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Effects of new construction and renovation on ethnic and social mixing in apartment buildings in Estonia

Residential segregation between social groups has grown in European cities, while the housing sector has boomed in major cities since 2009. These two forces raise questions about the role of new housing construction in the growth of segregation. This article explores the sorting of both socio-economic and ethnic groups into three housing types: older, newer and renovated apartment buildings. We employ data from Tallinn, the capital city of Estonia, where new housing construction has been extensive during the past ten years. We link census data with building-level data for publicly subsidised and privately funded housing renovations, and we calculate segregation indices by housing type and construct a multinomial regression model. Results suggest that publicly subsidised housing renovation contributes to continued mixing of socio-economic (occupational) groups, while new housing construction and especially private renovation increase segregation between ethnic and occupational groups. Ethnic and occupational segregation interact most strongly in privately funded apartment building renovations primarily within central city historic neighbourhoods.

Keywords: ethnicity, occupation, Tallinn, Estonia, housing segregation, housing separation, social mixing, housing, housing renovation

Introduction

Housing segmentation and residential segregation between socio-economic groups have increased in Europe in recent decades, but they are still lower than in many other parts of the world, such as cities in the United States (Musterd et al., 2008; Tammaru, Musterd et al., 2016). Changes in ethnic segregation are varied, depending on ethnic groups studied and cities and time periods considered (Andersson et al., 2018; Arbaci, 2008; Lan et al., 2020). The most important structural factors driving these changes relate to growing social inequality, increased marketisation of the European housing sector, and an overlap between ethnic and socio-economic segregation, or ‘eth-class’ segregation (Andersson and Kährik, 2016; Musterd et al., 2017; Torpan et al., 2020). At the individual level, housing segmentation and residential segregation are usually

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explained by income differences, individual preferences and the effects of discrimination. These individual-level differences are reinforced by sorting into housing and neighbourhoods, which is a household-level process. Since similar people – e.g. based on education or ethnicity – tend to partner, income differences generated in the labour market often replicate in the housing market (Tammaru et al., 2021). As a rule of thumb, a stronger market presence is related to more intensive sorting of social and ethnic groups into various types of housing and neighbourhoods. Such residential sorting co-evolves with changes in an urban housing stock that take place in three primary ways: (1) demolition of housing units, (2) construction of new housing units and (3) renovation of existing housing units (or functional conversion of space in buildings that enriches or reduces housing supplies).

We draw our empirical evidence from Estonia's capital city, Tallinn; its housing sector, dominated by private ownership, is one of the most liberal in Europe. Tallinn also has a sizeable minority population. With these conditions, it is not surprising that Tallinn has become one of Europe's most segregated cities during the course of post-socialist transformation (Tammaru et al., 2016). Since housing is at the core of residential segregation (Maloutas and Fujita, 2012; Torpan et al., 2020), we focus on the role of various housing types in the segregation and mixing of ethnic and socio-economic (occupational) groups. Our central research question asks: what is the role of publicly subsidised renovation, privately funded renovation and new housing construction in shaping the residential segregation of ethnic and occupational groups in Tallinn's highly market-based housing system? This research question is of wider importance beyond our study site, since housing marketisation has increased across Europe (Allen, 2006; Dewilde and De Decker, 2016; Lowe, 2003; Norris and Shiels, 2007; Ronald and Dewilde, 2017). In many countries, functional conversion and demolition are also important elements of housing change (Watt, 2021). In Tallinn's dynamic housing market, however, both functional conversion and demolition are rare and therefore omitted from this analysis.

Since the fall of the Berlin Wall in 1989 and the disintegration of the Soviet Union in 1991, vast societal changes have taken place in formerly socialist countries, including changes in economies and political systems (Gentile et al., 2012; Liepa-Zemeša and Hess, 2016; Sykora and Bouzarovski, 2012). Cities – and especially their urban housing stocks – have naturally transformed in response, since the housing stock evolves to accommodate new lifestyles, new opportunities and new aspirations (Krisjane and Berzins, 2012; Kubeš and Kovács, 2020; Mezentsev et al., 2019; Špačková and Ouředníček, 2012). Updating the multi-family housing stock in post-World War II modernist housing in Eastern European cities is a significant challenge, since these apartment buildings have suffered from underinvestment and deferred maintenance both during state socialism and after (Hess and Tammaru, 2019a; Hess et al., 2018a; Kabisch and Grossman, 2013; Vasilevska et al., 2020). Although this housing segment

has largely maintained its social mix and building renovations have become more common, signs of socio-economic downgrading are apparent and consequently young professionals often opt to live in traditional inner-city neighbourhoods instead of housing estates (Kährik and Tammaru, 2010; Hess and Tammaru, 2019a; Kovács and Herfert, 2012; Szabó and Burneika, 2020; Temelová et al., 2011). Consequently, our prime interest is in the role of public-sector-supported renovations – the primary housing intervention strategy in housing estates in Tallinn – in residential mixing and segregation in the urban housing stock.

We begin with a literature review, focusing on ethnic and social segregation and mixing, followed by setting the context for Tallinn. Next we present the research strategy, in which we merge individual-level population and housing census data (for the full population) with comprehensive building-level renovation data. This unique linked database allows us to identify the population composition of all new apartment buildings, publicly subsidised and privately funded renovated apartment buildings, and older (unrenovated) apartment buildings in Tallinn. Our approach allows us to explore levels of residential segregation in those four housing types. We focus on the ethnic and socio-economic differences of people living in various housing types as well as on relevant background characteristics identified from the literature. We conclude by explaining how segregation is affected by housing supply expansion (through new construction) and existing housing supply improvement (through renovation of apartment buildings).

Residential sorting of ethnic and social groups

The residential sorting of people into housing types (housing segmentation) and neighbourhoods (residential segregation) occurs due to various institutional structures, including the degree of privatisation of housing markets, and it also results from discriminatory practices and individual/household choices (or lack thereof) and preferences in choosing a home (Krysan and Crowder, 2017; Tammaru et al., 2021). In a market-based context, segregation is often driven by the residential choices of higher-income groups seeking homes in the most desirable segments of the housing market located in the most attractive neighbourhoods (Hulchanski, 2010; Musterd et al., 2017). Sorting into certain apartment buildings is often explained by a phenomenon known as homophily, in which people choose to concentrate among others with comparable social status, ethnicity, lifestyle or preferences, because they are more comfortable among similar neighbours than among ‘others’ (Blumenstock et al., 2015; McPherson et al., 2001). People with higher incomes have greater resources and hence a higher likelihood of satisfying their individual preferences compared to people with lower incomes (Hess et al., 2012; Leetmaa et al., 2015; Van Ham et al., 2021). Residential sorting into various housing and neighbourhood types can occur

in unregulated conditions but can be disrupted by policy and planning interventions regardless of predominant ownership patterns (private or public) in a housing market (Hess et al., 2018b; Torpan et al., 2020).

At any given time, most of the dwelling units in a housing stock are ‘recycled’ – selling and purchasing, or renting existing housing units – and only a small share is brand-new housing. Older apartment buildings generally have inferior construction quality, and residents, through their housing associations, often seek to renovate older dwellings in order to extend their life expectancy, protect their investments and improve human comforts and energy efficiency (Wassenberg, 2013). Both new housing construction and renovation of the existing housing stock affect the residential sorting of ethnic and social groups. Inner-city neighbourhoods near a city centre or otherwise well-connected site often have cheap dwellings with historic charm in settings with prime access; during recent decades these sites have upgraded quickly, both physically and socially (Bernt, 2016; Hess, 2011; Hess and Hiob, 2014; Korcelli-Olejniczak and Tammaru, 2020; Kubeš and Kovács, 2020; Lees et al., 2016; Wessel and Lunke, 2019). The places usually most in need of policy intervention and financial assistance for renovation include high-rise modernist housing dating from the 1950s to the 1980s (Van Kempen et al., 2004). Such housing is often built in vast planned estates that are characterised by a repetition of high-rise prefabricated apartment buildings and were established in adherence to modernist town planning principles to rationalise construction processes and costs (Hess et al., 2018b; Metspalu and Hess, 2018).

In most European cities, 25 to 75 per cent of the total housing stock consists of apartments in modernist housing estates, with lower shares typical in Western European and higher shares in Eastern European cities (Hess and Tammaru, 2019b; Van Kempen et al., 2004; Wassenberg, 2013). In cities such as Warsaw, Bucharest, Riga, Vilnius and Tallinn, a majority of housing falls into this segment (Krisjane and Berzins, 2012; Marcińczak and Hess, 2020; Marcińczak et al., 2015; Szabó and Burneika, 2020). At the time of their construction, these apartment buildings in most European cities were highly valued because they were new and modern and possessed desirable amenities, and housing estates quickly become home to the working class (Leetmaa and Hess, 2019; Wassenberg, 2013). Their social and ethnic composition has changed over the past decades, and – as a result of rapidly rising house prices in gentrifying inner-city neighbourhoods – they form the most affordable housing segment that provides shelter predominantly to vulnerable people (Bolt et al., 2010; Scanlon et al., 2015; Ogródowczyk and Marcińczak, 2021; Watt, 2021).

Even the most economically vital cities today that are successful in attracting highly skilled specialists require a workforce for lower-order activities (Manley et al., 2016; Musterd et al., 1999); consequently, differences in housing and neighbourhood outcomes are unavoidable because of income inequality. What is most problematic, however, is that two chief dimensions of housing segmentation – socio-economic status

and ethnicity – are often interlinked, since immigrants and ethnic minorities tend to be over-represented in the low-wage labour market, among unemployed persons, and among those living in poverty and working outside the (formal) labour market (Ubalde and Alarcón, 2020). With time, migrants and their descendants have concentrated in modernist housing in many parts of Europe (Hess et al., 2018b; Van Kempen et al., 2004; Wassenberg, 2004). Housing estates also form geographically bounded clusters (Hess et al., 2018b; Hess and Tammaru, 2019a). Many cities experience gentrification of central neighbourhoods, while increased poverty clustering occurs in more affordable housing estates in suburbs (Hochstenbach and Musterd, 2018; Marcińczak et al., 2015; Hess and Tammaru, 2019a). This clustering of ethnic, social and spatial disadvantage in suburbs has been termed ‘eth-class’ segregation by Andersson and Kährrik (2016).

Affected by risk of social downgrading, housing estates have increasingly become the focus of urban policy and urban planning intervention, with the explicit aim of improving their residential environments through, for example, apartment building renovation and investing in public spaces, social infrastructure, urban amenities and accessibility (Hess and Tammaru, 2019a; Lelévrier and Melic, 2018). Interestingly, though, financing for renovation programmes in such areas is often justified by better energy efficiency rather by arguments of social equity. About 25 per cent of CO₂ emissions in Europe emanates from the housing sector (Petersdorff et al., 2006). In formerly centrally planned Eastern European cities in particular, improving the energy efficiency of modernist apartment buildings is often an important element of urban policy affecting housing estates (cf. Kabisch and Grossman, 2013; Kuusk and Kurnitski, 2019).

Housing in Tallinn

We situate our research in Tallinn, the capital city of Estonia, because it provides a compelling setting for studying the role of housing in segregation patterns in a city that has shifted during a 25-year period from absolute administrative control to extreme market functioning of the housing sector (Tammaru, Musterd et al., 2016). The shift sets the stage for housing segmentation and residential segregation. When Estonia was part of the Soviet Union (between 1944 and 1991), social inequalities were low and the majority of people were comparably poor (Kornai, 1992). State-financed construction of large high-rise modernist housing estates provided new apartments; today, almost three out of four people live in this housing segment in Tallinn (Kährrik and Tammaru, 2010; Kährrik et al., 2019). Since they were allocated administratively and rents and maintenance costs were highly subsidised, apartments in socialist Tallinn were within reach of all social groups irrespective of income. This administrative distribution of housing during the Soviet period generally led to higher levels of social

mix and lower levels of socio-economic segregation in Eastern Europe compared to Western Europe (Marcinićzak et al., 2015). Tallinn is an exemplar Eastern European city in this regard (Kährrik et al., 2019; Leetmaa et al., 2018).

However, large-scale migration of Russians and other Russian-speaking ethnic groups for employment in industry led to high levels of ethnic clustering in certain housing segments during the Soviet period; people arriving in Estonia needed immediate housing and they were usually granted apartments in newly built housing in modernist housing estates (Leetmaa et al., 2018). Today, the Russian-speaking population forms an ethnic minority nationally in Estonia but almost half of the population of Tallinn; Estonian is the official language of Estonia, where Estonians form a majority population nationally. After the Soviet Union collapsed, Russian-speakers suffered more from the social transformations that occurred in the 1990s, since the majority of job losses took place in industries that were not competitive in the newly forming market-based economy. Minorities with modest Estonian language skills had particular difficulties securing better-paying jobs in the service sector. Consequently, the Soviet era affected housing outcomes for ethnic and social groups in several ways (Kährrik and Tammaru, 2010; Leetmaa, 2017). First, levels of social mixing were high during the Soviet years and directors and low-skilled workers employed by an enterprise often lived in the same apartment buildings, since housing allocation often occurred through employers. Second, levels of ethnic clustering in certain housing segments were high since Russian-speakers arriving from other parts of the Soviet Union had better access to new apartments. However, virtually no maintenance occurred during the Soviet period, and consequently apartment buildings desperately need renovation today. Third, ethnic minorities have fewer economic resources compared to Estonians, since they suffered more due to the system change from an industry-based planned economy to a service-based market economy. There is some evidence of ethnic discrimination in the Estonian labour market (Saar and Helemäe, 2017) but no explicit discrimination in the housing market (Leetmaa, 2017).

Research strategy and assumptions

Residential segregation is regularly explored in scholarly research at the neighbourhood level but seldom at the more fine-grained level of residential buildings, since segregation is traditionally an area-based phenomenon. Still, certain types of housing opportunities tend to cluster into certain neighbourhoods; individual housing units and the buildings within which they lie therefore become integral to residential decision making and are crucial for understanding evolving urban segregation patterns (Madoré, 2004; Maloutas, 2012). We thus focus our research on people's sorting tendencies into apartment buildings in a city that has undergone a rapid growth of ethnic and socio-economic segregation (Tammaru et al., 2016). In addressing the

topic of housing segmentation, we seek to learn whether or not renovation subsidies (derived from public funds), privately financed renovation and new housing construction increase or decrease housing inequalities between social groups and along ethnic lines.

Two key mechanisms contribute in important ways to housing segmentation and residential segregation in Tallinn. First, apartment owners, on behalf of their flat owners' associations, can take advantage of an energy-efficiency-focused governmental programme in Estonia, known as Fund KredEx (hereafter Kredex), which subsidises the renovation costs of apartment buildings. Only 5 per cent of Soviet-era high-rise apartment buildings in Tallinn are fully renovated to date. Most of these apartment buildings are located in post-World War II modernist housing estates. Second, people may upgrade their own living conditions by relocating to newly built apartment buildings or to pre-World War II multi-family housing located in central city neighbourhoods. Pent-up demand for new housing opportunities produced a residential building and renovation boom in the 2000s that has ebbed and flowed – in the 25 years since the end of socialism – based on various external factors, including rising incomes among certain groups and the liberal market-based functioning of the housing sector.

We give consideration to the complex elements of Tallinn's dynamic housing market, and shifting patterns of residence among socio-economic and ethnic groups, by establishing a series of assumptions upon which our analysis rests. We assume that people working in higher occupations more likely reside in new apartment buildings, in KredEx-renovated apartment buildings and in privately renovated apartment buildings. We further assume that ethnic differences exist and that Estonians more likely live in the three housing segments other than older apartment buildings. Finally, we expect that occupation and language interact so that people with Estonian mother tongue (as a proxy for the ethnic majority) and working in higher occupations most likely reside in new apartment buildings, in KredEx-renovated apartment buildings and in privately renovated apartment buildings.

Data and methods

We employ data from three distinct datasets: (a) an individual-level database from the Estonian Population and Housing Census (2011) for the total population of Tallinn, (b) a complete building-level database of residential renovation grants (from 2010 to 2014, the first granting period) provided by KredEx and (c) a complete building-level data set of privately funded renovations in multi-family apartment buildings provided by Statistics Estonia. The distribution of multi-family apartment buildings is uneven in Tallinn. The largest and newest district, Lasnamäe, provides shelter to approximately 25 per cent of Tallinn's inhabitants and consists mainly of apartment

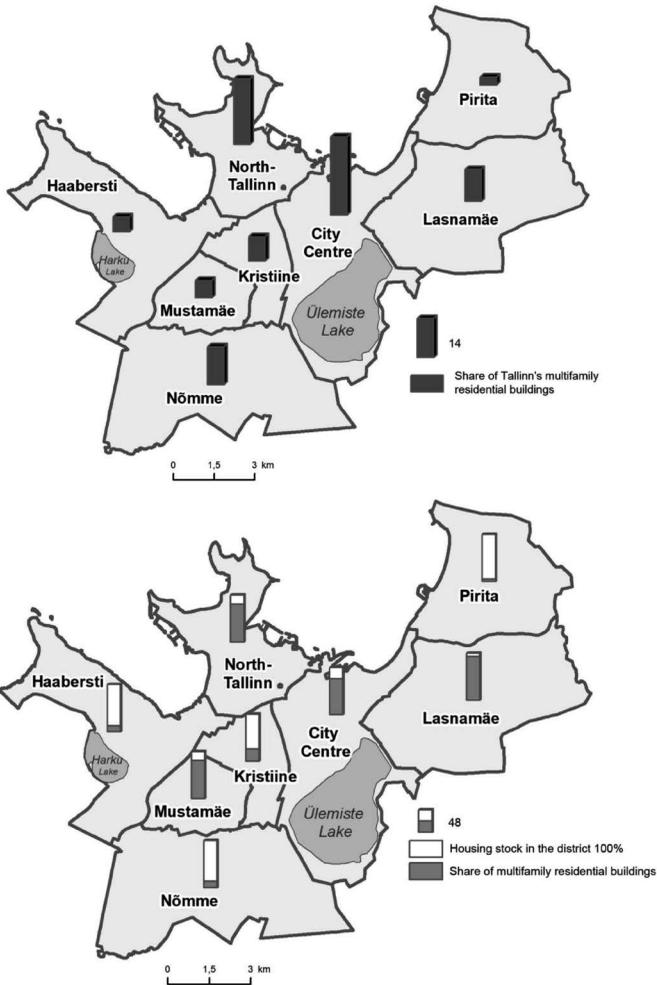


Figure 1 Distribution of apartment buildings in Tallinn

buildings (Figure 1). Constructed during the 1980s, it contains affordable flats. The second-largest Soviet-era housing district, built in the 1970s, is located in Mustamäe. The third-largest modernist housing estate is located in Haabersti, but this district is characterised by a mix of apartment buildings and single-family homes. These three districts are the main targets of KredEx-funded housing renovation. Apartment buildings also dominate the city centre, where buildings are diverse in terms of design and construction period. Finally, north Tallinn is a gentrifying nineteenth-century inner-city district where housing of historic charm and newly constructed expensive houses are increasingly mixed.

When multi-family housing was privatised in the 1990s in Eastern and Central Europe, there were few public funds to support urgently needed renovation programmes. Such funds became available in many countries, however, after they joined the European Union. This is the case in Estonia, where the KredEx public funding scheme was established in 2010 to provide subsidies for the renovation of older apartment buildings to improve their energy efficiency (Lihtmaa et al., 2018). Funding is derived from international carbon-trading resources via European agencies, including the European Regional Fund. Grants (covering approximately 25 to 30 per cent of renovation costs) are used mainly for improving energy efficiency in post-World War II modernist apartment buildings. Housing associations (usually formed by apartment owners in multi-family buildings) can apply to receive co-financing subsidies to be used for energy-conserving building improvements (such as renovating building facades, adding insulation and upgrading mechanical systems, including heating). Social equity is not factored into funding allocations; that is, the socio-economic characteristics of apartment building occupants are not taken into account.

With the assistance of Statistics Estonia, we also compiled a data set of privately funded apartment building renovations, in which apartment owners self-financed improvements, and these renovations occurred primarily in housing situated in central city neighbourhoods of historic value. We link the three data sets using a unique building identifier, allowing us to construct pooled databases of people living in older apartment buildings (built before 2006), newer apartment buildings (built after 2006), renovated apartment buildings using Kredex funding (as of 2011), and privately financed renovated apartment buildings (Figure 1). We define a variable (called 'housing type') that distinguishes which of these four apartment buildings is the place of residence for each individual person; this is the core of our empirical analysis. We include in our data all residential buildings with three or more dwelling units and the universe of all apartment buildings in Tallinn, not merely a sample. These housing units are distributed as follows: 86 per cent are unrenovated older apartment buildings, 5 per cent are new apartment buildings (built since 2006), 7 per cent are renovated apartment buildings using Kredex subsidies, and 1 per cent are privately funded renovated apartment buildings (Table 1). KredEx-funded renovations are spatially concentrated in modernist housing estates as well as central parts of the city possessing Soviet-era infill housing (see Figure 1). Privately renovated apartment buildings are mainly located in historic neighbourhoods near the city centre or in northern Tallinn. Newer apartment buildings are clustered in the city centre and in Pirita, as well as in northern Tallinn. For all housing in Tallinn, about 95 per cent of housing units are in private ownership and about 87 per cent of housing units are owner-occupied (Statistics Estonia, 2017). The rental sector is relatively small and operates predominantly on the private market.

Table 1 Distribution of apartment buildings in Tallinn

	Older apartment buildings		Newer apartment buildings		Publicly renovated apartment buildings		Privately renovated apartment buildings		Total
Haabersti	262	5%	59	17%	24	8%	0	0%	345
City centre	1649	29%	92	26%	69	22%	68	63%	1878
Kristiine	491	9%	29	8%	43	14%	3	3%	566
Lasnamäe	662	12%	52	15%	30	10%	2	2%	746
Mustamäe	321	6%	20	6%	57	19%	0	0%	398
Nõmme	824	14%	18	5%	25	8%	11	10%	878
Pirita	126	2%	45	13%	5	2%	1	1%	177
North Tallinn	1415	25%	41	12%	55	18%	23	21%	1534
Total	5750	100%	356	100%	308	100%	108	100%	6522

The individual-level database is a combined census–KredEx data set; we used the housing identifier for linking the databases. Census data include a rich set of variables for individuals, including demographic characteristics such as sex and year of birth, as well as social characteristics such as occupation. We use the nine main categories of the International Standard Classification of Occupations (ISCO) designated by the International Labor Organization. The census data also include an individual's mother tongue. Estonia is linguistically divided into two main ethno-linguistic groups: ethnic Estonians speak Estonian as a mother tongue (98 per cent) and minorities mainly speak Russian as a mother tongue (90 per cent). In addition, we strive for temporal consistency in the data sets, although most of the variables we use in the individual census data do not vary in time. The most important time-varying variable is occupation. While people may change jobs occasionally or frequently, shifting employment between the main occupational groups is less common. Still, our results related to occupation should be interpreted with greater care compared to our second main variable, mother tongue.

We begin with an ecological analysis of residential segregation by calculating an Index of Segregation (IS) for 'eth-class' pairings for four groups (low-occupation Estonians, low-occupation minorities, high-occupation Estonians and high-occupation minorities) living in four housing types (older housing, KredEx-renovated, privately renovated, and newer housing). This allows us to understand how segregation levels vary within housing types. IS indicates the segregation of a given group from the rest of the population, and it can be expressed as follows:

$$IS = \sum_{i=1}^n \left(\frac{x_i}{X_T} - \frac{t_i - x_i}{T_T - X_T} \right)$$

where n is the number of neighbourhoods; x_i is the number of people in the given group living in neighbourhood i ; X_T is the total number of this group in the city; t_i is the number of all other groups' members in the neighbourhood i ; and T_T is the total number of all groups living in the city. IS values range from 0 to 100. As a rule of thumb, an IS value less than 20 can be considered low socio-economic segregation and less than 30 can be considered low ethnic segregation, while values higher than 40 and 60 can be considered high socio-economic and ethnic segregation respectively (Marcinićzak et al., 2015; Massey and Denton, 1993). We proceed with an individual-level analysis of housing segmentation by focusing on differences in personal characteristics between people living in the four housing types based on the linked census and KredEx and private multi-family renovation data. We specify a series of multinomial logistic regression models:

$$\ln \frac{p(Y_i = j)}{p(Y_i = 1)} = \alpha + \sum_{k=1}^K \beta_{jk} X_{ik}$$

where $p(Y_i = j)$ is an individual's $i = 1, \dots, I$ probability of living in a newer apartment building ($j = 1$), in a KredEx-renovated apartment building ($j = 2$), in privately renovated apartment building ($j = 3$) or in an older apartment building ($j = 4$). Furthermore, α is the constant, and X_{ik} is an individual-level variable (and β_{jk} is the parameter for this individual-level variable), with K variables (Table 2). We focus our discussion around two key variables: mother tongue (representing the major ethnic divisions in Tallinn) and occupation (representing the major socio-economic divisions). We employ the International Standard Classification of Occupations (ISCO-88) major occupational categories, but we exclude military personnel and agricultural workers (since there is a negligible number living in Tallinn). Occupational groups serve as a reasonable proxy for income (income is not included in the census). The ISCO-88 occupational categories are ordered from highest income potential (managers, professionals) to lowest income potential (elementary workers). We study both the main effects of mother tongue and occupations and their interactions. The models also include demographics (gender, age, household status) and other relevant data (education and language skills) as control variables.

Table 2 Distribution of characteristics of apartment building residents

	Older apartment buildings		Newer apartment buildings		Publicly renovated apartment buildings		Privately renovated apartment buildings	
All people in apartment buildings (n)	290,608	86%	19,778	6%	25,223	7%	1,661	1%
MOTHER TONGUE								
<i>Estonian mother tongue (n)</i>	136,387	48%	12,491	65%	13,841	56%	1,500	90%
<i>Russian mother tongue (n)</i>	146,094	52%	6,758	35%	10,784	44%	161	10%
SEX								
<i>Male</i>		44%		47%		43%		47%
<i>Female</i>		56%		53%		57%		53%
AGE								
<i>Age 0–9</i>		10%		19%		9%		13%
<i>Age 10–19</i>		7%		7%		8%		10%
<i>Age 20–29</i>		17%		24%		17%		19%
<i>Age 30–39</i>		15%		25%		15%		24%
<i>Age 40–49</i>		12%		10%		12%		13%
<i>Age 50–59</i>		14%		7%		12%		8%
<i>Age 60–69</i>		11%		4%		11%		6%
<i>Age 70–79</i>		9%		3%		11%		4%
<i>Age 80+</i>		4%		1%		5%		2%
HOUSEHOLD STATUS								
<i>Married</i>		29%		22%		28%		22%
<i>Single parent</i>		8%		7%		8%		7%
<i>Living with a partner</i>		12%		21%		12%		19%
<i>Single</i>		51%		50%		52%		48%
EDUCATION								
<i>Secondary and basic education</i>		83%		80%		83%		62%
<i>Bachelor's degree</i>		9%		10%		9%		21%

	Older apartment buildings	Newer apartment buildings	Publicly renovated apartment buildings	Privately renovated apartment buildings
<i>Master's degree</i>	7%	8%	7%	16%
<i>Doctor's degree</i>	1%	2%	1%	1%
OCCUPATION				
<i>Managers</i>	9%	16%	9%	22%
<i>Professionals</i>	20%	27%	21%	33%
<i>Technicians and associate professionals</i>	16%	21%	17%	19%
<i>Clerical support workers</i>	8%	7%	8%	7%
<i>Service and sales workers</i>	15%	11%	15%	9%
<i>Craft and related trades workers</i>	13%	8%	13%	5%
<i>Plant and machine operators, assemblers</i>	9%	4%	8%	1%
<i>Elementary occupations</i>	10%	5%	9%	4%

Finally, we conducted a one-hour face-to-face interview with the head of the Health and Social Board of Tallinn. The Health and Social Board of Tallinn is responsible for the welfare of the most vulnerable social groups in Tallinn. The aim of the interview was to gain expert feedback about the patterns of housing segmentation and residential segregation in Tallinn found in our study and the possible mechanisms behind them.

Findings

Segregation levels by occupation and ethnicity across housing types

We begin our analysis by investigating the degree of residential segregation among 'eth-class' pairings within the four housing types. Since few people with Russian mother tongue or low-income groups live in privately renovated buildings, we do not include them in the analysis. People with Estonian mother tongue and people with Russian mother tongue are almost equal in share in Tallinn, and 90 per cent of people living in privately renovated apartment buildings have Estonian mother

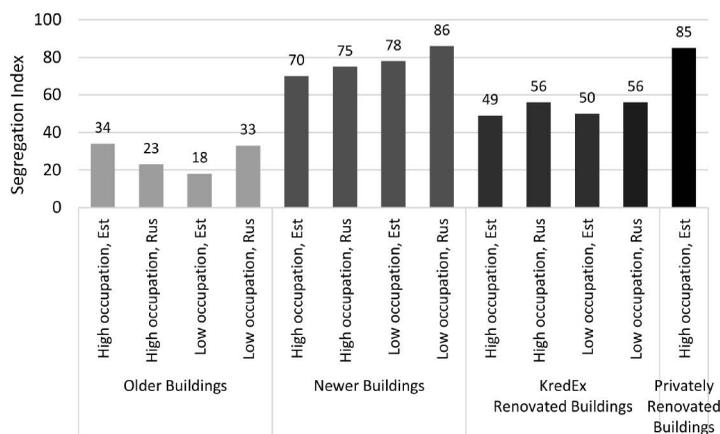


Figure 2
Index of segregation for Estonian speakers and Russian speakers by housing type, 2011

tongue. Likewise, only 10 per cent of residents in this housing type are from lower occupational groups. For the groups that remain in the analysis, we find that segregation varies quite consistently between housing types. Regardless of the ‘eth-class’ group, segregation is the highest in newer housing, moderate in KredEx-renovated housing, and lowest in older housing (Figure 2). Most people live in pre-2006 apartment buildings where segregation levels for all ‘eth-class’ groups are in the medium range, while low-income minorities and high-income Estonians are the most segregated groups (with IS values 33 and 34 respectively). This suggests that some ‘eth-class’ segregation is evident in the older housing stock.

A striking finding is the high level of segregation of all ‘eth-class’ groups living in post-2006 apartments, where IS values are all higher than 70. Equally high is the IS value for Estonians living in privately financed renovated apartment buildings. The value of IS for low-income Russian-speakers living in newer apartment buildings is remarkable at 86, reflecting the most segregated group in Tallinn. A closer inspection of this counterintuitive finding suggests two explanatory reasons: first, the number of low-skilled workers living in newer apartment buildings is small, and second, they primarily live in a small number of newly built and municipally owned apartment buildings in dense formation (newly built municipal social housing in Tallinn, with subsidised rents, has been clustered into a handful of neighbourhoods in the Lasnamäe district).

The interview with the head of the Health and Social Board of Tallinn city government revealed that the first social housing projects launched by the city became spatially clustered due to limited financial resources for carrying out the projects; it was cheaper to build newer housing on a single plot of land than distributed across several plots of land (Torjus, 2016). However, our interviewee confirmed that spatial

dispersal of new social housing construction would be more desirable than concentration, since, due to negative peer effects, it is more challenging to effectively deliver social services, especially for children, in poverty clusters. In other words, municipal housing policy in the late 2000s – used to determine the site for the construction of new subsidised rental apartment buildings – unfortunately still contributes to socio-economic segregation in Tallinn today.

The analysis of IS values shows that residential segregation varies more between housing types than between ‘eth-class’ groups within each housing type. New housing construction as well as privately financed renovations are important drivers of residential segregation, both for high-income and low-income groups. Renovation of apartment buildings in historic neighbourhoods produces especially high levels of segregation along both social and ethnic lines. In a city with nearly equal shares of people with Estonian and Russian mother tongue, Estonians constitute 90 per cent of residents in privately renovated apartment buildings in these desirable historic neighbourhoods.

Individual-level correlates with housing types

Next, we specify multinomial regression models to identify differences in the probabilities of occupational and ethnic groups, as well as people with other demographic or socio-economic characteristics, to reside in the three more attractive types of apartment buildings (newer, privately renovated or KredEx-renovated) relative to older unrenovated apartment buildings (Table 3). In doing so, we hope to identify the types of housing renovation that relate more strongly to ethnic and socio-economic disadvantage. Findings suggest that the differences between residence in older and KredEx-renovated apartments are not statistically significant between occupational groups; however, Estonians are more likely to live in KredEx-renovated buildings (Table 3). Consequently, KredEx-renovated apartment buildings are still socially mixed. However, both ethnic and occupational differences are important when we compare people residing in newer buildings and people residing in privately renovated buildings with those living in older apartment buildings. The main differences are as follows: (1) people with Estonian mother tongue are more likely to live in newer and privately renovated apartment buildings than are people with Russian mother tongue; (2) managers have a higher probability of living in newer and privately renovated apartment buildings than do people with elementary occupations; and (3) most other professional groups, except machine operators, are more likely to live in newer apartment buildings compared to people with elementary occupations.

Table 3 Results of multinomial regression analysis: differences between people living in older, publicly renovated, privately renovated, and newer apartment buildings (relative to people in older apartment buildings)

Variable	New apartment buildings (reference: old apartment buildings)	KredEx-renovated buildings (reference: old apartment buildings)	Privately renovated buildings (reference: old apartment buildings)
	Exp(B)	Exp(B)	Exp(B)
Intercept	-2.924	-2.645	-6.423
Mother tongue Estonian	1.611***	1.384***	7.601***
Mother tongue Russian	Reference Group		
Age 19–24	0.642***	1.001	0.702*
Age 35–49	0.574***	1.027	0.894
Age 50–64	0.324***	0.976	0.571***
Age 65+	0.237***	1.169**	0.549**
Age 25–34	Reference Group		
Married	1.305***	0.999	1.233
Single parent	1.265***	1.001	0.976
Partners	1.532***	0.936	1.187
Single	Reference Group		
Secondary and basic education	0.867***	0.995	0.772**
University education	Reference Group		
Managers	2.073***	0.956	2.160***
Professionals	1.634***	1.019	1.511
Technicians	1.567***	1.033	1.258
Clerical support workers	1.302***	1.069	1.262
Service and sales workers	1.166**	1.021	0.919
Craft and related trades workers	0.893	1.028	0.729
Plant and machine operators	0.824**	0.949	0.265***
Elementary occupations	Reference Group		
Model characteristics	N = 170989 N = 170989 N = 141465		
	-2 Log likelihood = 9351 -2 Log likelihood = 9351 -2 Log likelihood = 6209		

* $p < 0.05$, significant at the 0.05 level; ** $p < 0.01$, significant at the 0.01 level; *** $p < 0.001$, significant at the 0.001 level

Note: This model is also controlled for sex; results not presented here

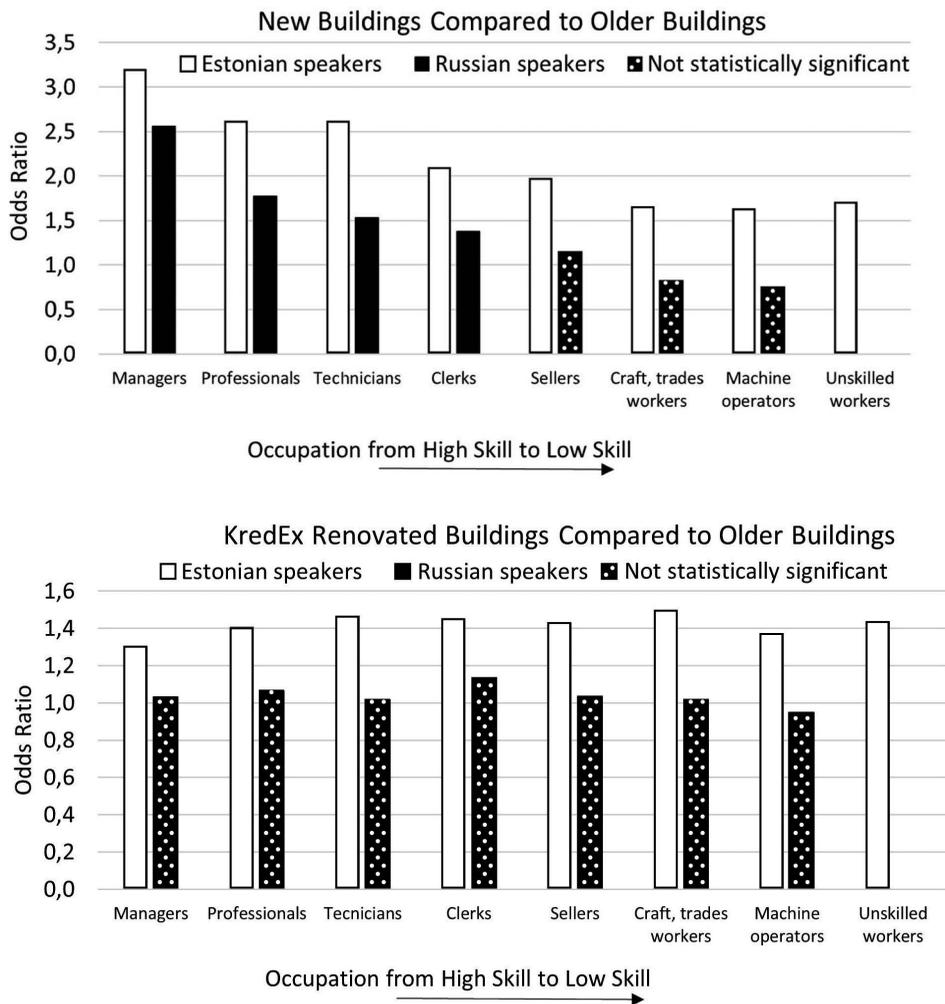


Figure 3 Interaction between mother tongue and occupation for people living in renovated, newer and privately renovated apartment buildings compared to people living in older apartment buildings, 2011

Note: Empty columns are not statistically significant at 0 to 0.05 level

Ethno-linguistic differences are significant in our models (which include occupation and other control variables). In order to further explore relations between ‘eth-class’ and residence in various housing types, we add to our full model an interaction term between mother tongue and occupation. We designate Russian-speakers with elementary occupations as the reference group. (Since the number of people with Russian

mother tongue and low-level occupations is small in privately renovated housing, we are unable to conduct the ‘eth-class’ interaction analysis between older and privately renovated housing.) Findings suggest that ‘eth-class’ differences are the smallest in older apartment buildings and largest in KredEx-renovated housing (Figure 3). Results of the ‘eth-class’ interaction analysis, when comparing the two types of housing stock renewal relative to older housing, yield a clear pattern: differences by occupation and mother tongue are smaller in KredEx-renovated buildings than in newly built apartment buildings. Still, for all Estonians, irrespective of occupation, the probability of living in a KredEx-renovated apartment building is higher than for people with Russian mother tongue and working in elementary occupations. Among people with Russian mother tongue, no occupational group has a higher probability of living in a KredEx-renovated apartment building than people working in elementary occupations. Hence the major division occurs across ethnic rather than occupational lines with respect to people living in older and KredEx-renovated apartment buildings.

Discussion and conclusions

Our central research question was aimed at clarifying the role of publicly subsidised and privately financed housing renovation and new housing construction in shaping the residential sorting by ethnicity and by occupation (or ‘eth-class’ groups) in Tallinn’s highly market-based housing system. Tallinn is a compelling city to study, given that the levels of marketisation and residential segregation have risen in many European cities, and some of the biggest changes in Europe can be found in Tallinn (Musterd et al., 2017). We focused primarily on publicly subsidised or KredEx-renovated apartment buildings, since these represent the main intervention measures for improving living conditions in large housing estates that are at risk of physical and social downgrading in Eastern European cities (Kabisch and Grossman, 2013). However, we also included the two other types of residence in Tallinn’s multi-family housing stock: newly built and privately renovated apartment buildings. We expected that higher occupational groups (assumption 1) and people with Estonian mother tongue (assumption 2) would be more likely live in the three renovated housing segments. We further expected to find that occupation and mother tongue interact with each other, and people belonging to higher occupational groups and speaking Estonian as a mother tongue live most likely in the three renovated housing segments (assumption 3).

Findings from our empirical inquiry suggest (1) that provision of housing renovation subsidies (primarily motivated by energy efficiency) is unrelated to occupational composition of residents but is related to ethnic composition among residents, and (2) that new housing construction accelerates residential segregation between ethnic and occupational groups. Our study thus mostly confirmed assumptions 1 and 2, with the exception that there are no statistically significant differences between the

occupational status of people living in older unrenovated and publicly subsidised renovated apartment buildings. These two housing types occur predominantly in high-rise modernist apartment buildings clustered into housing estates, confirming the continued social stability of these housing estates in Eastern Europe found in previous studies (Hess et al., 2018b; Kährik and Tammaru, 2010; Kovács and Herfert, 2012). Although there are no statistically significant differences between occupational compositions of older unrenovated and publicly subsidised renovated buildings, our study is not able to predict long-term consequences of renovation on the sorting of people into various housing types and residential areas. Large-scale renovation is a recent phenomenon that began only after Estonia joined the EU in 2004, when European funds became available. We thus need more time to observe whether an increased supply of renovated apartment buildings contributes to differential residential mobility patterns by ethnicity and occupation.

While occupational mixing is high in publicly subsidised renovated apartment buildings, we find evidence of an important change in which Tallinn becomes more similar to many Western European cities (c.f. Andersson and Kährik, 2016; Wessel, 2016): ethnic minorities tend to increasingly concentrate in modernist housing in Tallinn on the one hand (Kährik and Tammaru, 2010), but primarily in the least desirable housing units on the other hand. Furthermore, important results relate to our third assumption and stem from the interaction analysis between mother tongue and occupation: for all Estonians, irrespective of occupation, the probability of living in a KredEx-renovated apartment building is higher than for people with Russian mother tongue and working in elementary occupations. Among people with Russian mother tongue, no occupational group has a higher probability of living in a KredEx-renovated apartment building than people working in elementary occupations. This suggests that the major 'eth-class' division occurs in Tallinn across ethnic rather than occupational lines. This is even more evident when it comes to privately renovated housing. We were not able to undertake a more detailed analysis of this segment (although our database includes all apartment buildings and all people living in Tallinn) because there were simply not enough Russian-speakers and low-income groups living in privately renovated apartment buildings to calculate segregation indices or to conduct an interaction analysis between occupation and mother tongue. This finding supports evidence from recent studies suggesting that Estonian-speaking people, not Russian-speaking people, are the key gentrifiers in desirable neighbourhoods in the Tallinn city centre (Holvandus et al., 2015).

Some unexpected findings emerged as well from our analysis. Most importantly, we find that the most segregated group is low-income people with Russian mother tongue living in newly built social housing. While this group is small in size, its segregation is driven by spatially clustered construction of new social housing (because it is cheaper to construct new apartment buildings rather than evenly distribute them

throughout urban neighbourhoods), or by supply side effects. In a strongly market-driven social context with limited city budgets, even new public housing construction programmes entrench and deepen residential segregation instead of cushioning it. Furthermore, city administrators generally recognise that such clustering of social housing exacerbates social problems – e.g. making it more challenging to effectively deliver social services, especially to children living in poverty clusters. Such residential clustering has little connection to homophilious desires to dwell among similar people, but instead to the availability of low-cost apartments that are few in number and highly restricted spatially to certain urban neighbourhoods.

The strong ethnic dimension in housing sorting outcomes related to apartment building renovation processes in Tallinn reflects the long-standing segmentation of Estonia's housing market (Hess et al., 2012; Leetmaa et al., 2015). Since incomes do not restrict housing choices for high-income Russian speakers, such differences can be attributed to preference-based housing sorting (Leetmaa et al., 2015) or to discrimination – either directly or indirectly – of ethnic minorities in the housing market. However, more research is needed, particularly focusing on Russian-speaking groups, to better understand people's residential preferences and housing careers. A host of factors could potentially explain the continuity of own-group neighbour preference among Russian-speaking minorities: minorities have traditionally experienced different opportunities than Estonian-speaking people for information acquisition about housing opportunities due to language barriers, alternative media usage, insular Russian-language-based social networks and different perspectives about neighbourhoods and their assets (Hess et al., 2017; Leetmaa, 2017). Our study shows that these differences persist even in higher-income groups among people with Russian mother tongue, thus contributing to higher rather than lower levels of housing segmentation and residential segregation.

The capital city of Estonia provides compelling insights into residential mixing and segregation by housing type since housing is mainly governed by market forces. In this context, people with different occupational and especially ethnic backgrounds tend to readily sort themselves into certain housing types and residential neighbourhoods. Interestingly, a strong role for markets tends to affect residential sorting along ethnic lines more strongly than along occupational lines. Even public-sector interventions succumb to the rules of the market in Tallinn, amplifying rather than minimising spatial inequalities in residential space. Evidence from Helsinki (Torpan et al., 2020; Vaattovaara et al., 2018) and Vienna (Friesenecker and Kazepov, 2021) reveals that a more equal geographic distribution of social housing would help to keep levels of residential segregation low. Since ethnic minorities are also over-represented among low-income groups, their levels of residential segregation are affected by the supply of social housing. Clustering of social housing occurs because the city government does not own land and must purchase it from the open market. As urban planners

in Tallinn explained to us, buying larger plots of land in the most affordable district (Lasnamäe) helps the city government to minimise costs for construction of new social housing. This contrasts with the experience in nearby Helsinki, Finland, where migrants readily move to desirable neighbourhoods even if they remain in social housing (Torpan et al., 2020).

We identify two important takeaway messages from this study.

- 1 Reversing housing inequalities, especially between ethnic groups, amid today's urban and societal complexities – especially shrinking welfare provision, increased marketisation of the European housing sector and growing numbers of low-income immigrants – is an enormous challenge. Solutions seem to lie, especially in the Eastern European context, in better control of new housing construction, since this is the main driver of residential segregation, and through more publicly subsidised renovation schemes. The latter would mean, first, that renovation of apartment buildings using public subsidies should consider social and ethnic inequality. This applies to many other Eastern European countries (and beyond), since state-financed renovation subsidy programmes funded through carbon trading or European funding schemes focus on energy efficiency rather than on social and ethnic equity (Ahas et al., 2018). Motivating housing renovation among residents of apartment buildings with higher shares of ethnic minorities seems to be the key, since ethnic rather than occupation differences relate to the capacity to apply for and acquire public subsidies to fund apartment renovations.
- 2 When it comes to new housing construction, cities must avoid succumbing to market forces, and instead strive towards applying equitable planning strategies and prescribing sensible rules for housing developers that help to minimise housing segmentation and residential segregation. Eastern European cities adopted liberal planning regimes when they shed their centrally planned histories over two decades ago, but perhaps it is time to reintroduce a degree of governmental oversight of the housing sector. There is recent evidence that families undertake joint decisions concerning where to live and where to school their children (Bernelius et al., 2021; Boterman et al., 2019; Nieuwenhuis and Xu, 2021). Such joint decision making may become the key element in intergenerational transmission of inequality, leading to the vicious circles of segregation as residential segregation and school segregation reinforce each other (Tammaru et al., 2021). The fact that modernist housing estates still possess social stability underscores the importance of interventions – to prevent social erosion – that address ethnic and social equity in addition to physical improvements.

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