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THE IMPACT OF NEW HOUSING ON MOSCOW'S URBAN FABRIC: TRACKING FUNCTIONAL CHANGE WITH MOBILE DATA

Roman Aleksandrovich Babkin^{1,2*} , Svetlana Vadimovna Badina^{3,4*} ,
Alexander Nikolaevich Bereznyatskiy⁵ 

¹Plekhanov Russian University of Economics, Research Laboratory "Medical Informatics and Health Economics", Moscow, Russia

²Federal Center of Competencies in Employment, All-Russian Research Institute of Labor of the Ministry of Labor and Social Protection of the Russian Federation, Moscow, Russia; e-mail: babkin_ra@mail.ru

³Lomonosov Moscow State University, Faculty of Geography, Moscow, Russia

⁴Bernardo O'Higgins University, Santiago, Chile; e-mail: bad412@yandex.ru

⁵Central Economics and Mathematics Institute of the Russian Academy of Sciences, Laboratory of Applied Econometrics, Moscow, Russia; e-mail: artandtech@yandex.ru

Abstract: This article examines how the commissioning and early settlement of large new residential complexes is associated with changes in the functional organization of the Moscow agglomeration. The study integrates two datasets: aggregated anonymized multi-operator mobile-phone location data for October 2021 and October 2023 and an author-compiled database of residential complexes commissioned in 2021–2022. Functional organization is assessed through systematic differences between night-time (residential) presence and day-time (active) presence. An Attractiveness Coefficient (AC) is computed as the ratio of day-time to night-time presence, allowing functional shifts to be analyzed over time at two spatial scales: municipalities and 500 × 500 m localities. The results reveal a pronounced core–periphery pattern. Within the Moscow Ring Road (Moskovskaya Koltsevaya Avtomobilnaya Doroga—MKAD), new housing supply is more strongly associated with redevelopment of previously used land (brownfield). Beyond the MKAD – particularly within 30 km in municipalities of Moscow Oblast and in New Moscow – greenfield projects dominate and coincide with growth in night-time presence; in several territories this is accompanied by strengthening residential dominance. The proposed integration of housing and mobile data provides a scalable approach for monitoring functional imbalance and supports evidence-based coordination of housing delivery with local employment and transport development.

Keywords: mobile operator's data; new housing; spatial structure; urban functions; Moscow agglomeration

1. Introduction

Classical research associated with the Chicago School established an understanding of the city as a system of zones shaped by social interaction and competition among groups for urban space. Early empirical work showed that socio-demographic differences, including

*Corresponding author, e-mail: babkin_ra@mail.ru, bad412@yandex.ru

ethnicity and social status, can intensify spatial differentiation and reinforce neighborhood-level contrasts (Park et al., 1984). This line of inquiry was later extended through more comprehensive models linking settlement patterns to the functional structure of the city and transport accessibility. Within such approaches, commercial and industrial zones tend to align with transport corridors and form a spatial framework relative to which residential areas emerge, often with housing stock of varying quality (White, 1988).

In the literature on USA metropolitan development, rapid suburban growth and the emergence of large, fast-growing suburban municipalities were conceptualized through the notion of “boomburbs” (Lang & Simmons, 2007). Related discussions addressed the suburbanization of immigrant settlement and the formation of suburban ethnic clusters described as “ethnoburbs,” characterized by the co-location of residential areas and business districts (Li, 1998). While these concepts provide a useful starting point for linking migration, housing, and urban space, early ecological models were largely developed on USA cases and are not always directly transferable to European and post-socialist contexts, where spatial dynamics have been shaped by urban decline, immigrant concentration, and subsequent gentrification influenced by market forces as well as planning and housing policies (Vendina, 2022).

In Russian scholarship, housing construction has repeatedly been examined as a major driver of social and spatial change in large agglomerations. For the Moscow region in particular, studies emphasize how new housing supply affects the spatial structure of the capital’s agglomeration and contributes to core–periphery differentiation (Aganbegyan, 2012; Baburin & Tsaplina, 2015; Blokhin et al., 2021; Kuricheva & Popov, 2016; Makhrova, 2013). Research also suggests that migration inflows to Moscow and adjacent territories can act as a powerful stimulus for new residential development, especially where large-scale economy-class projects dominate on previously vacant sites in the inner belt of the agglomeration, often described as the area within approximately 30 km from the Moscow Ring Road (Moskovskaya Koltsevaya Avtomobilnaya Doroga—MKAD; Kurichev & Kuricheva, 2018). According to some estimates, the zone of the most intensive population increase may extend further and, in some cases, reaches distances of about 50–60 km from the MKAD (Babkin, 2024). Additional approaches to housing-market analysis rely on, for example, the geography of purchases and comprehensive spatial comparisons across market segments (Kurichev & Kuricheva, 2020; Popov, 2018).

For the purposes of this article, it is essential to distinguish between two concepts: commuting and migration. Commuting refers to daily movements between the place of residence and locations of day-time (active) presence. The direction and intensity of these movements can be used to interpret the functional organization of a space. Migrants are defined here as individuals who have changed their place of residence as a result of internal migration (from other Russian regions) or international migration. Migration is therefore treated not as a direct indicator of a territory’s functional role, but as a key driver of new residential development. An increase in the number of newcomers may raise housing demand, accelerate the development of new sites, and contribute to subsequent functional shifts, especially where residential construction outpaces the formation of jobs and urban infrastructure.

The Moscow agglomeration concentrates the country’s largest labor market and remains one of the major destinations for both internal and international migration, which sustains steady housing demand, including demand for new construction (Mkrtychyan, 2015). At the same time, relatively few studies directly link the geography of newly commissioned housing to migration-related dynamics and to measurable changes in functional organization at

multiple spatial scales, although the problem has been repeatedly highlighted in research on migration and the development of the capital region (Babkin et al., 2025; Dmitriev & Misikhina, 2016; Mkrtychyan, 2015; Nozdrina, 2011).

Until recently, the empirical base for such analyses in Russia largely relied on surveys, census materials, and municipal statistics from Federal State Statistics Service (Rosstat), which are useful for describing general trends, but are limited in spatial detail, periodicity, and potential biases (Mkrtychyan, 2011). Additional data sources, including analytics-service databases and developers' data, have more often been used in applied market research and much less frequently have served as the basis for academic studies, partly due to barriers of access, cost, and regulatory constraints (Babkin et al., 2022; Cian PLC, 2023). In this context, the present study combines two complementary sources of spatio-temporal information—aggregated multi-operator mobile data and a database of newly commissioned residential real estate – to produce robust quantitative estimates of how new housing construction is associated with migration-related drivers and functional characteristics of territories within the Moscow agglomeration.

Mobile operator data belong to the category of Big Data, increasingly used in urban geo-analytics to capture population distribution and mobility. International studies demonstrate that such datasets can reveal stable rhythms of population redistribution between night-time (residential) and day-time (active) locations, providing a basis for “day–night” functional diagnostics (Sevtsuk & Ratti, 2010). At the same time, conceptual and methodological discussions highlight the opportunities and limitations of large-scale consumer and mobility datasets for analyzing residential relocation and neighborhood change, including issues of validity and representativeness (Ramiller et al., 2024; Toole, 2015). Mobile data have also been applied to quantify mobility inequalities and relate observed movement patterns to the socio-spatial structure of disadvantaged areas (Rodrigues et al., 2021). In Russia, studies using mobile operator data specifically to link newly commissioned housing to functional shifts in urban structure remain relatively scarce (Babkin et al., 2025; Badina et al., 2023). In this study, functional change is operationalized through shifts between night-time (residential) and day-time (active) presence and is related to the geography of newly commissioned large residential complexes.

The aim of the article is to quantitatively assess how the commissioning and subsequent settlement of large new residential complexes (commissioned in 2021–2022) is associated with changes in the functional organization of urban areas in the Moscow agglomeration. Functional change is understood as a shift in the ratio between night-time (residential) and day-time (active) presence derived from anonymized mobile operator data. To ensure seasonal comparability, the analysis uses October 2021 and October 2023 aggregates and the observed changes are related to the geography of newly commissioned residential complexes and their settlement.

Accordingly, the study addresses the following research questions: 1) Where are the main volumes of new housing construction (2021–2022) concentrated spatially and how does this concentration relate to the core–periphery organization of the Moscow agglomeration? 2) How is the commissioning of new housing associated with changes in night-time residential presence at two analytical scales—municipalities and 500 × 500 m localities?, and 3) Is new housing construction associated with systematic changes in day-time population redistribution (inflow/outflow relative to the place of residence) and under what territorial conditions does this reinforce a dormitory profile, that is, increasing residential dominance without a comparable increase in local jobs?

2. Methodology

2.1. Study area

The Moscow agglomeration is treated as an integrated settlement system and a single labor-market area, with the City of Moscow as its core and the municipalities of Moscow Oblast as its periphery. For a correct interpretation of results, administrative units and functional zones of the agglomeration are distinguished throughout the study. The following terms are used consistently: the City of Moscow and Moscow Oblast (both are constituent entities of the Russian Federation); Old Moscow, referring to the territory of Moscow within its pre-2012 administrative boundaries; and New Moscow, referring to the territories incorporated into Moscow in 2012 (transferred from Moscow Oblast) and currently forming part of the City of Moscow (Moscow Government, 2011). These territories differ in governance and planning regimes, housing-market characteristics, and the spatial distribution of jobs. Therefore, comparisons rely on a unified set of indicators with explicitly fixed spatial boundaries.

The analytical framework follows a core–periphery perspective using the MKAD as a key reference boundary. Particular attention is paid to the inner belt of the agglomeration—areas within 0–30 km from the MKAD – because this zone concentrates the overwhelming majority of newly commissioned housing and exhibits the most intensive settlement processes, accompanied by stronger commuting flows and more pronounced functional differentiation. Functional organization is assessed through population redistribution between night-time (residential) presence and day-time (activity-related) presence at two spatial scales: municipalities, and localities – a regular grid of 500 × 500 m cells.

2.2. Dataset and analysis

The empirical basis comprises two main components: 1) a database of newly commissioned residential complexes, and 2) aggregated anonymized mobile-operator data on subscriber locations. The first component is a database of new residential complexes commissioned in the City of Moscow and Moscow Oblast in 2021–2022. This period was selected, first, because comparable mobile-operator aggregates are available for evaluating temporal change and, second, because a time lag exists between commissioning and effective settlement. In practice, the most intensive settlement typically occurs during the first year after commissioning. Therefore, projects commissioned substantially before 2021 or after 2022 are excluded, as the main phase of settlement would not align with the mobile-data time slices used in the study (October 2021 and October 2023). The residential-complex database was compiled from the systematic collection and processing of developers' project declarations. The unit of observation is a residential complex, while key attributes are recorded for each building (block/section) within a complex to support spatial referencing and linkage with mobility aggregates. The collected indicators include the address, actual commissioning date, number of floors, type of residential units (apartments, aparthotel units, etc.), number and total area of residential units, project class (economy/comfort/business, etc.), and coordinates for geocoding, as well as additional characteristics used in subsequent analyses. The final sample contains 424 residential complexes comprising 413,200 apartments with a total residential floor area of 21.1 million m². In addition, a separate

database on primary-market prices was compiled to analyze price characteristics of new supply (the source and time coverage are specified in the corresponding subsection).

The second component consists of aggregated anonymized data on the spatial distribution of mobile subscribers provided by the Moscow Department of Information Technology. The dataset draws on the four largest Russian mobile operators—MTS, MegaFon, Beeline, and Tele2/T2—which together account for about 70% of the national mobile market, thus ensuring broad coverage of subscriber activity patterns. The underlying mobile-data array consists of impersonalized information on subscriber locations aggregated in 500 x 500 m grid cells and recorded with a 30-minute temporal step. Primary processing includes the identification of dominant locations associated with regular night-time and day-time presence, followed by spatial aggregation and the construction of indicators suitable for territorial comparison. To assess functional shifts, the analysis uses indicators of the average number of subscribers with night-time (residential) presence and day-time (active) presence for October 2021 and October 2023. Using the same calendar month reduces the influence of seasonality in year-to-year comparisons. Night-time presence is defined as the number of subscribers for whom a given location is dominant during the night interval (23:00–06:00) across the days of the reporting month, provided that the total time spent in that location accounts for at least 20% of the total night-time hours in the month. Day-time presence is defined as the number of subscribers for whom a given location is dominant during the day interval (10:00–17:00) on working days of the reporting month, provided that the total time spent in that location accounts for at least 25% of the total day-time hours and that the location does not coincide with the subscriber's home location.

Differences between day-time and night-time presence largely reflect commuting (daily movements between places of residence and locations of work and other routine activities). A predominance of day-time presence over night-time presence typically corresponds to territories functioning as day-time activity attractors, whereas the inverse relationship indicates a predominantly residential (“dormitory”) profile.

To quantify the functional profile of territories, an Attractiveness Coefficient (AC) as $AC = \text{day-time presence} / \text{night-time presence}$ was calculated. Values $AC > 1$ indicate an excess of day-time presence (net attraction of daily mobility), while $AC < 1$ indicates a predominantly residential profile. For interpretation, the following typology is applied:

- Attractor: $AC > 1.25$
- Attractive (balanced attractor): $1.00 < AC \leq 1.25$
- Residential-attractive (balanced residential): $0.67 < AC \leq 1.00$
- Residential: $0.50 < AC \leq 0.67$
- Super-residential: $AC \leq 0.50$

The same indicator and typology are applied at both analytical scales: municipalities and 500 x 500 m localities, ensuring cross-scale comparability. The research procedure consists of four steps.

Step 1. Spatial linkage of data sources. The residential-complex database and mobile aggregates were linked through spatial referencing. For each residential complex, its coordinates were used to identify (1) the municipality and (2) the corresponding 500 x 500 m locality (regular-grid cell) in which the complex is located. This linkage enabled aggregation of housing-commissioning characteristics at the municipal level and comparison with night-time and day-time presence indicators at both spatial scales.

Step 2. Spatial concentration of new housing. Based on the residential-complex database, the volumes of newly commissioned housing in 2021–2022 (number of units and/or floor area) were assessed and territories with the highest concentration of new construction were identified. The analysis was conducted across major administrative units (the City of Moscow, New Moscow, and Moscow Oblast) and at the municipal level, consistent with a core–periphery interpretation of the agglomeration.

Step 3. Changes in night-time and day-time presence in areas of new construction. Changes in night-time (residential) and day-time (active) presence were evaluated using mobile data for October 2021 and October 2023 at both scales – municipalities and 500 × 500 m localities. Dynamics were calculated as absolute differences (and, where appropriate, relative changes) between the two time slices and compared with indicators of newly commissioned housing.

Step 4. Assessment of functional shifts and classification of territories. For each territory, AC was computed using October aggregates. Functional shifts were assessed by comparing AC values for October 2021 and October 2023. An increase in AC is interpreted as strengthening the role of a territory as a day-time activity attractor, whereas a decrease indicates strengthening residential dominance. Territories were then assigned to functional types according to the typology defined above.

3. Results and discussion

3.1. An overview of the housing market in the Moscow agglomeration

According to official statistics on the housing stock and housing commissioning (Rosstat, 2025b), Moscow and Moscow Oblast together account for about 14% of total residential floor area in the Russian Federation. These regions are also among the national leaders in housing construction; in 2014–2024, their combined share of total commissioned housing increased from 15.7% to 16.7%, while the absolute volume rose from 13.2 to 17.9 million m² (Rosstat, 2025a; Figure 1).

At the same time, per-capita housing provision increased only moderately over the same period: from 19 to 22 m² per person in Moscow and from 28 to 34 m² in Moscow Oblast (Rosstat, 2025b; Figure 2). This divergence between the dynamics of housing delivery and per-capita provision is consistent with the assumption that migration-driven population growth has played an important role in sustaining demand. However, a direct test of this hypothesis would require linking these indicators to population dynamics and net migration statistics.

An additional context is the changing structure of supply in the primary market. A number of studies (cf. Kholodilin, 2025) report a tendency since the early 2000s toward a decline in the average size of newly built apartments in Russia and in several European countries. Against the background of declining purchasing power, a substantial share of Russia's primary housing market has shifted toward compact formats, including studio units of around 20 m². The prevalence and dynamics of such formats can be treated as an indirect indicator reflecting the interaction of demand factors (including migration-related demand), affordability constraints, financial conditions, investor preferences, and regulatory changes. In particular, in 2024, Moscow introduced additional restrictions affecting the design/construction of very small apartments, which could influence the structure of supply and average unit sizes in new projects (Moscow Government, 2024).

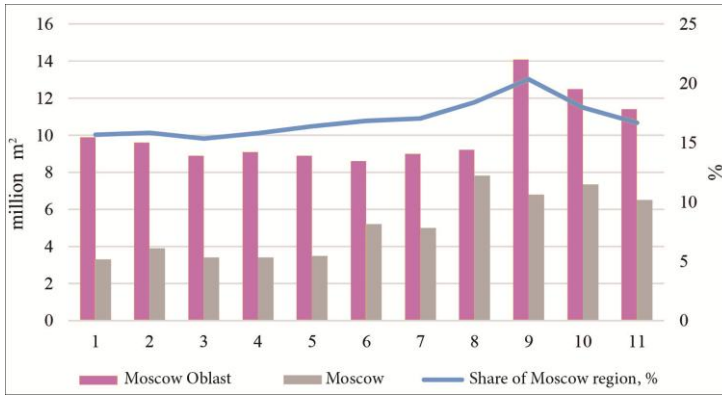


Figure 1. Annual Housing Completions. Data are from “Housing completions (total floor area of dwellings put in place)” by Rosstat, 2025 (<https://www.fedstat.ru/indicator/59262>). In the public domain.

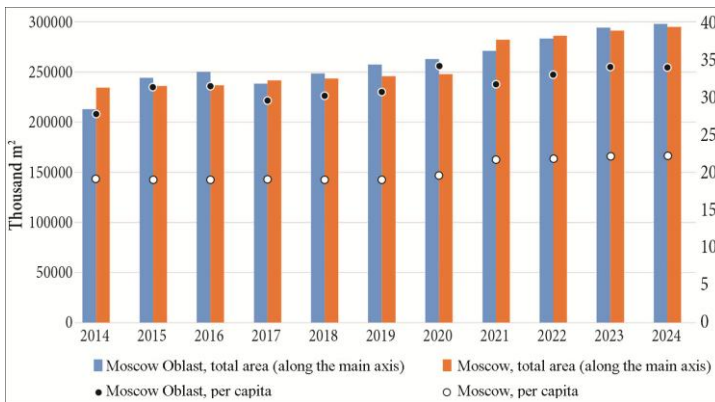


Figure 2. Residential Floor Space. Data are from “Total residential floor space by Rosstat, 2025b (<https://www.fedstat.ru/indicator/57479>). In the public domain.

Turning to housing prices and housing-market institutions in Moscow, several features are relevant for interpretation. As shown by Zavisca (2008), the evolution of Russia’s post-Soviet housing market can be described through several stages, including privatization (1992–1994), “property without markets” (1995–2003), and “state-sponsored markets” (2004–2007). Against this background, the contemporary Moscow housing market is often characterized by relatively high liquidity and a wide range of supply, although the degree to which supply matches household demand differs across segments and locations. Housing purchases in Moscow are also frequently discussed not only as consumption decisions but as investment strategies and a means of preserving savings under inflation and currency risks; however, the share of investment-driven demand is difficult to estimate consistently, and this point should therefore be interpreted cautiously (market commentary sources, e.g., Yandex Realty).

Privatization dynamics indicate a substantial decline in the number of newly privatized apartments: while in 2005–2014 the annual average in Moscow was about 76,000 privatized units, in 2015–2024 it fell to around 18,000 (Rosstat, 2025c). Official statistics also suggest that less than 5% of Moscow's housing stock remains unprivatized (Rosstat, 2025c). In addition, the tenure/ownership structure in Moscow is more strongly shifted toward private ownership than the national average (about 70% versus 41%, according to Rosstat, 2025c).

When considering new housing construction in relation to migration and settlement dynamics, a convenient descriptive proxy of affordability is the ratio of the average primary-market price per 1 m² to average monthly per-capita monetary income (Figure 3). This indicator can be interpreted as the number of average monthly per-capita incomes required to purchase 1 m² of housing. In 2022, Moscow reached a peak value of this ratio of about 3.5 (Rosstat, 2025d; Figure 3). In 2023–2024, the ratio declined; this period coincided with tighter mortgage conditions, adjustments to subsidized mortgage programs, and weaker market activity (RBC Realty, 2023).

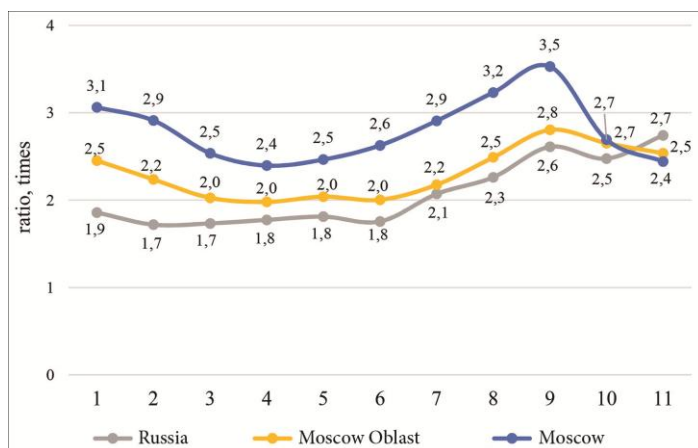


Figure 3. Ratio of the average price per 1 m² of apartments on the primary housing market to the average monthly per capita monetary income of the population.

Data are from “Average price per square meter of apartments on the primary and secondary housing markets” by Rosstat, 2025d (<https://www.fedstat.ru/indicator/31452>). In the public domain; and “Average monthly per capita monetary income of the population” by Rosstat, 2025e (<https://www.fedstat.ru/indicator/57039>). In the public domain.

For context, it is also important to briefly describe key parameters of the existing housing stock in Moscow and Moscow Oblast. As of 2024, total residential floor area amounted to approximately 295 million m² in Moscow and 298 million m² in Moscow Oblast (Rosstat, 2025b). The age structure includes a large share of relatively recent construction: about 46% of the region's housing stock was built after 1995 (Rosstat, 2025f).

A separate factor affecting the renewal of Moscow's housing stock is the city's housing renovation program launched in 2017, which targets the resettlement and replacement of low-rise residential buildings constructed in 1957–1968 (Moscow Government, 2017). At the same time, the contribution of renovation to the overall age structure may vary across areas

and requires separate quantitative assessment based on program-specific data on resettlement, demolition, and commissioning.

Indicators of physical depreciation in the capital region also differ from national averages. The share of housing with a depreciation level exceeding 30% is about 20% in Moscow and 34% in Moscow Oblast, compared with a national average of around 45% (Rosstat, 2025f). These characteristics provide context for interpreting current housing dynamics, as renewal and replacement of older stock, alongside development on new sites, shape the broader spatial pattern of new construction and subsequent settlement change.

3.2. Geography of new residential developments in the Moscow agglomeration

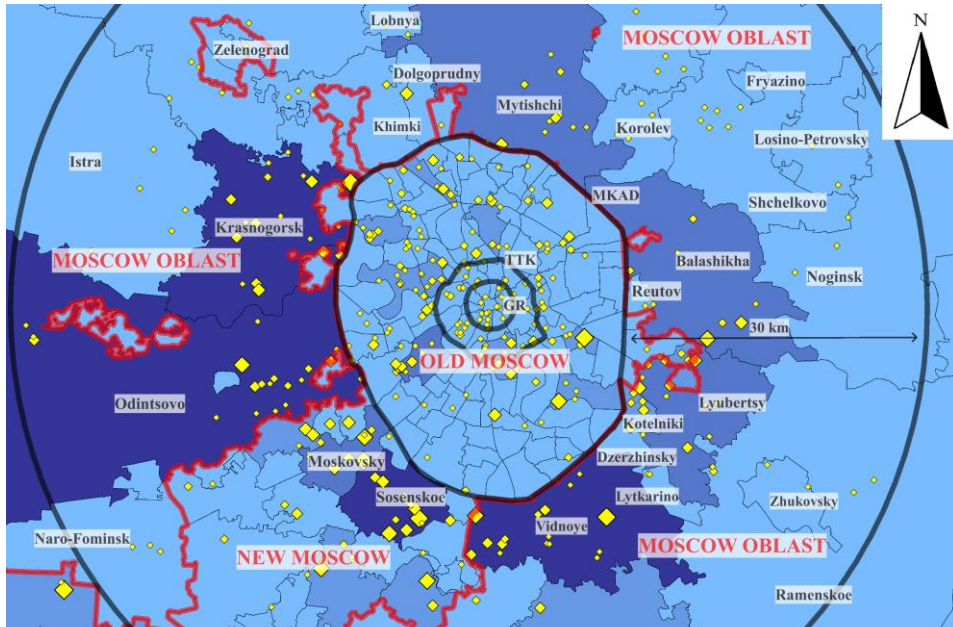
The main increase in new housing construction during the period under review is concentrated in municipalities located immediately outside the MKAD, i.e., in the inner belt of the Moscow agglomeration (Figure 4). At the current stage of spatial development, the nearest suburbs attract population more intensively than the core, as noted in studies of migration processes in the capital region (Karachurina & Mkrtychyan, 2021). This tendency was previously described by Makhrova as “Moscow growing into the near Moscow region” (Makhrova, 2013, p. 249).

According to the database of residential complexes commissioned in 2021–2022, the largest volumes of commissioned housing (residential floor area) are observed in three major satellite municipalities of Moscow Oblast—Vidnoye, Krasnogorsk, and Odintsovo—as well as in Sosenskoye (New Moscow). In each of these municipalities, more than 1 million m² of residential floor area was commissioned over the two-year period. Together, these four municipalities account for about one quarter of the total commissioned housing recorded in the analyzed dataset (approximately 4.9 million m² out of 21.1 million m²). If four additional territories with more than 0.5 million m² each are included (the urban okrugs of Lyubertsy, Mytishchi, and Balashikha in Moscow Oblast, and Moskovsky in New Moscow), their combined share increases to nearly 40% of the total commissioned volume in the dataset. Combining the database of newly commissioned residential complexes with aggregated mobile-operator data at a spatial resolution of several hundred meters makes it possible to analyze changes not only at the level of administrative units but also at a local scale, relating them to the location of specific housing projects.

Further analysis focuses primarily on the largest (residential floor area above 100,000 m²) and large (above 50,000 m²) residential complexes. Over the two years under consideration (2021–2022), the database compiled by the authors contains 141 such projects: 61 largest and 80 large complexes. Of these, 140 are located within a 30 km zone from the MKAD, which confirms the concentration of mass housing construction in the inner belt of the Moscow agglomeration. Among the largest projects, six “super-large” complexes stand out, each with a residential floor area of about 250,000–270,000 m². Three of them are located in New Moscow, two in Moscow Oblast (the satellite municipalities of Vidnoye and Krasnogorsk), and one within Old Moscow on a redeveloped former industrial site.

The observed geography of housing construction is shaped not only by market demand but also by institutional factors. In Russia, land-use regulation and territorial planning are implemented through a hierarchy of planning documents with the participation of municipal and regional authorities. In Moscow, a number of development parameters are additionally coordinated at higher levels of governance, and large-scale programs and projects may set

priorities for redevelopment and housing construction. As a result, the spatial distribution of commissioned housing reflects both economic incentives and features of multi-level planning.



Legend

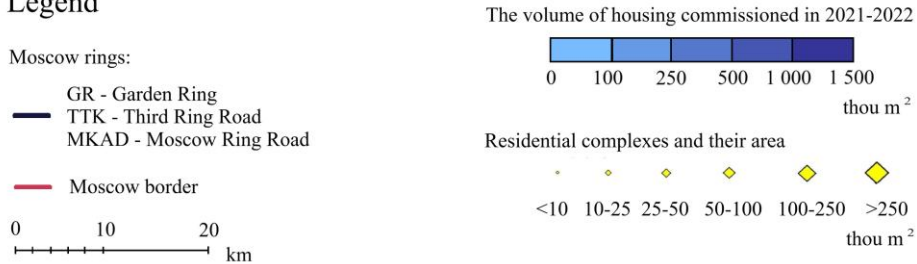


Figure 4. Housing Completions in the Moscow Region, 2021–2022.

Note. Compiled by the authors based on their proprietary database of residential real estate objects.

Contemporary housing dynamics in the Moscow agglomeration are therefore driven by both market factors and urban-planning regulation. In the inner belt (Moscow Oblast and New Moscow), a substantial share of new housing is delivered through development on previously undeveloped sites (greenfield), which is related to limited land availability, high land prices, and high development density in the core. In general, greenfield development—where, as a rule, costs associated with demolition of existing buildings and relocation of utility and engineering infrastructure are minimal—can support faster growth of commissioned housing volumes and accelerate the formation of new residential areas in the inner belt.

At the same time, housing development in the Moscow agglomeration is not limited to peripheral greenfield expansion. Within Old Moscow, redevelopment of previously used

sites (brownfield) plays a substantial role. In this study, brownfield projects are defined as those implemented on land plots that had an industrial or commercial functional use prior to development, as identified from project documentation and confirmed through spatial verification within the housing database. According to this classification, brownfield projects account for about 40% of the commissioned volume in the analyzed dataset, and almost all of them are concentrated within Old Moscow. This group includes large residential complexes with residential floor areas of several hundred thousand square meters, highlighting the importance of redevelopment as a major source of new housing supply in the core of the agglomeration.

Launching brownfield housing projects requires site preparation and more complex approval procedures. Compared with greenfield development, brownfield redevelopment typically implies a higher degree of infrastructure planning and project coordination, as it involves changes in functional use, reconfiguration of transport and utility networks, and alignment with urban-development programs (Moscow Government, 2010). In Moscow, the redevelopment context is linked to post-Soviet transformations in land use and industrial location: a portion of production functions was moved beyond central urban zones, and the released territories became a reserve for new construction (Chernyshova, 2011). Planning documents and development programs, including master plans and related decisions on transport infrastructure and reorganization of production areas, set the institutional framework and priorities for such redevelopment (Moscow Government, 2010).

Thus, the spatial distribution of housing commissioning in the agglomeration reflects an interplay of market demand and regulatory choices. This is important for the present study because greenfield and brownfield trajectories may affect functional shifts in different ways: peripheral housing expansion can strengthen the residential (“dormitory”) profile where residential growth outpaces job creation, whereas redevelopment in the core is more likely to occur within a more diverse functional environment and may be associated with different patterns of day-time population presence.

3.3. *Quality of the new housing stock*

When discussing the spatial concentration of new housing construction, it is important to characterize the quality and price parameters of the commissioned stock. Moscow has a pronounced radial–ring structure; therefore, location relative to the key transport rings—the Garden Ring (GR), the Third Transport Ring (Tretye Transportnoye Koltso—TTK), and the MKAD—is traditionally considered one of the factors associated with housing-price differentiation. In the present study, this relationship is illustrated using an author-compiled database of residential complexes commissioned in 2021–2022, which records price indicators and geographic position for each project.

Table 1 reports average price characteristics of new-build housing by “between-the-rings” zones (from the historical center toward the periphery). The expected gradient is observed: with increasing distance from the center, both the average price per 1 m² and the average apartment price decline. It is important to emphasize that these figures refer to the analyzed sample and represent within-sample averages.

In Russian practice, the primary market is commonly described using housing classes – standard/economy, comfort, business, and premium. However, there are no universally codified regulatory criteria defining the boundaries between these classes. In this study, the

class of each project is taken from developer documentation recorded in the author's database. This limits interpretation and implies that housing classes should be treated as an expert-based typology for comparing project characteristics within the sample.

Table 1. Relationship between New Housing Prices and the Geographical Location of Residential Complexes

Location	2021	2022
Inside the GR		
Average price per 1 m ² , RUB	1,800,519	2,147,701
Average apartment price, RUB	247,428,790	253,965,686
Average apartment area, m ²	137	118
From GR to TTK		
Average price per 1 m ² , RUB	439,947	534,253
Average apartment price, RUB	25,677,736	31,027,746
Average apartment area, m ²	58	58
From TTK to MKAD		
Average price per 1 m ² , RUB	323,002	326,362
Average apartment price, RUB	17,339,132	15,609,253
Average apartment area, m ²	54	48
Moscow and Moscow oblast outside the MKAD		
Average price per 1 m ² , RUB	221,278	234,154
Average apartment price, RUB	9,448,953	9,456,584
Average apartment area, m ²	43	40
Moscow average price per 1 m ² , RUB	345,407	346,836
Moscow average apartment price, RUB	18,465,627	16,620,406

Note. Exchange rates are based on average annual data from the Central Bank of Russia (1 USD = 73.7 RUB in 2021; 1 USD = 68.6 RUB in 2022). The table was compiled by the authors using their proprietary database of residential real estate objects.

The distribution of residential complexes by class, together with their territorial and demographic characteristics (based on mobile-operator data), is presented in Table 2. In the analyzed sample, standard/economy projects account for 16% of complexes (or 15% by total commissioned residential floor area). These projects are located outside the MKAD and, in 2023, account for 18% of night-time population presence observed in the 500 × 500 m localities where the sampled projects are situated. The most pronounced increase in night-time presence relative to 2021 is observed in the standard/economy and comfort segments, which is consistent with more active settlement of mass housing in the inner belt of the agglomeration.

Table 2. Structure of Residential Complexes by Class

Class	Number of Complexes	Total Area (million m ²)	Located in Old Moscow, %	Average Distance to MKAD, km	Locality Population - Night 2021, thousand people	Locality Population - Night 2023, thousand people
Standard/Economy	69	3,10	7	16	151	192
Comfort	209	12,74	34	6	396	518
Business	99	4,42	78	-8	224	256
Premium/Elite/De Luxe	47	0,87	97	-13	132	116

Note. Compiled by the authors based on their proprietary database of residential real estate objects and mobile operator data.

The largest share of projects in the sample belongs to the comfort class (about half of all complexes and 30% of total residential floor area). This segment is spatially more diverse: a substantial share is located in the inner zone around the MKAD, while roughly one third is situated within Old Moscow. The business and premium segments in the sample are concentrated mainly in central areas, reflected in their high share of projects located within Old Moscow. At the same time, the total commissioned floor area of these projects is relatively small, which may be related to smaller project sizes and a different development morphology in central locations.

3.4. Transformation of the functional role of housing construction areas

The commissioning of new housing may be associated with changes in a territory's functional profile, either reinforcing or, conversely, smoothing disparities between residential locations and day-time centers of activity. Functional shifts are assessed using the AC, defined as the ratio of day-time population presence to night-time population presence. An increase in AC is interpreted as a stronger role of the territory as a day-time activity attractor, whereas a decrease in AC indicates strengthening residential dominance. The inter-annual dynamics of AC for the study period suggest that territories with a more mixed profile (attractors and near-balanced areas) generally display smaller changes, while predominantly residential territories more often exhibit noticeable shifts (Figure 5).

The most pronounced decreases in AC (i.e., strengthening of the residential function) are observed in several types of municipalities: (1) a number of municipalities in New Moscow with an already predominantly residential profile; (2) selected areas within Moscow located in the belt between the TTK and the MKAD; and (3) several satellite municipalities in Moscow Oblast where the expansion of the housing stock is accompanied by a less pronounced increase in local day-time activity (including Kotelniki, Krasnogorsk, and Solnechnogorsk).

Overall, the spatial pattern of AC changes is consistent with the core-periphery structure of the capital region. Most territories within Old Moscow either increase AC values or maintain them at a relatively high level, which corresponds to a more stable combination of residential and day-time functions. In contrast, strengthening residential dominance is more often recorded on the periphery of the agglomeration – in a number of satellite municipalities and in New Moscow, including territories that also exhibit the largest volumes of commissioned housing in the analyzed dataset for 2021–2022 (e.g., Krasnogorsk, Sosenskoye, and Moskovsky – approximately 0.8–1.3 million m² of residential floor area per territory over two years).

Thus, commissioning new housing in territories with limited local employment opportunities may be accompanied by strengthening residential dominance and a decline in AC, corresponding to a more pronounced “dormitory” profile. In this sense, a “dormitory trap” can be described as a situation where rapid growth of the night-time population (as new residential areas are settled) is not matched by comparable growth of the day-time population, and the territory increasingly functions as a source area for daily commuting to other parts of the agglomeration. Such shifts are most evident where residential development outpaces the formation of new employment centers and urban infrastructure, increasing residents' dependence on inter-district and suburban commuting.

In this study, these effects are treated not as an unequivocal consequence of housing construction but as an observed dynamics of functional indicators that is spatially and temporally associated with the scale of new housing commissioning. The identified AC changes make it possible to distinguish territories where housing growth coincides with

strengthening residential dominance without a comparable increase in day-time attractiveness. This is relevant from a policy perspective because it highlights areas where the “housing-jobs” imbalance may emerge or intensify and, accordingly, points to the importance of synchronizing housing development with the growth of local employment, public transport, and basic urban infrastructure.

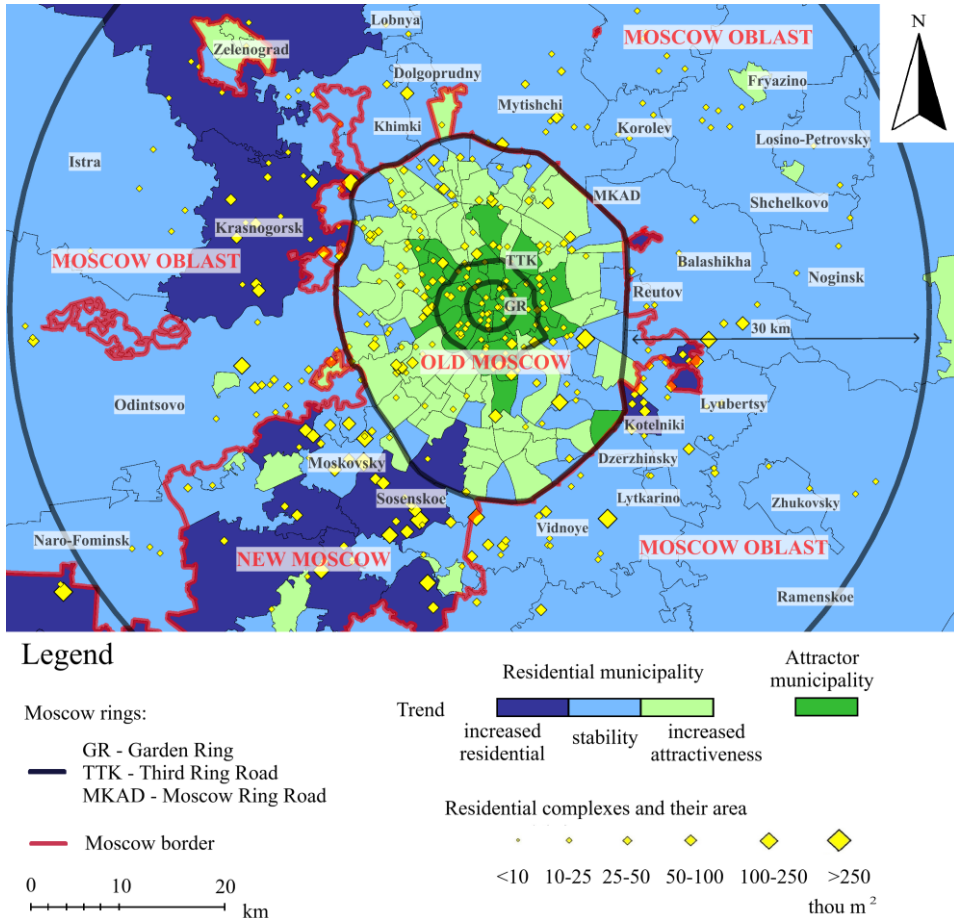


Figure 5. Functional Transformations of Municipalities in the Moscow Region, 2021–2023.
 Note. Compiled by the authors based on their proprietary database of residential real estate objects.

4. Conclusion

The analysis shows that the spatial pattern of new housing commissioning in the Moscow agglomeration in 2021–2022 is concentrated in several stable zones that differ in development type and in their potential implications for functional profiles. In the analyzed dataset, three main zones can be distinguished: 1) Old Moscow, where redevelopment of previously used sites (brownfield) plays a substantial role; 2) New Moscow; and 3) satellite municipalities of Moscow Oblast in the inner belt of the agglomeration (within 30 km of the

MKAD), where development on previously undeveloped land (greenfield) predominates. Overall, this configuration reflects the simultaneous operation of two trajectories: redevelopment in the core and residential expansion in the inner suburban belt.

Within Old Moscow, redevelopment is increasingly concentrated not only in the historical core but also across a broader belt of former industrial areas. According to the analyzed dataset, Old Moscow accounts for about 42% of commissioned residential floor area in 2021–2022, and it concentrates the largest share of commissioning in higher price segments (78% of business-class and 97% of elite housing within the dataset). Redevelopment in the built-up urban fabric can reduce the need for further peripheral expansion and can create a different context for functional change compared with greenfield growth; however, the magnitude and direction of these effects depend on local conditions, the surrounding mix of functions, and infrastructure provision.

The association between new housing commissioning and changes in territorial functional profiles was assessed using the AC, defined as the ratio of day-time presence to night-time presence and computed from aggregated mobile-operator data for October 2021 and October 2023. The results indicate that in New Moscow and Moscow Oblast, changes in night-time presence and AC dynamics more often coincide with large-scale housing commissioning, which is consistent with housing construction acting as one of the key drivers of territorial change in these zones. In Old Moscow, where the urban environment is more functionally complex and population redistribution is shaped by multiple concurrent processes, housing commissioning is much less consistently accompanied by comparable growth in night-time presence, suggesting a weaker linkage between functional organization and new construction.

Finally, spatial differences in AC dynamics make it possible to identify territories where housing growth is accompanied by strengthening residential dominance (a decline in AC), that is, a more pronounced “dormitory” profile. In this study, this pattern is interpreted as a risk of reinforcing a “housing–day-time activity” imbalance in some municipalities of the inner suburban belt.

From an applied perspective, the key contribution of the study is that combining a database of newly commissioned residential complexes with mobile-operator aggregates enables the identification of areas of potential functional imbalance at multiple spatial scales (municipalities and 500 × 500 m localities). This, in turn, can support more coordinated planning of housing delivery, the development of local employment centers, public transport, and basic urban infrastructure.

The results should also be considered in light of the Modifiable Areal Unit Problem, according to which analytical outcomes may vary depending on the spatial units used and the level of aggregation (Openshaw, 1983). Since the same indicators are applied here at both the municipal level and the 500 × 500 m grid level, part of the observed variation may be related to scale effects. The use of two analytical scales improves the robustness of the overall interpretation, although some local differences remain sensitive to the chosen spatial framework.

The findings should also be interpreted with caution in terms of causal inference. The study identifies a stable spatial and temporal association between the geography of newly commissioned housing and changes in territorial functional profiles, but these shifts are also influenced by broader contextual factors, including inherited land-use structure, transport accessibility, labor-market organization, and infrastructure provision. In addition, the analysis

relies on aggregated anonymized mobile-operator data, which capture day-time and night-time population presence indirectly rather than individual migration trajectories. Finally, the comparison is based on two temporally comparable observation points (October 2021 and October 2023), which makes it possible to detect early post-commissioning effects but does not fully reflect longer-term processes of settlement and functional adaptation.

From the perspective of the future development of the Moscow agglomeration, the results indicate that large-scale housing construction not accompanied by a corresponding expansion of new jobs may significantly exacerbate the existing spatial imbalances, which are already substantial (Babkin, 2024). In such cases, newly developed residential areas risk reinforcing “dormitory” patterns of urban life, increasing pressure on transport infrastructure and daily commuting systems, especially in the inner suburban belt. In the longer term, this may also contribute to the formation of territorially concentrated labor zones and socially segmented residential areas, including the risk of localized migrant and, in some cases, ethnic labor enclaves (Babkin et al., 2025). For this reason, the spatial concentration of new housing should be assessed not only in terms of construction volume, but also in relation to the parallel development of jobs, transport accessibility, and urban service infrastructure.

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References

- Aganbegyan, A. (2012). Ctroitel'stvo zhil'ya – lokomotiv social'no-ehkonomicheskogo razvitiya strany [Housing construction – The driving force of the country's socioeconomic development]. *Voprosy Ekonomiki*, 5, 59–69. <https://doi.org/10.32609/0042-8736-2012-5-59-69>
- Babkin, R., Badina, S., & Bereznyatskiy, A. (2022). Application of mobile operators' data in modern geographical research. *Encyclopedia*, 2(4), 1829–1844. <https://doi.org/10.3390/encyclopedia2040126>
- Babkin, R. A. (2024). Prostranstvennaya struktura Moskovskoj metropolii [The spatial structure of the Moscow metropolis]. *Federalism*, 29(2), 110–130. <http://doi.org/10.21686/2073-1051-2024-2-110-130>
- Babkin, R. A., Badina, S. V., & Bereznyatskiy, A. N. (2025). Vliyaniye novogo zhilishchnogo stroitel'stva na strukturnyye transformacii naseleniya Moskovskoj aglomeracii v kontekste migracionnykh processov [The role of housing development in population shifts during migration (the case of Moscow and Moscow Oblast, Russia)]. *Ekonomika regiona*, 21(2), 318–331. <https://doi.org/10.17059/ekon.reg.2025-2-5>
- Baburin, V. L., & Tsaplina, K. G. (2015). Faktory, limitiruyushchie ehkstensivnoe razvitie Moskvy i ee sputnikov [Limiting factors of the extensive growth of Moscow and its satellite towns]. *Vestnik Moskovskogo universiteta. Seriya 5, Geografiya*, 6, 76–84. <https://cyberleninka.ru/article/n/factory-limitiruyushchie-ekstensivnoe-razvitie-moskvy-i-ee-sputnikov/viewer>

- Badina, S. V., Babkin, R. A., & Skobeev, N. M. (2023). Izmenenie prostranstvennoj uyazvimosti naseleniya krupnykh gorodov k prirodnyim i tekhnogennym opasnostyam pod vozdeystviem zhilishchnogo stroitel'stva [Changes in spatial vulnerability of the population of large cities to natural and man-made hazards under the influence of housing construction]. *Vestnik Sankt-Peterburgskogo Universiteta. Nauki o Zemle*, 68(2), 357–377. <http://doi.org/10.21638/spbu07.2023.208>
- Blokhin, A. A., Sternik, S. G., Teleshev, G. V. (2021). Institutional transformations of the housing construction sphere in 2020. *Studies on Russian Economic Development*, 32(2), 147–154. <https://doi.org/10.1134/S1075700721020039>
- Central Bank of the Russian Federation. (n.d.). *Exchange rates statistics*. <https://www.cbr.ru/eng/>
- Chernyshova, N. A. (2011). *Transformatsiya proizvodstvennykh territoriy Moskvy* [Transformation of Moscow's industrial areas] [Unpublished candidate's dissertation, Lomonosov Moscow State University, Moscow, Russia]. https://genplanmos.ru/download/problemy_transformacii_proizvodstvennykh_territoriy_moskvy/?ysclid=mm99csh3d644444331
- Cian PLC. (2023). *Report and consolidated financial statements for the year ended December 31, 2022* [Report]. Retrieved February 10, 2026, from <https://ir.ciangroup.ru/upload/iblock/f36/fq430iuo6dwrz26cmnbljm2egtucjg0k/Cian%20Plc%20Report%20and%20CFS.pdf>
- Dmitriev, M. E., & Misikhina, S. G. (2016). Rynok zhilya moskovskoy aglomeratsii: vyzovy dlya naseleniya i ekonomicheskoy politiki [The housing market of the Moscow agglomeration: Challenges for the population and economic policy]. *Obshchestvennyye nauki i sovremennost'*, 4, 78–88.
- Karachurina, L. B., & Mkrtchyan, N. V. (2021). Intraregional population migration in Russia: Suburbs outperform capitals. *Regional Research of Russia*, 11, 48–60. <https://doi.org/10.1134/S2079970521010068>
- Kholodilin, K. A. (2025). *The end of the era of increasing home sizes* (SSRN Working Paper No. 5384222). SSRN. <https://doi.org/10.2139/ssrn.5384222>
- Kurichev, N. K., & Kuricheva, E. K. (2018). Relationship of Housing Construction in the Moscow Urban Agglomeration and Migration to the Metropolitan Area. *Regional Research of Russia*, 8, 1–15. <https://doi.org/10.1134/S2079970518010069>
- Kurichev, N. K., & Kuricheva, E. K. (2020). Prostranstvennaya struktura zhilishchnogo stroitel'stva v Moskovskoy aglomeratsii: radial'no-sektoral'naya differentsiatsiya [Spatial structure of housing construction in the Moscow agglomeration: Radial-sectoral differentiation]. *Vestnik Sankt-Peterburgskogo Universiteta. Nauki o Zemle*, 65(1), 74–95. <https://doi.org/10.21638/spbu07.2020.105>
- Kuricheva, E. K., & Popov, A. A. (2016). Housing construction dynamics in the 2010s as a factor of transformation of the Moscow agglomeration. *Regional Research of Russia*, 6, 9–20. <https://doi.org/10.1134/S207997051601007X>
- Lang, R. E., & Simmons, P. A. (2007). Boomburb “Buildout”: The Future of Development in Large, Fast-Growing Suburbs. *Urban Affairs Review*, 42(4), 533–552. <http://doi.org/10.1177/1078087406295893>
- Li, W. (1998). Anatomy of a New Ethnic Settlement: The Chinese Ethnoburb in Los Angeles. *Urban Studies*, 35(3), 479–501. <http://doi.org/10.1080/0042098984871>
- Makhrova, A. G. (2013). Transformatsiya rasseleniya v Moskovskom regione v postsovetskij period [Transformation of settlement in the Moscow region in the post-Soviet period]. *Voprosy geografii: Geografiya naseleniya i social'naya geografiya*, 135, 245–269. <https://www.demoscope.ru/weekly/2013/0569/analit02.php>
- Mkrtchyan, N. V. (2011). Population dynamics of Russia's regions and the role of migration: Critical assessment based on the 2002 and 2010 censuses. *Regional Research of Russia*, 1, 228–239. <https://doi.org/10.1134/S2079970511030087>
- Mkrtchyan, N. V. (2015). Migratsiya v Moskve i Moskovskoy oblasti: regional'nye i strukturnye osobennosti [Migration in Moscow and the Moscow region: Regional and structural features]. *Regional'nyye issledovaniya*, 3, 107–116. <https://www.demoscope.ru/weekly/2017/0727/analit03.php>
- Moscow Government. (2010). Zakon goroda Moskvy No. 17 “O General'nom plane goroda Moskvy” [Law of the City of Moscow No. 17 “On the General Plan of the City of Moscow”]. <https://stroimsk.ru/document/322>

- Moscow Government. (2011). Soglasenie ob izmenenii granicy mezhdu sub"ektami Rossijskoj Federacii gorodom Moskvoy i Moskovskoj oblasti [Agreement on changing the border between the constituent entities of the Russian Federation—the City of Moscow and Moscow Oblast, dated November 29, 2011, approved by the Resolution of the Moscow City Duma No. 372 of December 7, 2011, and the Resolution of the Moscow Oblast Duma No. 1/177-P of December 7, 2011]. <https://www.mos.ru/authority/documents/doc/9515220/>
- Moscow Government. (2017). Postanovlenie Pravitel'stva Moskvy ot 1 avgusta 2017 goda №497-PP "O Programme renovacii zhilishchnogo fonda v gorode Moskve" [Resolution of the Moscow Government dated August 1, 2017 No. 497-PP "On the Housing Renovation Program in the City of Moscow"]. <https://www.mos.ru/upload/documents/docs/PP-497.pdf>
- Moscow Government. (2024). Postanovlenie pravitel'stva Moskvy ot 23 iyulya 2024 goda № 1672-PP "O vnesenii izmenenij v postanovleniya Pravitel'stva Moskvy ot 30 aprelya 2013 g. № 284-PP i ot 28 marta 2017 g. № 120-PP" [Moscow Government Resolution No. 1672-PP of July 23, 2024 "On Amendments to Moscow Government Resolutions No. 284-PP of April 30, 2013 and No. 120-PP of March 28, 2017"].
- Nozdrina, N. N. (2011). O nekotorykh problemakh migracii [On some problems of migration]. *Zhurnal novoy ekonomicheskoy assotsiatsii*, 9, 189–191. <https://www.econorus.org/repec/journal/2011-9-189-191r.pdf?ysclid=mm9any5zc1497969449>
- Openshaw, S. (1983). *The modifiable areal unit problem*. Geo Books.
- Park, R. E., Burgess, E. W., & McKenzie, R. D. (1984). *The City*. University of Chicago Press.
- Popov, A. A. (2018). Geografiya pokupok zhiloy nedvizhimosti v stroyashchikhsya domakh v Moskovskom regione v 2010-e gody [Geography of residential real estate purchases in buildings under construction in the Moscow region in the 2010s]. In *Staraya i Novaya Moskva: tendencii i problemy razvitiya* (pp. 159–183). IP Matushkina I.I. https://www.elibrary.ru/download/elibrary_35082005_37241647.pdf
- Ramiller, A., Song, T., Parker, M., & Chapple, K. (2024). Residential mobility and big data. *Cityscape*, 26(3), 227–240. <https://doi.org/10.2307/48799257>
- RBC Realty. (2023). Vstupil v silu zapret na stroitel'stvo v Moskve kvartir menshe 28 kv. m. [A ban on the construction of apartments smaller than 28 square meters in Moscow has come into force]. Retrieved February 10, 2026, from <https://realty.rbc.ru/news/6580675d9a79471247092a66>
- Rodrigues, A. L., Giannotti, M., Barboza, M. H. C., & Alves, B. B. (2021). Measuring mobility inequalities of favela residents based on mobile phone data. *Habitat International*, 110, Article 102346. <https://doi.org/10.1016/j.habitatint.2021.102346>
- Rosstat. (2025a). *Housing completions (total floor area of dwellings put in place)* [Data set]. <https://www.fedstat.ru/indicator/59262>
- Rosstat. (2025b). *Total residential floor space* [Data set]. <https://www.fedstat.ru/indicator/57479>
- Rosstat. (2025c). *Total area of privatized residential apartments* [Data set]. <https://fedstat.ru/indicator/43229>
- Rosstat. (2025d). *Average price per square meter of apartments on the housing markets* [Data set]. <https://www.fedstat.ru/indicator/31452>
- Rosstat. (2025e). *Average monthly per capita monetary income of the population* [Data set]. <https://www.fedstat.ru/indicator/57039>
- Rosstat. (2025f). *Housing conditions* [Data set]. <https://77.rosstat.gov.ru/folder/64648>
- Sevsuk, A., & Ratti, C. (2010). Does urban mobility have a daily routine? Learning from the aggregate data of mobile networks. *Journal of Urban Technology*, 17(1), 41–60. <https://doi.org/10.1080/10630731003597322>
- Toole, J. L. (2015). *Putting big data in its place: Understanding cities and human mobility with new data sources* [Doctoral dissertation, Massachusetts Institute of Technology]. MIT Libraries. <https://dspace.mit.edu/handle/1721.1/98631>
- Vendina, O. I. (2022). Gorodskoe planirovanie i gorodskaya samoorganizaciya: transformaciya prostranstvennykh orientirov razvitiya Moskvy [Urban Planning and Spontaneous Spatial Order: The Post-Soviet Transformation of Spatial Guidelines for the Development of Moscow]. *Gorodskie issledovaniya i praktiki*, 7(4), 29–53. <http://doi.org/10.17323/usp74202229-53>
- White, M. (1988). *American Neighborhoods and Residential Differentiation*. Russel Sage Foundation
- Zavisca, J. (2008). Property without markets: Housing policy and politics in Post-Soviet Russia, 1992–2007. *Comparative European Politics*, 6(3), 365–386. <http://doi.org/10.1057/cep.2008.16>