classified as tech worker. Furthermore, in **Publication II**, eight eth-class groups are distinguished, which are formed by crossing four occupational status groups (tech, non-tech high, medium, low) and two ethnic groups (Estonians and Russians). The occupational status classification follows the conventional approach based on ISCO occupational groups, where 1 and 2 depicts high, 3 and 4 – medium, and 5 to 9 – low occupational status. The choice of the ethnic groups is explained by the ethnic context of Estonia, where Russians form about 80% of the total ethnic minority population. This also leads to methodological considerations, as the number of residents of other ethnicities would be too low for detailed neighbourhood-level analysis, which was fundamental to the empirical approach taken in **Publication II**.

4.3. Methods

The methodological approaches applied across the four publications reflect differences in data structure and the specific role each publication plays within the thesis. The core analytical part of this thesis is found in **Publication II**, which investigates changes in levels of eth-class segregation, measured by dissimilarity index, between 2011 and 2021 in Tallinn. Dissimilarity indices were calculated for eight eth-class groups in both time periods. Additionally, intra-urban, neighbourhood-level residential patterns of tech workers were mapped. For this, location quotients were calculated, which indicate over- and under-representation of a certain population group in a neighbourhood, compared to the mean of the whole city, with a value of 1 indicating that the share of local population matches the share across the city. The thresholds selected were >1.2 for over-representation and <0.85 for under-representation (Brown & Chung, 2006). To categorize neighbourhoods, a 5-group neighbourhood typology was developed, where all combinations of over- and under-representation across both ethnicities were identified as separate groups, while other location quotients led to the classification of the neighbourhood as mixed ethnic neighbourhood.

The following empirical analysis of **Publication II** consists of a set of linear regression models, which were estimated for 2021, with the dependent variable being the share of ethnic Estonians in the tech workers' neighbourhood of residence. The model includes variables across three groups: ethnicity, demographic (age, sex, children in household) and socioeconomic (education, income). The model has four variants. Firstly, it was estimated for both Estonian and Russian

tech workers, then split by ethnicity, and finally, an additional variable – country of birth – was included for a separate variant of ethnic minority model.

The supplementary material of **Publication II** includes further descriptive statistics to contextualize the case of Tallinn. It also provides more detailed nationwide analysis, following the analytical steps used for intra-urban scale. Firstly, dissimilarity indices for eight eth-class groups were calculated at the Estonian municipality level to measure eth-class segregation in 2011 and 2021. Secondly, multinomial logistic regression models for 2021 with four variants were fitted, comparing the differences in ethnic, demographic and socioeconomic characteristics between tech workers residing in Tallinn, its suburbs and the rest of the country.

Publication III continues the focus on Estonia, while widening the analytical scope to include the whole population in order to define long-term counter-urbanisation trends in Estonia. Important distinction between **Publication III** and other publications of this thesis is the longitudinal aspect, allowing to identify residential trajectories by linking people who were living in Estonia in two consecutive study years. To that end, various metrics are applied to characterise domestic or internal migration. Migration intensity describes the share of population moving between levels of settlement system. Migration Concentration Index, developed by Kontuly & Tammaru (2006), measures the ratio of upward moves, or urbanisation, as opposed to downward, or counter-urban, moves along the settlement system levels. While these two measures describe the whole settlement system, Net Migration Rate (NMR) is calculated for separate spatial units. It defines the ratio of in-migration vs. out-migration, divided by the local population size. In addition to calculating NMR for the highest and lowest settlement system levels, NMR values were also mapped at the scale of localities across four different time frames, where 2000–2011 and 2015–2019 served as periods of economic boom, while 2011–2014 and 2020–2021 were considered as periods of economic bust. To account for the different length of the time periods, the NMR for each time period was standardised per annum. The maps are presented for the total population, as well as for high- and low-skilled workers separately.

The methodological approach of **Publication IV**, which extends beyond Estonia to include all three Baltic States – Estonia, Latvia and Lithuania – is divided in three steps. Firstly, it examines the residential distribution of tech workers between the settlement system levels. This is complemented by mapping the share of tech workers from all working residents at the level of smallest territorial units. Next, the life course dimension was added by investigating the age distribution of tech workers, which provides context for the following analysis of tech workers' residential distribution across age groups and settlement units. Finally, the profile of tech workers living outside capital city metropolitan region was analysed via a binary logistic regression model, comparing them to those tech workers living within the capital city metropolitan region. The model includes six variables of personal (age, sex, ethnicity), household (partnership status) and housing charac-

teristics (dwelling type, tenure). To understand whether the effects are specific to tech workers' population, a parallel model was fitted for the rest of the workforce.

While the previous three publications are fundamentally empirical studies, in **Publication I**, the emphasis is on providing conceptual background of digital transition in urban inequality context. However, empirical analysis is also conducted in **Publication I**. It applies a rank system to position the different dimensions of contemporary urban inequalities against each other. The 15 European capital city regions included in this study are ranked in three levels – high, medium or low – across each dimension. From the two original dimensions, digital transition rank is based on the Digital Economy and Society Index, while housing unaffordability levels are based on the Rent Index from Numbeo. The remaining three dimensions are based on the results of a previous comparative study (Ubarevičienė et al., 2026), where levels of residential segregation are based on dissimilarity index, workforce professionalisation reflects the share of managers and professionals in the workforce, while the final dimension – income inequality – is based on Gini index.

5. RESULTS

5.1. Occupational change and the profile of tech workers

Occupational change in the context of digital transition, specifically the role of tech sector and its workers, sets the scene for residential restructuring dynamics across multiple spatial scales. Occupational change has been addressed empirically in **Publications II and IV**. **Publication II** explicitly relates the dynamics of tech workers to the broader occupational structure, thus also enabling the assessment of professionalisation and the role of digital transition in this process, while **Publication IV** is primarily concerned with the internal changes of the tech workforce, focusing on the growth of tech sector and the changing age structure of tech workers.

Providing an additional European-wide contextual comparison, **Publication I** compares changes in the upper levels of occupational structure with levels of income inequality, revealing that city regions with limited occupational upgrading are characterized by higher levels of income inequality. From the cities empirically investigated as part of this thesis, Riga and Vilnius emerge amongst the group of cities with high levels of income inequality, but Vilnius shows an exception to the rule as a city experiencing advanced professionalisation. Other cities with high levels of professionalisation reveal mixed income inequality contexts, while Tallinn combines comparatively medium levels of professionalisation and income inequality.

Publication II provides comprehensive occupational change analysis, considering the change of the tech workforce itself, as well as in relation to the overall and highly skilled workforce. Tech sector growth and its increasing role in the occupational structure is reflected in the rising number of tech workers. Amongst both Estonian-majority and Russian-minority tech workers, their number more than doubled between 2011 and 2021, with a similar increase in their share in the overall and highly skilled workforce (Table 2). While the share of Estonian and Russian tech workers in total workforce did not go beyond 2% in 2021, tech workers constituted almost 8% of all Russian ethnic minority highly skilled workforce in the country. Therefore, tech sector emerges as the main contributor to occupational upgrading in Estonia. In addition, the share of tech workers amongst managers and professionals decreases with age, but is consistently higher in the minority group, with the exception of the >54 age group. This indicator signifies the growing importance of tech sector in the labour market for young professionals, especially those of minority origin. However, **Publication II** also indicates notable changes in the age structure of tech workforce, with tech workers in the youngest age groups decreasing their relative share. This process reveals further ethnic differences, being more pronounced amongst Russian tech workers.

Table 2. Share of Estonian-majority and Russian-minority tech workers from total and high-skilled workforce in Estonia. Adapted from **Publication II**, Table 1

	EST, 2011	RUS, 2011	EST, 2021	RUS, 2021
Total (N)	4000	1186	8931	2484
Share in total workforce	0.9	0.8	2.0	1.7
Share in high-skilled workforce	3.1	4.3	6.0	7.9
Share in <25 high-skilled workforce	9.5	13.2	15.1	17.9
Share in 25–34 high-skilled workforce	6.7	9.6	11.8	16.9
Share in 35–44 high-skilled workforce	2.5	3.3	7.4	10.6
Share in 45–54 high-skilled workforce	1.1	1.3	2.7	3.1
Share in >54 high-skilled workforce	0.6	0.9	0.9	0.8

The comparison of Estonia, Latvia and Lithuania in **Publication IV** further clarifies the changing role and composition of tech workforce, focusing on the working-age (25–64) group. The main finding is that similar processes of tech workforce change have occurred across the Baltic States. Like Estonia, both Latvia and Lithuania have seen a significant rise in tech workforce. Between 2011 and 2021, the number of tech workers in Latvia just over doubled, while in Lithuania, it more than quadrupled – from just over 4500 to more than 19000 tech workers (Figure 2). These findings are worth considering in the context of the professionalisation metrics from **Publication I**, where Riga is in the lowest group, Tallinn is in the middle group, while Vilnius shows high levels of professionalisation. The sharp increase in tech workforce thus depicts the wider processes of professionalisation taking place in Lithuania and its capital city. All three countries also replicate broad patterns of age distribution, with the relative share of tech workers decreasing with age (Figure 2). However, the age structure of tech workers has experienced changes which highlight ageing processes within the tech workforce. Similar to Estonia, also Latvia and Lithuania have seen decrease in the relative share of the youngest – 25–34 – age group, which is largely mirrored by an increase in the relative share of tech workers aged 35 to 44. Combined, the findings of growth and ageing highlight remarkable similarities in the composition of tech workforce across the Baltic States, which allows to better distinguish the role of other factors.

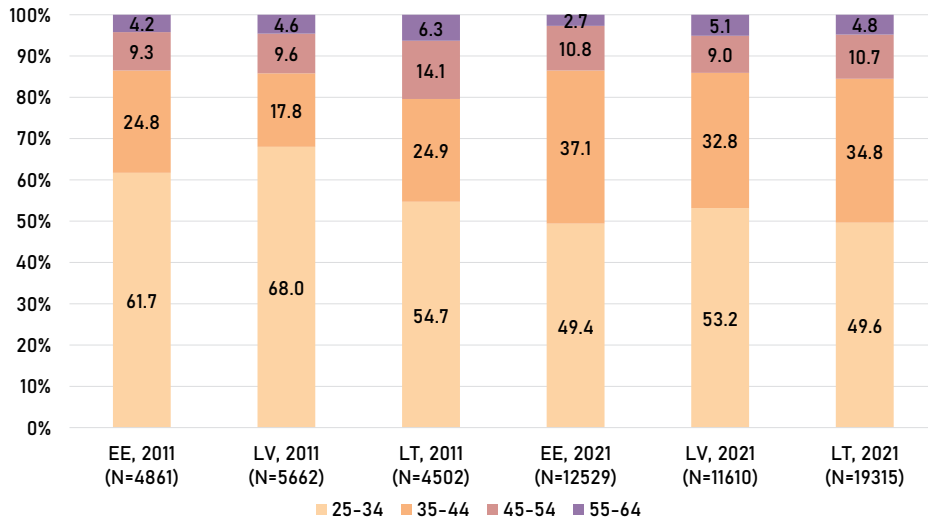


Figure 2. Age distribution and total number of working-age (25–64) tech workers in Estonia, Latvia and Lithuania in 2011 and 2021. Adapted from **Publication IV**, Figure 5

5.2. Intra-urban residential change and segregation

Moving from the occupational to residential dimension, this section addresses the residential restructuring processes taking place within capital cities in the context of professionalisation and digital transition. It draws empirical evidence from **Publication II**, which analyses the prevalence of class- vs. ethnicity-based segregation in Tallinn based on the case of tech workers, complemented by mapping their residential patterns. Additional conceptually framed insights are drawn from **Publication I**.

Similar to **Publication II**, **Publication I** considers segregation as central to understanding broader urban and residential inequality processes. In **Publication I**, residential segregation in European capital city regions is set against multiple dimensions, revealing varying interactions. Strongest links can be found between the levels of digital transition and residential segregation. All the cities ranked at the highest level in terms of digital transition are also characterised by at least medium levels of residential segregation. Meanwhile, the relationship between professionalisation, housing unaffordability and segregation is less straightforward. There are more highly segregated cities ranked “medium” in professionalisation and housing affordability dimensions than those ranked “high” in these two dimensions. These findings from the scale of urban regions in **Publication I** inform the detailed empirical analysis of **Publication II**, which zooms to residential dynamics within city boundaries.

In **Publication II**, the most striking finding is the eth-class desegregation of tech workers. Segregation levels have notably decreased not only between tech workers of ethnic majority and minority, but also between ethnic minority tech

workers and the rest of the ethnic majority workforce (Table 3). The most pronounced spatial integration occurred between Russian tech workers and highly skilled Estonians, with dissimilarity index value dropping from 49 to 34 in the 10-year period. In all cases, ethnic minority tech workers' eth-class segregation had reached medium levels in 2021, as indicated by the dissimilarity index of less than 40 (Marcinćzak et al., 2015). As a result, ethnic minority tech workers had become the least ethnically segregated of the eth-class groups. The highly skilled non-tech Russian group experienced much smaller desegregation. Their changes in segregation were more in line with the segregation dynamics of ethnic majority highly skilled workers, both in tech and non-tech, whose segregation levels also do not notably differ between each other.

In the backdrop of overall desegregation, there remains a notable case of increasing segregation amongst ethnic minorities, more specifically – between tech workers and non-highly skilled workers (Table 3). This has resulted in a situation where ethnic minority tech workers are more segregated from their co-ethnics than from Estonians, when comparing residents in low socioeconomic status occupations. These findings highlight the emergence of tech workers, particularly from minority backgrounds, as agents of change in contemporary segregation processes.

Table 3. Segregation and desegregation of ethnic and occupational groups in Tallinn between 2011 and 2021. Adapted from **Publication II**, Table 2.

	Tech minority	High minority	Middle minority	Low minority
Tech majority	47 (–14)	45 (–3)	50 (–3)	57 (–4)
High majority	49 (–15)	45 (–3)	50 (–4)	57 (–3)
Middle majority	42 (–12)	37 (–2)	42 (–2)	48 (–2)
Low majority	38 (–8)	33 (–3)	34 (–1)	39 (–2)
Tech minority		22 (0)	23 (+5)	30 (+6)
High minority	22 (0)		11 (–1)	20 (–2)
Middle minority	23 (+5)	11 (–1)		13 (0)
Low minority	30 (+6)	22 (–1)	13 (0)	

Despite the eth-class desegregation, results of linear regression modelling in **Publication II** revealed that ethnic minority tech workers continued to live in neighbourhoods with smaller shares of Estonians, compared to ethnic majority tech workers. Older Estonian tech workers in particular live in neighbourhoods with a higher share of their co-ethnics, while older Russian tech workers live in neighbourhoods with a higher share of ethnic minorities. Therefore, the desegregation effects can primarily be attributed to younger minority tech workers, especially if their income is in the higher thresholds. Also, the differentiating effect of migration background can be identified – foreign-born Russian tech workers live in neighbourhoods with more Estonian residents, especially if they are new migrants, in which case their mean share of Estonians in neighbourhood almost reaches the same share for Estonians in low-skilled occupations.

Mapping the residential patterns of tech workers provides insights in the spatial outcomes of desegregation (Figure 3). Two changes stand out in this. Firstly, inner city neighbourhoods of Tallinn have largely switched from over-representation of Estonian and under-representation of Russian tech workers, which was the most prevalent combination in 2011, to a mixed composition in 2021. In addition, several central neighbourhoods turned to over-representation of both ethnicity tech workers in the 10-year period, forming residential clusters. The second major change relates to the more peripheral housing estate neighbourhoods of Lasnamäe in the eastern part of Tallinn – in 2011, many of these neighbourhoods had an over-representation of Russian tech workers, but by 2021, this had switched to under-representation. The significance of these findings is underlined by the socio-spatial context of Tallinn, where central neighbourhoods have a high share of highly skilled workers, while the housing estate neighbourhoods which have been left by tech workers are also the ones with the highest shares of Russian-speakers. Therefore, the residential change of ethnic minority tech workers, as observed through their shift from peripheral to central areas of Tallinn, signifies an important shift in the geography of eth-class segregation.

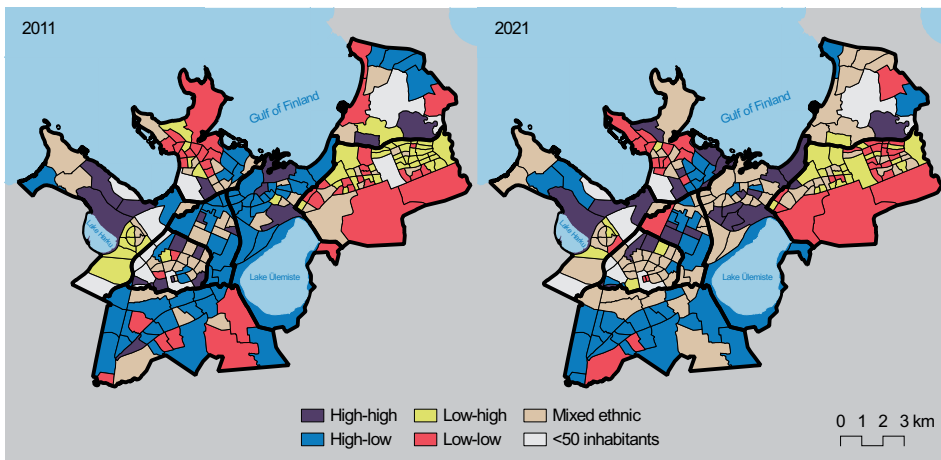


Figure 3. Neighbourhoods in which Estonian-majority and Russian-minority tech workers are over-represented (high) and under-represented (low) (2011 and 2021). Source: **Publication II**, Fig. 3. Reproduced with permission from Springer Nature

5.3. Metropolitan residential dynamics

While **Publication II** focuses on urban segregation, a more extensive picture emerges when considering the residential dynamics between urban and suburban areas induced by digital transition. **Publication IV**, in its comparative nationwide coverage of tech workers' residential change across the Baltic States, includes an explicit consideration of the metropolitan area. All capital cities, as well as major regional centres in Estonia and Lithuania – Tartu and Kaunas, have seen notable growth of tech sector residents (Figure 4). Beyond the city borders, first glimpses emerge of tech workers' residential expansion, as tech workers in Estonia have grown their residential presence not only in the suburbs of Tallinn and Tartu, but also in the localities surrounding Tallinn metropolitan region. Similar processes can be identified between Vilnius and Kaunas in Lithuania, yet with more limited spatial reach. Meanwhile, tech sector growth has had a different effect for metropolitan residential distribution in the monocentric context of Latvia, with pronounced increase in the suburbs closer to Rīga, while expansion into the immediate surroundings of Rīga metropolitan region is largely limited to a few localities to the east of the metropolitan region.

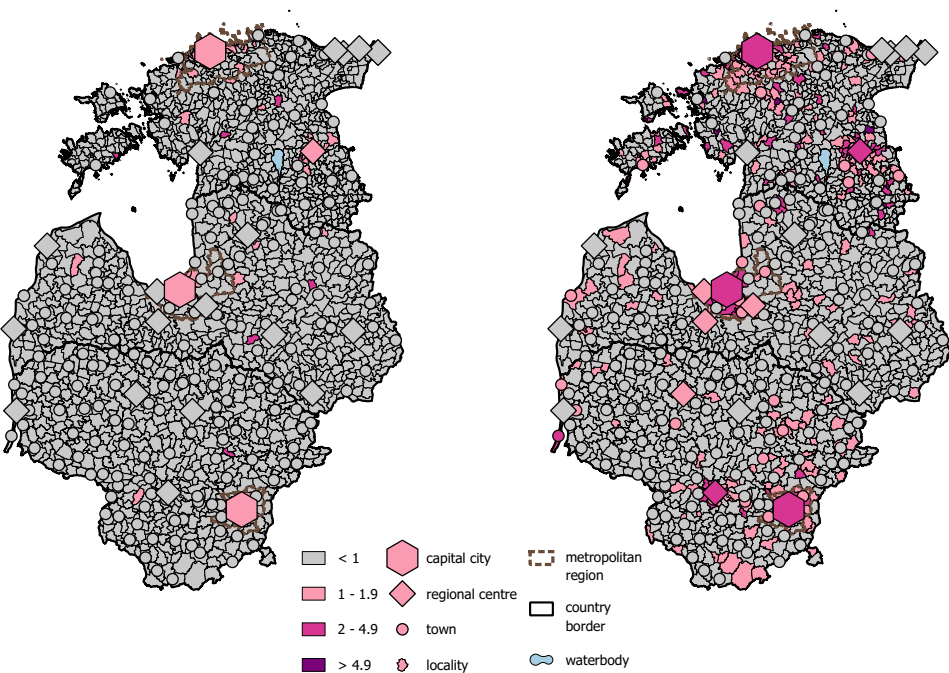


Figure 4. Share (%) of working-age (25–64) resident tech workers from total working-age residents in employment across settlement unit levels and countries in 2011 and 2021 (left – 2011, right – 2021). Adapted from **Publication IV**, Figure 4

Several individual and household-level factors can be identified which differentiate urban and suburban dwellers. These were addressed in **Publication II** in the form of a multinomial regression model, comparing Tallinn and its suburbs. Ethnicity had the most pronounced effect, with Russian tech workers much less likely to live in the suburbs of Tallinn than Estonian tech workers. Suburbs are also highly family-oriented, with increased odds for living in suburbs, compared to Tallinn, amongst both Estonian and Russian tech workers with children in household. Belonging to a higher income variable also revealed significant, yet inconsistent effects towards living in suburbs, with only the highest income bracket – earning at least 5000€ a month – leading to significantly increased odds of living in suburbs than in Tallinn for both ethnicities. Interestingly, the model revealed that ethnic majority tech workers between the ages of 25 to 34 are less likely to live in suburbs than in Tallinn, compared to even younger tech workers.

5.4. Counter-urban residential restructuring

Residential restructuring beyond the capital city metropolitan area – and across the whole settlement system – is core to **Publications III and IV**, while also forming a substantial part of **Publication II**. **Publication III** sets out a broader perspective of residential mobility in Estonia, with the focus on understanding trends of counter-urbanisation, while **Publications II and IV** are concerned with nationwide residential change in light of digital transition, focusing on tech workers' residential differentiation.

Publication III analyses the upward and downward, or urban and counter-urban, moves in the settlement hierarchy across the whole population of Estonia. It demonstrates that the main residential trajectory in Estonia since the 1990s is urbanisation, which in the context of a monocentric settlement system means that Tallinn urban region can be considered the main beneficiary in terms of population gains driven by residential mobility. However, the strength of the balance between urban and counter-urban directions in residential mobility depends on economic periods, with more “push” away from Tallinn urban region in times of economic downturn leading to increased proportion of counter-urbanisation in migration balance, while the “pull” of Tallinn urban region and urbanisation is stronger when the economy is growing (Figure 5). The economic logic of counter-urban residential mobility in Estonia is given further nuance by the fact that people in highly skilled occupations showcase the most sensitivity to the economic situation in their residential trajectories, meaning that their Migration Concentration Index is particularly fluctuating between periods of economic boom and bust. Therefore, highly skilled occupational group emerges as a key contributor to counter-urbanisation, even when considering that the overall mobility rate of the highly skilled population does not differ significantly from medium-skilled, and in most time periods, neither from the low-skilled occupational group.

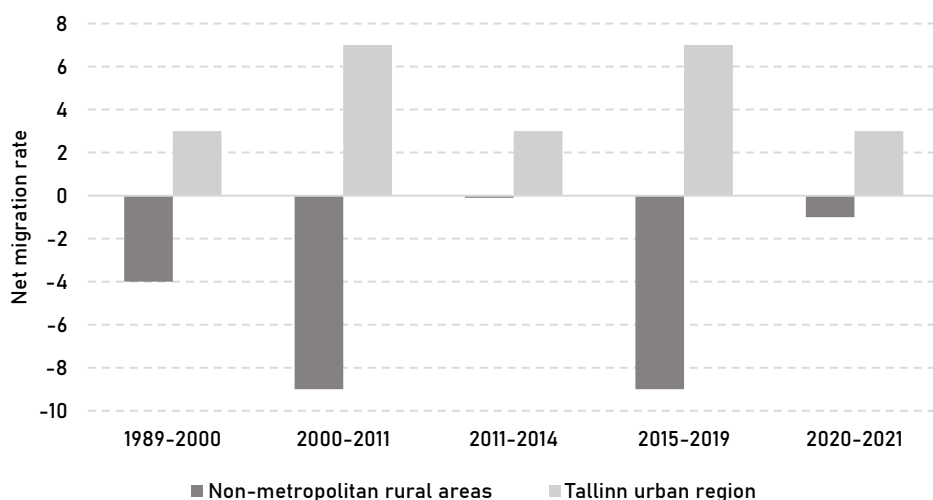


Figure 5. Net migration rate in non-metropolitan rural areas and in the Tallinn urban region (%), 1989–2021. Source: **Publication III**, Fig. 2

The specific context of digital transition lends support to the processes of nationwide residential expansion and counter-urbanisation, as tech workers became residents in a much larger number of localities across the Baltic States by 2021, compared to 2011 (**Publication IV**). While the number of tech workers in most localities remains small and the local demographic impact thus is limited, tech workers can be important from the socioeconomic perspective of regional and rural development, especially in Estonia, where in many localities tech workers form at least 2% of the working residents' population (Figure 4). Amenity-rich locations are in a particularly favourable position from this regard. Tech workers, similarly to the highly skilled population in general, prefer coastal areas in counter-urban environments – in Estonia, islands, and in Lithuania, the Curonian Spit emerges with a comparatively higher share of local residents – tech workers (**Publication III and IV**).

The existing settlement system structure influences how the interaction between occupational and residential change manifests itself across nationwide space. The monocentricity-polycentricity continuum of settlement systems was considered in a comparative framework in **Publication IV**. In 2011, Latvia had the highest share of tech workers in the capital city across the Baltic States, with Lithuania having a similar share as Estonia but with smaller share in capital city's suburbs and higher share across regional centres (Figure 6). This situation reflected each country's differentiated position in the existing settlement system structure, with Latvia being the most monocentric and Lithuania – the most polycentric. By 2021, Estonia and Latvia had converged to similarly monocentric residential distribution of tech workers between the capital city, suburbs, regional centres and the rest of the country. The polycentric settlement system structure of Lithuania, however, supported counter-urban redistribution of tech workers, as they

significantly decreased their share in Vilnius, while increasing residential presence outside Vilnius metropolitan region and regional centres. Meanwhile, Latvia was the only Baltic country with growing relative share of tech workers in the capital city suburbs, thus highlighting the continued importance of suburbanisation in Latvia, which contrasts to the more diversified residential change pathways in Estonia and Lithuania.

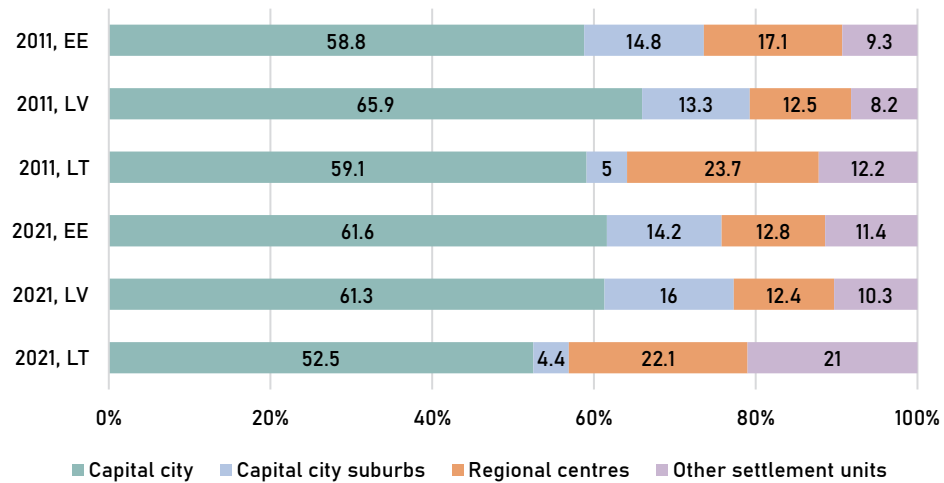


Figure 6. Relative residential share (%) of working-age (25–64) tech workers in 2011 and 2021 across countries and settlement unit levels. Adapted from **Publication IV**, Figure 3

The nationwide scale is also where the role of other, individual-level mediating factors can be fully addressed. Estonian case highlights that younger inhabitants – aged 15 to 29 – are particularly mobile, and they are also much more directed towards the capital city region in their residential mobility (**Publication III**). On the contrary, tech workers in early career life stages have oriented themselves away from cities. The relative residential share of 25–34-year-old tech workers outside capital city metropolitan regions and regional centres has increased in Estonia and Lithuania, even when their share in the tech workforce has decreased (Figure 7a, 7b, 7c). In Latvia, the relative share of tech workers in the age group 25–34 has decreased more notably in Riga, Riga suburbs and regional centres than in the rest of the country, increasing the difference in the presence of younger tech workers between the settlement system levels. The results of the binary logistic regression model in **Publication IV** confirm that tech workers in the age group 25–34, as well as single tech workers, are more likely to live outside capital city metropolitan regions, suggesting a particular life course profile in terms of counter-urban residence. Additionally, increased income is associated with decreased odds for living outside Tallinn metropolitan region amongst tech workers, compared to living within the capital city (**Publication II**).

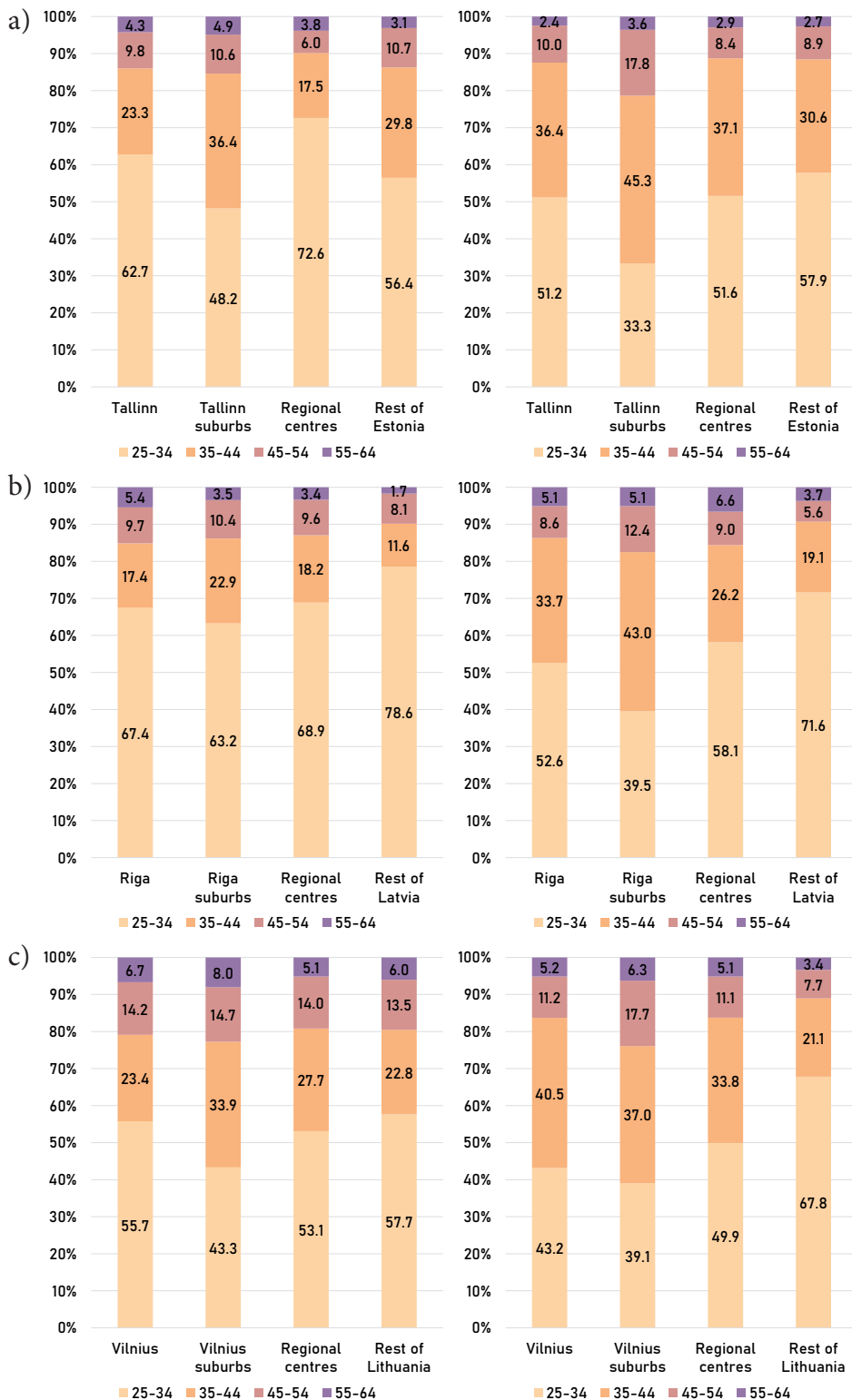


Figure 7a, 7b, 7c. Relative residential share (%) of tech workers across age groups and settlement units in 2011 and 2021 in Estonia (7a), Latvia (7b) and Lithuania (7c) (left – 2011, right – 2021). Adapted from **Publication IV**, Figure 6a, 6b, 6c

Furthermore, the ethnic dimension is an important factor explaining counter-urban residential differentiation. While the Russian ethnic minority in Estonia is already highly concentrated in Tallinn and Northeast Estonian cities, digital transition amplifies this ethnic concentration, as minority tech workers clustered towards Tallinn between 2011 and 2021, while ethnic majority tech workers dispersed across the settlement system (**Publication II**). Such residential trajectories have been a consistent differentiating feature of Estonian- and Russian-speaking population groups' residential mobility since 2000s (**Publication III**). This has led to increased nationwide ethnic segregation not only between tech workers, but also between minority tech workers and the rest of ethnic majority workforce (**Publication II**). Therefore, urban and counter-urban scales show an opposite picture regarding changes in ethnic segregation.

6. DISCUSSION

6.1. Digital transition as an occupational trajectory

Occupational structure serves as an indicator of the distribution of socioeconomic opportunities in a society. These opportunities, when expressed as the availability of resources, are fundamental to residential decision-making, which in turn leads to residential restructuring. Occupational structure itself is dynamic, with the contemporary debate on this process being divided between polarisation and professionalisation trajectories, where the former describes an occupational structure dominated by high- and low-skilled occupations, while the latter indicates growth specific to highly skilled occupational groups. The main trends of occupational structure change across Europe have pointed to professionalisation (Oesch & Piccitto, 2019; Ubarevičienė et al., 2026). While professionalisation can be seen as occupational upgrading, it does not exclude some growth in the lower levels of the occupational structure, or ‘polarised upgrading’ (Oesch et al., 2025). In either case, it suggests an overall improvement of people’s socioeconomic conditions, as more people work in occupations that are able to offer higher incomes. The findings of **Publication I** support this: a high share of professionals and managers tends to form in cities with less pronounced income inequality contexts.

The digital transition adds another layer to contemporary occupational dynamics of professionalisation. The development of the tech sector has contributed to occupational class restructuring, with tech workers emerging as leaders in the growth of the professional class across Europe (Oesch et al., 2025; Vas et al., 2024). The increasing importance of tech workers in the highly skilled workforce emerges as a dominant occupational trend in Estonia and across the Baltic States. Lithuania stands out in this regard, combining a particularly high rate of growth of tech workers with high levels of professionalisation, which underlines the significant contribution of the digital transition to the expansion of the professional and managerial class. Furthermore, the impacts of tech sector growth are most notable among early-career stage workers. At this stage, the selected field of work has long-lasting impacts not only on occupational but also on broader life course trajectories.

Tech workers are particularly well positioned in this regard. The growth dynamics of the tech sector has allowed an increasing number of young professionals to enter the highest income brackets. This expands their opportunity set, allowing tech workers to translate a lucrative labour market position into improved personal and household conditions. Often, this is done by making residential adjustments. As emphasised in **Publication I**, strong links between labour and housing markets exist in an urban context. Thus, occupational upgrading provides the conditions for changes in housing demand, which in turn lead to residential restructuring. As work opportunities in the tech sector are concentrated in cities, both globally (Braesemann et al., 2022) and in Estonia (Aasa et al., 2026), the largest shifts in occupational structure – and therefore residential restructuring –

can also be expected at the intra-urban scale. However, the second key characteristic of tech workers is their ability to work remotely. This can widen the spatial reach of their residential decision-making or, conversely, support staying in place, when otherwise obtaining a highly skilled position would often necessitate a residential move. In either case, the additional factor of remote work induces suburban and counter-urban residential restructuring, thus highlighting tech workers as a dynamic occupational class with a key role in broader residential restructuring processes.

6.2. Tech workers as agents of change in urban segregation

Intra-urban residential restructuring has a strong inequality component. From the ethnic dimension, the digital transition appears to decrease existing inequalities. The dual trend of residential change among ethnic minority tech workers in Tallinn – an increase in representation in inner city neighbourhoods paralleled by a switch from over- to under-representation in the most distant housing estate neighbourhoods – suggests that ethnic minority tech workers have used their occupational position as a lever to move into more attractive urban residential environments. While upgrading their living conditions, ethnic minority tech workers also experience spatial integration, especially with the highly skilled ethnic majority. Thus, these processes of residential change are in line with the spatial assimilation framework (Massey & Denton, 1985). As tech workers constitute a larger part of the highly skilled occupational group for ethnic minorities – particularly among younger cohorts – this underlines the importance of the digital transition in acquiring residential assimilation in the early stages of independent housing careers. It also suggests the continued role of occupation and the associated income in the ability of younger generations to enter urban housing markets, as wealth accumulation becomes a more important driver of housing inequalities, including in Tallinn (Coulter, 2023; Kährik & Pastak, 2023).

These findings also give more nuance to residential restructuring processes in post-socialist cities. After the ethnic majority moved away from housing estates to increasingly favourable inner-city neighbourhoods, a similar residential trajectory has since been taken by the most successfully integrated members of the ethnic minority. This decreases ethnic segregation, yet also intensifies and diversifies the gentrification of the inner city (Kubeš & Kovács, 2020). It also highlights the scope for inner-city redevelopment in post-socialist cities, supported by labour market professionalisation from the demand side, and housing market development from the supply side, reiterating the tight links between urban labour and housing markets. In many European cities, the demand for high-end inner-city housing has outpaced the supply (Ubarevičienė et al., 2026). However, in Tallinn, residential clustering of tech workers is largely limited to the inner city. On the one hand, the professionalisation and growth of tech workers in Tallinn are not as pronounced as, for example, in Vilnius, thus keeping the demand-side factors in balance. On the other hand, it may also be that the transition to a free-market

economy and rapid economic growth indicators – together with the wide availability of disinvested housing and land units in the aftermath of the socialist period – have stimulated real estate development to the extent that there is an oversupply in the upper segment of the housing market.

However, the full intra-urban residential restructuring effects of tech workers' changing residential patterns are reflected in the increasing class-based segregation and residential isolation of housing estate residents. Considering that Tallinn's housing estates have previously been identified as areas experiencing social decline (Kalm et al., 2023; Leetmaa et al., 2018), the findings of further spatial isolation are a cause for concern from the perspective of cohesive urban development. Such a trajectory of housing estate neighbourhoods highlights the difficulty of breaking the vicious circles of segregation (Tammaru et al., 2021) – while the digital transition has selectively allowed desegregation through the occupational dimension, the overall residential mobility from segregated neighbourhoods remains low (Nieuwenhuis et al., 2020). Class-based segregation can be exacerbated not only by the digital transition, as further highlighted in **Publication I**, but also by broader structural inequalities, as well as by urban planning approaches, such as the 15-minute city, which can escalate activity space segregation if not applied appropriately to the local context. This has motivated calls for a comprehensive policy framework to tackle the challenges of segregation – ranging from housing policy and transport planning to economic and ethnic integration (Ubarevičienė et al., 2026). In the specific context of Tallinn in the age of digital transition, this thesis underlines the need for inclusive policy measures, focusing on improving the profile of housing estates. This can be done through community-building activities, as well as by retrofitting existing housing stock and diversifying it through new housing construction. Furthermore, public transport connections need to be strengthened to ensure the connectivity of the housing estate residents with the rest of the city and its population, thus minimising the effects of residential isolation.

These findings also shed new light on professionalisation-polarisation dynamics. While professionalisation may be the prevailing process in the occupational dimension, socio-spatial polarisation can be identified as an outcome of residential restructuring. Polarisation has also emerged in housing markets (Hochstenbach & Arundel, 2020), and strong urban labour-housing market links (**Publication I**) can reinforce this trend through labour market professionalisation, leading to further residential polarisation. Thus, it could be argued that the perspective on professionalisation and polarisation should be extended beyond a single, occupational dimension. This further strengthens the view that professionalisation and polarisation are not exclusive processes; instead, they can take place in parallel, as already highlighted through the notions of 'asymmetric polarisation' (Hamnett, 2024) and 'polarised upgrading' (Oesch et al., 2025) describing occupational class restructuring.

6.3. Residential restructuring beyond the capital city

In addition to intra-urban transformations, the largest cities continue to exert their spatial influence under the conditions of digital transition, as witnessed through the trends of suburbanisation and counter-urbanisation. Across the population of Estonia, urbanisation continuously outweighs counter-urbanisation in the structure of internal migration. Furthermore, tech workers' residential differentiation largely reflects the existing settlement system structures. The continued dominance of the capital city in residential restructuring processes remains even when considering that highly skilled workers are more inclined to counter-urbanisation, and that there is a substantial increase in the number of localities where tech workers reside. The agglomerative effects of the digital transition can be explained in several ways. First, counter-urbanisation gains momentum in times of economic bust, while the tech sector has experienced substantial growth, which suggests that tech workers were able to largely bypass economic difficulties in the study period. Second, the advent of remote work has in practice been largely limited to hybrid work (McCollum, 2025). Thus, residential restructuring is limited, as workers remain linked to the physical location of their workplaces, reinforcing the dominant role of metropolitan areas (Reuschke & MacLeavy, 2026).

However, certain regions and places in the Baltics appear to have benefitted from the digital transition and the associated residential restructuring. First, the largest regional centres emerge as core tech hubs in the more polycentric contexts of Lithuania and Estonia. These cities – Kaunas in Lithuania and Tartu in Estonia – are characterised by the presence of major universities. In combination with sufficiently strong local labour markets and more affordable housing markets, these cities appear to make a strong case for retaining graduates in tech-associated fields, offering a viable alternative to the capital city for settling down. Secondly, localities which are outside yet close to the currently recognised metropolitan region have gained a population of tech workers as part of the 'extended doughnut' (Ahrend et al., 2025). The settlement system structure has a role in shaping opportunity structures which influence residential decision-making at the metropolitan level. In Estonia, where the 'extended doughnut' is most pronounced, long-term development has been more limited to the city boundaries, leaving room for eventual residential expansion. This is the most notable dispersive effect of the digital transition, further supporting the notion of developing strong regional universities, as it can stimulate population growth not only for the regional centre itself, but also for its surrounding municipalities. Third, coastal areas and islands appear to be favoured in selective counter-urbanisation, not only by tech workers but also by the highly skilled population more broadly, fitting with the lifestyle motivations of counter-urbanisation. However, broader counter-urbanisation trends – specifically its increase during economic downturns – offer more nuance to understanding its drivers, highlighting the importance of counter-urbanisation as an economic resilience strategy. Furthermore, the findings reveal income disparities between tech workers living in capital city metropolitan areas and those in counter-urban regions. Therefore, the digital transition may not hold the expected regional socioeconomic development prospects, especially when considering the limited magnitude of counter-urban residential restructuring

(Knuepling et al., 2025). For coastal regions that are too distant from major labour markets, economic policy should focus on stimulating growth in local, highly skilled jobs, rather than relying on the limited pool of remote workers (Reuschke & MacLeavy, 2026).

Regarding regional demographic trajectories, the finding of younger tech workers being more likely to live outside of capital city metropolitan regions deserves further attention. This is a reversal of the classic life course notion, where the residential mobility of younger people to urban regions is expected. For tech workers, the attraction of cities may be fading, as their occupation allows them to expand their job search without residential relocation. As tech workers are most present amongst the younger cohorts of professionals and managers, the digital transition seems to offer an interesting pathway for regional demographic development, where retaining or returning younger highly skilled workers becomes a viable option, rather than attracting population from elsewhere.

6.4. Study limitations and directions for future research

Some limitations of the research constituting this thesis should be noted. By addressing these, future research agenda can be proposed. First, while the research framework is set to investigate the processes of residential restructuring, the cross-sectional study design of **Publications II and IV** does not allow for an explicit distinction between the roles of residential and social – or occupational – mobility. While research on residential restructuring has been so far largely focused on residential mobility, the processes of moving and staying interact to generate local population dynamics and neighbourhood change (Bailey et al., 2017; Coulter, 2023). Furthermore, the role of job mobility and associated residential stability has more recently gained attention in the specific context of digital transition (Hostettler Macias et al., 2025; Reuschke & MacLeavy, 2026). This is particularly important in the context of this thesis, which puts occupational status at the core.

Therefore, a longitudinal approach is necessary to identify the extent to which changes in tech worker residential patterns can be explained by residential relocation, as opposed to in situ changes related to the expansion of the tech sector. This should be done within the framework of the life course approach, extending it beyond the study design of **Publication IV**, where life course considerations are largely limited to age. The life course approach allows researchers to capture the variety of residential patterns and processes (Coulter, 2023). It has also been proposed as a way to better understand residential change as part of the digital transition (Hostettler Macias et al., 2022). Therefore, building upon the life course approach would make it possible to distinguish the inter-related roles of the various life domains in residential decision-making, and to interpret the resulting patterns of residential mobility and stability to describe how places change. However, such a study would be impossible to implement strictly with census data due to its 10-year time period. This is where register data comes into play – as suggested by **Publication III**, access to yearly data allows for tracking life course trajectories with sufficiently great detail.

7. CONCLUSIONS

The digital transition is a wide-reaching process characterising contemporary economic and social relations. It affects labour markets and thus contributes to changes in occupational structure, where the tension between polarisation and professionalisation is central. Occupational class, meanwhile, is a central mechanism explaining residential patterns. Thus, wider societal transformations, such as the digital transition, may affect residential decision-making through occupational change, leading to residential restructuring. Considering that most dynamic labour markets are traditionally in cities and the close links between urban labour and housing markets, residential restructuring is most likely to occur first at the intra-urban scale, ultimately shaping segregation levels and patterns. However, the digital transition is associated with remote work, which can decouple the links between the location of home and workplace. In this case, urban-suburban, or metropolitan residential dynamics may be influenced. Finally, counter-urbanisation as a residential trajectory has gained popularity, which can also be reinforced by the digital transition, leading to residential restructuring at the counter-urban scale. The ways in which residential restructuring operates are mediated by several personal-level factors that influence residential decision-making, most notably life course and ethnicity. In addition, settlement structure conditions residential dynamics across intra-urban, metropolitan and counter-urban scales.

This thesis offers two fundamental original contributions. First, it conceptualises the links between the digital transition, occupational change and residential restructuring across multiple spatial scales. Second, these linkages are empirically tested by addressing residential change in a comprehensive spatial framework, considering intra-urban, metropolitan and counter-urban change as inter-linked outcomes of residential restructuring. A further strength of this thesis lies in its comparative study design. While the primary empirical focus of this thesis is on Estonia, it is complemented by an analysis of countries with comparable historical and digital development backgrounds: Latvia and Lithuania. In this way, the thesis benefits from the extensive, harmonised data infrastructure development across the Baltic States, which has so far seen limited comparative research application. In addition, the findings are set against the wider European context, building upon previous comparative research.

The empirical contribution of this thesis is achieved through an in-depth study of highly skilled tech workers, an occupational group that possesses two main characteristics expanding their residential choice: exceptionally high incomes and remote work capability. These factors differentiate tech workers from the rest of the workforce, including from other highly skilled workers, thus warranting their selection as an occupational class with the strongest potential impact on residential restructuring in the age of digital transition. The underlying occupational change analysis of this thesis reveals the impact of the digital transition on labour markets, demonstrating significant growth in the number of tech workers, as well as their

share in the occupational structure, particularly among the early-career stage workforce. The growth dynamics of tech workers is more pronounced in contexts of professionalisation, where the share of professionals and managers is high. This highlights the connection between digital and occupational dimensions, at the same time contributing to the professionalisation-polarisation discourse regarding occupational class restructuring, as tech workers reshape the upper end of the occupational structure.

The growing share of tech workers has most notably impacted residential restructuring at the intra-urban scale. This restructuring has a strong ethnic dimension, resulting in the decoupling of eth-class segregation. Ethnic minority tech workers have experienced and contributed to ethnic desegregation, with their residential patterns shifting from housing estates to inner-city neighbourhoods. An unintended outcome of such residential change is an increase in class-based segregation, as ethnic minority residents in low-skilled occupations become spatially isolated in housing estate neighbourhoods. Urban residential restructuring and segregation dynamics underline the interaction between labour and housing markets, with the digital transition magnifying the effects of professionalisation. It also shifts the professionalisation-polarisation dynamics beyond the occupational dimension. While professionalisation dominates over polarisation in the labour market, polarisation manifests itself in the residential sphere. Meanwhile, to address the potential consequences of spatial isolation, a comprehensive policy toolkit is proposed, focusing on housing estates and their residents. This includes community development, housing retrofits and public transport connections.

Residential restructuring effects outside of capital cities, however, have been less pronounced. Capital cities concentrate not only tech workers and their residences, but also the general population, as long-term domestic migration trends reveal that urbanisation prevails over counter-urbanisation as the dominant contemporary population movement trajectory. While the residential mobility of highly skilled workers is more responsive to periods of economic boom and bust, the residential expansion of tech workers has not resulted in significant counter-urban residential restructuring. Instead, residential dynamics largely reflect levels of settlement system centralisation along the monocentric-polycentric continuum. However, some changes in regional dynamics can be identified. The most notable metropolitan level restructuring outcome, in fact, reaches beyond the metropolitan region, with the residential expansion of tech workers beyond the established borders of capital city metropolitan regions. This process is supported by regional centres with major universities. Thus, these cities appear to be in an advantageous position to benefit from residential restructuring in the digital transition, offering educational opportunities, sufficiently active labour markets and relatively affordable housing markets. Meanwhile, counter-urbanisation can be observed in amenity-rich coastal areas, supporting the notion of lifestyle-driven counter-urbanisation. While young families are the population group most actively contributing to counter-urbanisation, the young, single profile of tech workers outside capital city metropolitan regions suggests a reversal of classic life course patterns, offering regional demographic perspectives. Meanwhile, the

increase in counter-urbanisation during economic bust periods, as well as income disparities between tech workers living in the capital city metropolitan region and outside of it, highlight the limitations of the digital transition towards the socio-economic revival of counter-urban regions. Ethnicity also plays a role, with the ethnic majority being more likely to participate in counter-urbanisation, reflecting existing residential differentiation between ethnic groups.

This thesis provides a novel contribution to understanding contemporary socio-spatial dynamics, revealing residential restructuring as a varied outcome of major societal change in the form of the digital transition, which influences labour and housing markets. In addition, it addresses the role of individual factors, namely life course and ethnicity, as well as the spatial structure of settlement hierarchy, in mediating residential restructuring processes. The thesis holds value beyond academic research, with its insights well positioned to inform urban and regional policymaking towards more sustainable social, economic and demographic trajectories in the age of digital transition.

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SUMMARY IN ESTONIAN

Elukohavalikud digiajastul: muutused linna, linnaregiooni ja asustussüsteemi kui terviku tasandil

Tänapäeva ühiskonda iseloomustab digitaliseerumine. Digitaalse mõõtme kasvavat mõju ühiskonnas kirjeldatakse sageli mõistega digipööre (digitaalne üleminek). Digipööre mõjutab ka tööturгу, soodustades tehnoloogiasektori kasvu ja uute töökohtade loomist. Selle tulemusena võivad süveneda juba toimuvad muutused tööturu ametialases struktuuris. Tänapäeva tööturгу iseloomustab professionaliseerumine ehk kõrgelt kvalifitseeritud töötajate, eelkõige juhtide ja spetsialistide, osakaalu suurenemine ametialases struktuuris. Tehnoloogia-töötajad kuuluvad nende ametirühmade hulka, kes digipöördest ja professionaliseerumisest enim kasu saavad, kuna töö tehnoloogiasektoris pakub neile kõrget sissetulekut ning võimalust teha kaugtööd. Need eelised suurendavad tehnoloogiätöötajate valikuvabadust eluasemeturul, võimaldades neil valida suurema hulga elukohtade vahel ning säilitada või parandada oma elamistingimusi. Kuna tehnoloogiätöötajate arv kasvab kiiresti, võivad nende elukohavalikud mõjutada üha enam ka rahvastiku ruumilist paiknemist.

Kuna tööturгу areneb jätkuvalt eelkõige linnades, võib eeldada, et muutused elukohavalikutes avalduvad kõige selgemalt linnapiirkondades, eriti pealinnades. Sellega võivad kaasneda muutused segregatsioonis, mis väljendab erinevate rahvastikurühmade ruumilist eraldumist sotsiaalmajanduslike ja etniliste tunnuste alusel. Samas ei piirdu muutused elukohavalikutes üksnes pealinnadega ning ulatuvad ka linnaregioonidesse ja neist väljapoole. Linnaregioonides võivad linna ja tagamaa eluasemeturgude tihedad seosed seda protsessi võimendada, kuna eluasemete taskukohasus linnakeskustes väheneb ning tagamaa pakub rohkem võimalusi elada avaramates eluruumides. Väljaspool linnaregioone võivad muutused elukohavalikutes väljenduda vastulinnastumises ehk rahvastiku liikumises asustushierarhias allapoole (nt linnast maale). Selliseid valikuid soodustab eelkõige kaugtöö, mis võimaldab tehnoloogiätöötajatel elada oma töökohast kaugemal.

Selle doktoritöö eesmärk on aidata paremini mõista muutusi elukohavalikutes digipöörde tingimustes. Fookuses on ametialase struktuuri muutuste ja elukohavalikute vahelised seosed linna, linnaregiooni ja asustussüsteemi tasandil, keskendudes tehnoloogiätöötajatele.

Doktoritöö eesmärgist lähtudes sõnastasin neli uurimisküsimust:

1. Milliste mehhanismide ja ametialaste muutuste kaudu on digipööre seotud muutustega elukohavalikutes? (Publikatsioonid I, II, IV)
2. Kuidas mõjutavad tehnoloogiätöötajate elukoha muutused segregatsiooni linnas? (Publikatsioon II)

3. Millised muutused iseloomustavad tehnoloogiätöötajate elukohavalikuid linna-regioonis ning millised tegurid eristavad linnas ja tagamaal elavaid tehnoloogiätöötajaid? (Publikatsioonid II, IV)
4. Milline on vastulinnastumise roll kõrgelt kvalifitseeritud elanikkonna, sealhulgas tehnoloogiätöötajate, elukohavalikute muutumisel? (Publikatsioonid II, III, IV)

See doktoritöö keskendub Eesti näitele, pakkudes samal ajal võrdlevat perspektiivi Läti ja Leedu (Publikatsioon IV) ning teiste Euroopa pealinnade kontekstis (Publikatsioon I). Kõrge digitaliseerituse tase ning sotsiaalmajandusliku ja etnilise ruumilise eraldatuse kattumine muudavad Eesti sobivaks paigaks digipöörde ja elukohavalikute vaheliste seoste uurimisel. Lisaks pakub rahvastiku tugev koondumine pealinna ning pealinna ja ülejäänud asustussüsteemi selge eristumine häid võimalusi vastulinnastumise analüüsimiseks. Kuigi doktoritöö keskendub peamiselt Eestile, paigutub selle analüüs laiemasse Balti konteksti. Seda võimaldab Eestis, Lätis ja Leedus välja kujunenud rahvastikuandmete taristu, mis võimaldab teadusuuringutes kasutada indiviiditasandi rahvaloenduse andmeid. Rahvusvahelist perspektiivi avardeb Publikatsioon I, mis tugineb Euroopa pealinnade linnaregioonide varasemale uuringule (Ubarevičienė jt, 2026) ning käsitleb selle tulemusi digipöörde vaatenurgast.

Doktoritöö annab kaks olulist originaalset panust. Esiteks töötab see välja kontseptuaalse raamistiku, mis seob digipöörde, ametialase struktuuri muutused ja muutused elukohavalikutes. Lisaks sotsiaalmajanduslikele ressursidele arvestab raamistik ka teiste individuaalsete tunnuste, eelkõige elukäigu ja etnilise kuuluvuse mõjuga elukohaga seotud otsustele. Teiseks hinnatakse neid seoseid empiiriliselt, analüüsides muutusi elukohavalikutes linna, linnaregiooni ja asustussüsteemi tasandil.

Tehnoloogiätöötajana käsitatakse käesolevas doktoritöös tehnoloogiasektoris töötavaid juhte ja tippspetsialiste. Neid võrreldakse teiste kõrgelt kvalifitseeritud töötajate ning keskmise ja madala kvalifikatsiooniga ametirühmade esindajatega. Lisaks eristatakse eesti ja vene rahvusest elanikke, kuna venelased moodustavad ligikaudu 80% Eesti etnilistest vähemustest. Doktoritöö empiiriline osa tugineb peamiselt individuaaltasandi rahvaloenduse andmetele. Publikatsioonides kasutatakse peamiste analüüsimeetoditena segregatsiooniindekseid, kaardianalüüsi ning logistilist ja lineaarset regressioonmodelleerimist.

Ametialase struktuuri muutuste analüüs näitab digipöörde mõju tööturule. Tehnoloogiätöötajate arv ja osakaal ametistruktuuris on märkimisväärselt suurenenud, eriti karjääri algfaasis olevate noorte töötajate seas. Nende osakaal on kõige kiiremini kasvanud linnades, mida iseloomustab professionaliseerumine ehk spetsialistide ja juhtide osakaalu suurenemine ametistruktuuris. Tulemused osutavad digipöörde ja ametialase struktuuri muutuste tihedale seosele. Ühtlasi toetavad need arusaama tööturu professionaliseerumisest ja polariseerumisest, näidates, et tehnoloogiätöötajad moodustavad üha olulisema osa ametistruktuuri kõrgematest tasanditest.

Linnasisesel tasandil on Tallinnas toimunud märkimisväärsed muutused tehnoloogiatöötajate elukohavalikutes. Kui varem olid vene rahvusest tehnoloogia-töötajad üle-esindatud paneel elamurajoonides, siis nüüd on nad koondunud rohkem kesklinna naabruskondadesse. Seetõttu on vähenenud rahvuspõhine ruumiline eraldatus, kuna kesklinnas on eestlaste osakaal suur. Samal ajal on suurenenud sotsiaalmajanduslik ruumiline eraldatus, eriti keskmise ja madala kvalifikatsiooniga etniliste vähemuste seas, kes elavad valdavalt jätkuvalt paneel elamurajoonides. Tulemused viitavad sellele, et digipööre ja professionaliseerumine mõjutavad etnilist ja sotsiaalmajanduslikku ruumilist eraldatust erinevalt, suunates neid vastandlikes arengusuundades. Etniliste vähemuste suurenenud ruumiline isolatsioon viitab ühtlasi sellele, et professionaliseerumise mõju ei piirdu üksnes ametialase struktuuriga. Selle asemel võib ametialane professionaliseerumine viia linna eri osade elanike ruumilise polariseerumiseni.

Lisaks linnasisestele muutustele elukohavalikutes ulatub suurimate linnade mõju digipöörde tingimustes kaugele väljapoole linnapiire. Sellele viitab asjaolu, et eeslinnastumise ja vastulinnastumise mõju asustusstruktuurile on jäänud suhteliselt tagasihoidlikuks. Kõigi Balti riikide pealinnades ning Eesti ja Leedu suurimates regionaalsetes keskustes, Tartus ja Kaunases, on tehnoloogiatöötajate arv märkimisväärselt kasvanud. Eestis ja Leedus ulatub eeslinnastumine ka pealinna linnaregioonidest väljapoole, samas kui Lätis piirdub see peamiselt pealinna linnaregiooni siseste liikumistega. Need erinevused peegeldavad asustussüsteemide ajaloolist arengut. Tallinna linnaregiooni näitel ilmneb, et eeslinnades elavad tehnoloogiatöötajad on suurema tõenäosusega eestlased, neil on sagedamini leibkonnas lapsi ning nad kuuluvad enamasti kõrgeimasse sissetulekurühma. Kõigis Balti riikides on eeslinnades elavad tehnoloogiatöötajad keskmiselt vanemad kui mujal.

Kuigi vastulinnastumine on muutunud üha levinumaks, ületab linnastumise mõju Eesti siserändes jätkuvalt vastulinnastumise mõju. Ka digipöörde tingimustes säilitavad pealinnad keske rolli elukohavalikute kujundamisel. Seda vaatamata asjaolule, et kõrgelt kvalifitseeritud töötajad panustavad suhteliselt aktiivselt vastulinnastumisse ning tehnoloogiatöötajate elukohavalikud on märkimisväärselt avardunud. Digipööre soodustab siiski jätkuvalt tehnoloogia-töötajate koondumist suurematesse linnadesse ning sellel on mitu põhjust. Esiteks on vastulinnastumine tavaliselt tugevam majandusliku ebakindluse või kriiside ajal, samas kui tehnoloogiasektor kasvas uurimisperioodil kiiresti ning tehnoloogiatöötajaid mõjutasid majanduslikud raskused suhteliselt vähe. Teiseks toimub kaugtöö enamasti hübriidse töökorralduse vormis, mistõttu püsib vajadus regulaarselt kontoris käia. See omakorda piirab võimalusi elada suurematest linnadest kaugemal.

Siiski on mõned Balti riikide piirkonnad ja linnad digipöördest ning sellega kaasnevatest muutustest elukohavalikutes märkimisväärselt võitnud. Tartu ja Kaunas on kujunenud olulisteks tehnoloogiakeskusteks Eesti ja Leedu suhteliselt polütsentrilises asustussüsteemis. Mõlemas linnas paiknevad suured ülikoolid, mitmekesised tööturud ja pealinnaga võrreldes taskukohasemad eluasemeturud. See loob head eeldused tehnoloogiavaldkonna lõpetajate hoidmiseks ning pakub

pealinnale atraktiivset alternatiivi elukoha valikul. Tehnoloogiatöötajate elukohavalikute laienemine suurlinnapiirkondade piiridest väljapoole toetab omakorda tugevate regionaalsete ülikoolide arendamise ideed. See võib soodustada kõrgelt kvalifitseeritud elanikkonna kasvu mitte ainult regionaalsetes keskustes endis, vaid ka neid ümbritsevates omavalitsustes. Vastulinnastumise sihtkohtadena eelistavad rannikualasid ja saari nii tehnoloogiatöötajad kui ka teised kõrgelt kvalifitseeritud töötajad.

Doktoritöö tulemused pakuvad olulist sisendit linna- ja regionaalpoliitika kujundamiseks. Tallinnas suurenenud sotsiaalmajanduslik segregatsioon ja etniliste vähemuste ruumiline isolatsioon paneelalamurajoonides osutavad vajadusele senisest kaasavama linnapoliitika järele. Selle saavutamiseks tuleks parandada paneelalamurajoonide elukeskkonda, toetada kogukondlikke algatusi, uuendada olemasolevat elamufondi, soodustada uut elamuehitust ning tagada head ühistranspordiühendused. Regionaalpoliitika seisukohalt on oluline järeldus, et nooremad tehnoloogiatöötajad elavad suurema tõenäosusega väljaspool pealinna linnaregiooni. See viitab muutusele tavapärasel eluteekonnal, mille kohaselt noorte täiskasvanute elukohamobiilsus on olnud üks peamisi linnastumist soodustavaid tegureid. Tehnoloogiatöötajate jaoks võib linnade tõmbejõud väheneda, kuna nende amet võimaldab laiendada tööotsinguid elukohta vahetamata. Arvestades, et tehnoloogiatöötajad moodustavad märkimisväärse osa noorematest spetsialistidest ja juhtidest, võib digipööre avada uusi võimalusi regionaalse demograafilise arengu toetamiseks. Tulemused viitavad, et noorema kõrgelt kvalifitseeritud elanikkonna hoidmine või tagasimeelitamine võib olla tulemuslikum strateegia kui uute elanike ligimeelitamine teistest piirkondadest. Samas ei pruugi digipööre regionaalse sotsiaalmajandusliku arengu seisukohalt olla üheselt positiivne, kuna tulemused näitavad märkimisväärseid sissetulekuerinevusi pealinna linnaregioonis ja sellest väljaspool elavate tehnoloogiatöötajate vahel.

Kokkuvõttes annab doktoritöö olulise panuse tänapäevaste sotsiaal-ruumiliste protsesside mõistmisse. Töö näitab, kuidas digipööre kui ulatuslik ühiskondlik muutus mõjutab samaaegselt nii tööturгу kui ka eluasemeturgu ning kujundab seeläbi elukohavalikuid. Samuti toob doktoritöö esile individuaalsete tegurite, eelkõige elukäigu ja etnilise kuuluvuse, ning asustussüsteemi ruumilise ülesehituse rolli nende protsesside vahendamisel. Doktoritöö väärtus ei piirdu akadeemilise panusega, vaid pakub ka teadmispõhist alust linna- ja regionaalpoliitika kujundamiseks, et toetada kestlikumaid sotsiaalseid, majanduslikke ja demograafilisi arenguteid digipöörde ajastul.

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- Zālīte, J., Ubarevičienė, R., Bērziņš, M., Kalm, K., Leetmaa, K., Krišjāne, Z., & Tammaru, T. (submitted). Digital transition and settlement system change: Tech workers, life course, and residential differentiation.
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Zālīte, J., Kalm, K., Leetmaa, K., & Tammaru, T. (2026). The role of tech workers in ethnicity- and class-based urban segregation. *Nature Cities*, 3(4), 371–379. <https://doi.org/10.1038/s44284-026-00420-4>
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Kalm, K., Zālīte, J., Kāhrik, A., & Tammaru, T. (submitted). Residential integration of newly arrived immigrants: The role of different dimensions of socio-economic status.

Ettekanded konverentsidel:

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- 2025 International Urban Geographies of Post-Communist States Conference (CATference), Tirana, Albaania, "Regional inequalities in digital transition: comparative study of tech sector workers' residential geographies in Estonia, Latvia and Lithuania"
- 2024 International Geographical Congress (IGC), Dublin, Iirimaa, "Ethnic segregation of tech sector workers in Tallinn urban region"
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- 2023 International Urban Geographies of Post-Communist States Conference (CATference), Riia, Läti, "Towards multicultural gentrification: ICT sector worker residential choices in Tallinn"
- 2023 European Network for Housing Research (ENHR) Conference, Łódź, Poola, "Ethnic diversity of ICT sector worker residential patterns in Tallinn urban region"
- 2023 American Association of Geographers (AAG) Annual Meeting, Denver, USA, "Ethnic inequalities in the formation of ICT-sector driven gentrification in Tallinn"
- 2022 International Urban Geographies of Post-Communist States Conference (CATference), Budapest, Ungari, "The impacts of gentrification on contemporary segregation patterns in Tallinn"

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