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Public transport accessibility and the prices of nearby properties: the case of the first metro line in Warsaw

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This paper identifies the relation between metro proximity and the prices of residential properties in Warsaw. The analysis is based on 2006-2013 AMRON-SARFiN data. The results show that metro has a positive impact on property prices if it is located at most 1.5 km from the property. The greatest increase in price of 13 per cent is observed when metro is located up to 800 meters from the property. The results indicate that when the metro transportation is poor, it causes a large increase in property prices, which is not comparable to the impact of other transports, such as bus or tram.

***Keywords**: hedonic pricing model, metro proximity, property prices, public transport, spatial models, Warsaw housing market.*

1. Introduction

The subway / metro transportation plays a crucial role in the urbanization and urban development processes because it depends on its own specific infrastructure that is mostly located underground. This distinct feature of subway gives it a relative advantage over other means of transport, such as bus, trolleybus or tram. By its underground location metro allows its users to reach downtown city areas that struggle with high traffic limiting the number of vehicles and reducing the travel time. Due to the high number of users it also attracts the location of businesses and services, which seek for potential clients.

Given the characteristics of the metro transportation network, its accessibility should be capitalized by the value of the surrounding properties. There exists an extensive number of studies that look at the relation between metro accessibility and the prices of nearby properties. Most of these studies focus on the cities with a highly developed railway network infrastructure, such as cities in the USA (Damm et al., 1980, Armstrong and Rodríguez, 2006), South Korea (Bae et al., 2003), Taiwan (Lin and Hwang, 2004), the UK (Du and Mulley, 2007), Portugal (Martínez and Viegas, 2009), Italy (Pagliara and Papa, 2011 and Gallo, 2018), Greece (Efthymiou and Antoniou, 2013) or China (Zhang

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and Jiang, 2014, Liang et al. 2007 and Li et al., 2019). The results are mixed and they not always prove a rise in property price caused by the increased accessibility to metro. Some of the studies even report a negative impact of close proximity to metro on property prices, which is argued to be due to possible negative effects of metro, such as such noise, vibration or growing crime rates.

The aim of this paper is add to the existing research by examining the relation between metro proximity and the prices of the residential properties in Warsaw. Given the specific features of Warsaw transportation network and its housing market, it constitutes a distinct from so-far analyzed geographical settings. First, Warsaw with its app. 1.77 million[2] inhabitants and now two metro lines, has still one of the least developed subway infrastructure among the European capital cities. For example among the capital cities with a similar number of inhabitants, Prague has three metro lines, Budapest, Brussels or Bucharest four, and Vienna five. Two metro lines that are now operating in Warsaw, with the second line opened only in 2015 and not yet fully constructed, constitute thus relatively less developed subway network. Second, housing market in Poland differs substantially when compared to Western economies, for which most of the similar research related to metro and property prices has been developed. Poland ranks 31 out of 33 OECD countries in housing conditions, measured by the number of rooms per person, housing expenditure and dwellings without basic facilities (OECD, 2014). Housing affordability, measured by the ratio of the price of 70 m2 dwelling to the annual gross salary, is around 7.5, which is one of the lowest in Europe[3] and it is comparable to Czech Republic, Hungary, Italy and France (Deloitte, 2015). The respective ratio for Belgium, Germany and Denmark is between 3 and 4, while for Netherlands, Spain, Ireland, Sweden, and Austria it is between 4 and 6 (Deloitte, 2015). Third, despite relatively underdeveloped metro infrastructure, Warsaw has rich network of other means of transport. Compared to most EU main cities, it also more heavily relies on a public transport as a source of commuting (Gentile and Noekel, 2016). The dominant role in Warsaw's public transportation network plays bus transportation[4], which in certain parts of the city is complemented with light train transport (trams), (Pan Di, 2013). In that context, subway accessibility, which is still scarce, might be a highly valuable asset. What is important, the current stream of research consequently neglects the role of other means of public transportation, while evaluating the impact of the proximity of metro stations on property prices (Debrezion et al., 2007).[5] Warsaw, Poland, is thus particularly interesting case to analyze due to at least three main reasons: 1) subway infrastructure in Warsaw is still underdeveloped; 2) housing conditions and housing affordability in Poland are low; 3) there is a rich alternative to subway transportation network.

This paper complements existing studies not only by extending them based on geographical location, but also by adapting different methods and examining how the accessibility of other means of transport (bus / tram) affects the uncovered relation between the metro proximity and prices of residential properties. The results show that metro has strong positive impact on the transaction prices of residential properties in Warsaw. Specific estimates reveal that if the metro is located up to 1.5 km away, the property price is significantly higher, and the highest increase of 13 per cent is found for properties that are located within 800 meters from the metro station. For

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[2] Data according to Polish Central Statistical Office as for December 2018 [retrieved from stat.gov.pl on 23rd March 2020].

[3] With the exception of the UK, where the ratio is very high (10.0), which is partly explained by the high demand created by foreign investors (Deloitte, 2015).

[4] Whereas, most of the cities are based upon the rail system (for example: Tokyo, Seoul, London, Vienna, New York, Washington DC, Madrid) or at least these two systems are balanced (such as in Stockholm, Berlin, Taipei), cities where the bus system prevails can be divided into three categories in respect of public transport daily ridership: (1) differences don't exceed 50 per cent (for example in Chicago, Singapore); (2) bus system is around twice as popular as rail system (for example in London, Beijing); (3) bus system is almost four times more used than the rail system (Warsaw), (Pan Di, 2013).

[5] The notable exception with this respect is the study by Cervero and Kang (2011), who analyzed the effects of various means of public transportation (including subway and buses) for Seoul (Korea). They do not account, however, for the possible interaction effects between bus and metro accessibility.

properties in a very close proximity to metro, i.e., within 400 meters, the high positive effect of metro is seen irrespective of the availability of other means of transport. The positive effect of metro found for properties located within 400-800 meters from the metro station seems, however, to be lower once other transports are closer to the property than metro.

The remainder of the paper is structured into five sections. The next section presents the review of literature that deals with capitalizing metro accessibility by the value of the surrounding properties. Section three describes data and methods that are used to assess the relation between metro proximity and prices of residential properties in Warsaw, while section four presents the obtained results. The last section gives concluding remarks.

2. Literature review

There exists vast empirical research that examines the impact of railway proximity on property prices. Most of the previous studies focus on the analysis of local or inter-regional networks of conventional railway systems that are often referred to as heavy rails (Nelson, 1992; Bowes and Ihlanfeldt, 2001). However, following the increase of subway's importance as a kind of a fast city rail, the attention has been moved to the role of subway stations' location.

Results from the international studies that explicitly examine the effect of subways proximity on property prices mostly reveal a positive impact (e.g., Grass, 1992 for Washington D.C., Bajic, 1983 for Toronto, Al-Mosaind et al., 1994 for Portland, Bae et al., 2003 for Seul, Liang et al. 2007 and Li et al., 2019 for Beijing, Du and Mulley, 2007 for Tyne and Wear county in the UK, Martínez and Viegas, 2009 for Lisbon, Pagliara and Papa, 2011 and Gallo, 2018 for Naples, Efthymiou and Antoniou, 2013 for Athens, Zhou et al., 2019 for Shanghai, Chen et al., 2019 for Sydney). There are, however, few studies that report weak or no significant impact (Gatzlaff and Smith, 1993, Du and Mulley, 2007, Gu and Zheng 2010) or even a negative[6] impact (Bowes and Ihlanfeldt, 2001; Hewitt and Hewitt, 2012).

While most of these studies focused on the impact of metro stations on the prices of nearby properties some studies, such as Bae et al. (2003) and Chun-Chang et al. (2020), examine so-called anticipatory effects related to the opening of the metro stations. Bae et al. (2003) place their study in Seoul (South Korea) and find the biggest impact of metro on real estate prices prior the actual opening of the metro line. Chun-Chang et al. (2020) in turn - who analyze Taipei metro system - find a significant negative impact of metro after the beginning of its construction and no significant effect following its opening. In contrast, Lin and Hwang (2004) report a positive effect of the subway proximity on property prices even after launching the metro station (Taipei, Taiwan). They also show that the impact varies depending on the location of the property (center or periphery), type of real estate (residential or commercial) and other factors (for example availability of other metro lines).

A comprehensive review of the empirical research on the impact of railway infrastructure, including heavy rails and metro, on the price of nearby properties can be found in Debrezion et al. (2007) and Mohammad et al. (2013) who both systematize existing research using meta-regression framework. Based on the review of 57 estimated effects for the USA, Debrezion et al. (2007) conclude that different studies examine various railway infrastructure types, different types of properties (residential/commercial), and various societies that differ in terms of demographic and economic factors, such as income. Their findings from meta-regression indicate no significant average effect of the location of metro station and a positive significant effect of commuter railway stations on the prices of nearby properties. The results provided by Mohammad et al. (2013) that are based on the 102 estimated effects coming from 23 studies confirm this finding and indicate that the impact of heavy rail and metro is by 12 per cent points lower than that of light rail system.

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[6] However, these studies relate to the urban rail system rather than subway infrastructure.

This study also found that the impact of railways in Asian and European cities is likely higher compared to cities of North America.

While there exist some studies for European countries that look specifically at the effect of metro proximity on the value of residential properties in European cities (such as Laakso (1992) for Helsinki, Finland, Yankaya and Celik (2004) for Izmir, Turkey, Du and Mulley (2006) for London, UK, Forrest et al. (1995) for Manchester, UK, Martínez and Viegas (2009) for Lisbon, Portugal, Pagliara and Papa (2011) and Gallo, 2018 for Naples, Italy or Efthymiou and Antoniou (2013) for Athens, Greece) the number of empirical research concerning the impact of subway infrastructure on the prices of nearby properties for the Central and Eastern European (CEE) cities is still rather low.

For Warsaw, Borkowska et al. (2001) and Bazyl (2009) aimed at identifying determinants of the residential property prices, among which they also account for metro accessibility. While Borkowska et al. (2001) find significant effect of the subway location on the selling prices of houses, without specifying how far the metro is from the specific property, Bazyl (2009) provides more detailed estimates and reports that the proximity of less than 1 km from the metro station is likely to increase the prices of the properties by app. 15 per cent. These results suffer, however, from several limitations that refer to the spatial scope of the analysis and the unreliable source of data on prices of the analyzed properties. For example, Borkowska et al. (2001) base their analysis on the data that are voluntary provided by four real estate agencies, which clearly do not account for all properties that were sold in the market. They also consider only the presence of the metro station in the neighborhood (a dummy variable), without specifying the actual distance between the property and the metro station; it is also unclear how the neighborhood is defined. The analysis of Bazyl (2009) is in turn based on the asking prices, and not the actual transaction prices, which reflect the market value of the property. What is more, the analysis does not fully control for the neighborhood and property specific factors and includes only selected variables out of those considered as important determinants of property price (for example it does not account for the location on the floor or square footage).

Overall, there exists rich literature on the topic of how metro affects the prices of properties. While the early research concentrates mainly on cities in the US and selected countries of Europe, more up to date studies focus on Asian cities. What is common for the existing literature is that it mostly deals with cases in which the metro system is well-developed. The housing prices might be, however, differently affected by the metro availability if the metro system is poor, especially compared to other means of transport, as in the case of Warsaw.

It has to be noted that the Warsaw metro is the only metro that is operating in Poland. It was opened in 1995 and it now consists of two metro lines. The construction of the first metro line took 25 years and was completed only in 2008. The first metro line consists of 21 stations and connects the North and South parts of the city on the West side of the Vistula river (Rogiński, 2017). Compared to the initial construction phase, in the last years the Warsaw metro has been rapidly developing with a result of the opening of the first (central) section of the second metro line in 2015. Currently the second metro line consists of 13 stations that connect West and East parts of the city, crossing the river. It is planned that the construction of the second metro line will be finished by 2023 with o total of 21 stations.

Notwithstanding the recent development of the second metro line and the future plans that include the construction of the third metro line, the Warsaw metro system is rather poor, especially compared to other major European cities. According to World Metro Database the daily ridership of Warsaw metro system amounts to 384 thousand, while in other European countries this number is much higher – for instance, 4.18 million in Paris, 3.2 million in London, 1.74 million in Madrid, 1.38 million in Berlin, 907 thousand in Rome or 501 thousand in Lisbon.[7]

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[7] On-line database available at http://mic-ro.com/metro/table.html; data retrieved on 16th March 2020.

3. Data and methodology

In the present paper, we deal only with the first metro line, which is driven by the data availability. To be specific, to analyze the effect of metro proximity on the prices of nearby residential properties in Warsaw, this research draws on data coming from the AMRON-SARFiN database for years 2006-2013 (that is for years when the second metro line was not yet operating). AMRON-SARFiN database is a comprehensive database on real estate market and it is a leading commercial source of data for properties in Poland, commonly used in a banking sector. The advantage of this dataset - compared to reviewed studies that deal with property prices in Warsaw - is that it collects information on the selling price of the property, the date of transaction, and detailed characteristics of the property, such as the location (address), square footage, number of floors, or ownership type. The dataset is available free of charge for scientific purposes. The data are collected for the years 2006-2013 but they are not longitudinal in the sense that the same properties are not observed (sold) repeatedly in different years but they represent cross-sectional data repeated over time.[8]

The dataset lacks, however, information on the distance to metro or other public transport, such as bus or tram. This information is therefore extracted using geographical coordinates of the properties recoded from their address and geographical coordinates of metro, bus and tram stops in Warsaw, which are available to access (in vector/raster layers) free of charge from the online map services such as openstreetmap.org. New variables reflecting the distances between defined objects (for example given property and metro station) are then derived based on the coordinates and GIS software.

3.1 Basic approach: hedonic pricing model

To investigate the effect of metro station accessibility on property prices we use the hedonic pricing approach, which assumes that housing price is a function of physical (structural), neighborhood and spatial/location characteristics. In practice, hedonic residential pricing models is a multivariate regression analysis, with the dependent variable measuring the value of the property and the set of independent variables capturing physical, neighborhood and spatial factors.

Formally the model takes the following form:

$$\ln(price)_i = \alpha_0 + \alpha_1 metro_i + \alpha_2 bus_i + \alpha_3 tram_i + \alpha_4 center_i + \sum_{k=5}^{l} \alpha_k (physical)_{i,k} + \sum_{m=l+1}^{n} \alpha_m (neighborhood)_{i,m} + \alpha_{n+1} (time)_i + \epsilon_i \quad (1)$$

The dependent variable ln(*price*) is defined as the natural logarithm of a property sale price per square meter. Property prices is deflated using consumer price index (CPI).

The key variable of interest is *metro,* which indicates the distance between the property i and the nearest metro station. The variable is defined as a set of four dummy variables indicating exact distances. The dummy variables for a distance between the nearest metro station and a given property are defined as: (1) 0-400 meters; (2) 400-800 meters; (3) 800-1500 meters; (4) more than 1500 meters. The model also controls for the distance to other means of transport, i.e. bus and tram. Similarly to variable that indicates the distance from metro station, these variables are specified as a set of dummy variables indicating exact distances. The models also account for the distance from the city center, measured by the variable *center,* which once again takes a discrete form. The summary statistics concerning prices and distance related variables are shown in Table 1.

The variables denoted as $physical_k$ include: usable area of the property, age of the building, type of the market, floor location, legal ownership, and parking availability. For the purpose of the interpretation of the coefficients estimated for these variables, they are also recoded into dummy variables as indicated by Table 2 that presents summary statistics.

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[8] It is, however, possible to treat the data as panel data (where the panel is defined by location and time) because different properties that are sold in different years may be in the same location defined by the geographical coordinates. We discuss this issue in more detail in section 3.2.

Table 1. **Summary statistics of property prices per square meter and distance related variables**

Variable	Mean	Std. Deviation	Variable	Mean	Std. Deviation
Price per m2 (PLN)	7968.957	2815.194	Distance (km): Tram	1.727	2.065
Distance (km): Center	6.442	3.532	Tram: 0 - 200 m	0.176	0.380
Centrum: 0 - 3 km	0.187	0.390	Tram: 200 - 400 m	0.183	0.386
Centrum: 3 - 5 km	0.209	0.407	Tram: 400 - 800 m	0.179	0.383
Centrum: 5- 7 km	0.188	0.391	Tram: > 800 m	0.463	0.499
Centrum: 7 - 10 km	0.234	0.423	Distance (km): Bus	0.179	0.124
Centrum: > 10 km	0.182	0.386	Bus: 0 -100 m	0.276	0.447
Distance (km): Metro	3.934	3.413	Bus: 100 - 250 m	0.514	0.500
Metro: 0 - 400 m	0.075	0.263	Bus: 250 - 400 m	0.156	0.363
Metro: 400 - 800 m	0.133	0.339	Bus: > 400 m	0.054	0.225
Metro: 800 - 1500 m	0.103	0.304	**Number of observations**	**5576**	
Metro: > 1500 m	0.689	0.463			

Source: Own calculations based on AMRON-SARFiN data and geographical coordinates of the properties recoded from their address and geographical coordinates of metro, bus and tram stops in Warsaw.

Table 2. **Summary statistics of physical characteristics of properties**

Variable	Mean	Std. Deviation	Variable	Mean	Std. Deviation
Square meters	62.514	31.000	Floor 0	0.158	0.365
Square meters: 0-35	0.128	0.334	Floor 1	0.166	0.372
Square meters: 35-60	0.467	0.499	Floor 2	0.200	0.400
Square meters: 60-90	0.262	0.440	Floor 3	0.178	0.383
Square meters: >90	0.144	0.351	Floor 4	0.125	0.331
Parking	0.232	0.422	Floor 5-6	0.105	0.307
Primary market	0.256	0.436	Floor 7-9	0.047	0.211
Secondary market	0.744	0.436	Floor >=10	0.020	0.140
Age of the building	27.606	29.685	Private ownership	0.448	0.497
Age of the building: 0-2	0.287	0.453	Perpetual ownership	0.548	0.498
Age of the building: 2-10	0.191	0.393	Other type of ownership	0.004	0.064
Age of the building: 10-50	0.304	0.460	**Number of observations**	**5576**	
Age of the building: >50	0.218	0.413			

Source: Own calculations based on AMRON-SARFiN data

Table 3. **Summary statistics of neighborhood related variables**

Variable	Mean	Std. Dev.
Living condition index	0.494	0.155
Population density (thousands/m2)	4.390	2.762
Share of green areas	12.633	16.642
Share of recreational areas	6.128	6.821
Crimes per 1000 inhabitants	32.867	15.822
Children per 1000 children in kindergartens	757.333	138.412
Number of districts	**18**	

Source: Own calculations based on GUS (2012) and MOBP (2013) reports.

The next set of control variable denoted as $neighborhood_m$ includes characteristics of the surrounding measured at the district level. More specifically these measures account for population density, share of green areas, share of recreation areas, number of crimes per 1000 inhabitants, number of children attending kindergarten per 1000 children, living condition index. The data are extracted from GUS (2012) and MOBP (2013) reports. The summary statistics for the neighborhood related variables are shown in Table 3. The estimated equation additionally controls for time trend, measured by year and quarters fixed effects (denoted by *time*).

In the analysis, we also test the hypothesis concerning the interaction effect between various public transportation modes. We thus ask whether the importance of the metro accessibility weakens when other means of transportation are located closer than metro. To do that we define a dummy variable denoted as MOT which takes the value of 1 if other means of transport (bus or tram) are closer to the property than the nearest metro station and the relative distance between them is more than 250 meters; in other case the variable takes a value of 0. Put it differently, the variable equals to 1 if there is bus or tram available that is closer than metro and the distance to metro compared to bus or tram is quite far (i.e. more than 250 meters). This variable is then interacted with variables measuring the distance to the nearest metro station. The estimated coefficients on the interactions reveal whether the effect of metro proximity is affected by the relative distance of metro to other means of transportation. It is expected that when the other means of transportation are located closer than metro (i.e. the variable MOT takes the value of 1), the role of metro in shaping the property price will be lower. In other words, it is expected that the estimated coefficients on the interaction terms will prove to be negative.

3.2 *Alternative methods: SEM and SAR models*

Hedonic pricing models, though widely used in applied research on property prices, suffer from several important limitations. These mostly relate to heteroscedasticity, collinearity between the variables, and the spatial dependence/autocorrelation.

While the first problem – heteroscedasticity – is a common problem embedded in ordinary least squares estimation, it can be overcame with the use of logarithmic form and robust standard errors. Similarly, in order to avoid collinearity between variables, the VIF test can be performed and one of the linearly dependent variables can be dropped from the model. The third issue – the spatial dependence – is, however, more serious and therefore requires more attention.

More specifically, the problem of spatial dependence relates to the correlation of values within a given group of close objects, which may lead to the misspecification and estimation bias (Anselin and Arribas-Bel, 2012). It is worth noting that despite its significance, this issue has not been properly addressed in the number of previous studies on the topic (Damm et al., 1980; Bae et al., 2003, Li et al., 2017). Spatial autocorrelation is closely linked to the so-called first law of geography (Tobler, 1970), which says that objects which are near to each other are more similar (correlated) than those that are distant. In the context of real estate, this means that observation units (properties) in close proximity should exhibit similar effects (prices) to neighboring units. In this case, the dependence can be viewed as error dependence that violates the crucial assumption of OLS of the uncorrelation of the error terms (LeSage and Pace, 2009).

To deal with this issue, we re-estimate the models by applying: 1) *spatial error model* (SEM), and 2) *spatial lag model* (SAR); (Anselin and Arribas-Bel, 2012).

A spatial error model (SEM) introduces the spatial autocorrelation into the error term, as:

$$\ln(price)_i = \alpha_0 + \alpha_1 metro_i + \alpha_2 bus_i + \alpha_3 tram_i + \alpha_4 center_i + \sum_{k=5}^{l} \alpha_k (physical)_{i,k} + \sum_{m=l+1}^{n} \alpha_m (neighborhood)_{i,m} + \alpha_{n+1} (time)_i + \varepsilon_i \tag{2}$$

$$\varepsilon_i = \lambda \boldsymbol{W} \varepsilon_i + u_i$$

where λ is an autoregressive coefficient, $\boldsymbol{W}$ is a spatial weight matrix and u is an iid. error term.

A *spatial lag model* (SAR), on the other hand, regresses the dependent variable (property price) on the set of independent variables, as well as on the property price reweighted by the spatial matrix. Spatial dependence is included here as an additional regressor, that is a spatially lagged dependent variable:

$$\ln(price)_i = \alpha_0 + \rho \boldsymbol{W} * \ln(price)_i + \alpha_1 metro_i + \alpha_2 bus_i + \alpha_3 tram_i + \alpha_4 center_i + \sum_{k=5}^{l} \alpha_k (physical)_{i,k} + \sum_{m=l+1}^{n} \alpha_m (neighborhood)_{i,m} + \alpha_{n+1} (time)_i + \varepsilon_i \tag{3}$$

Where ρ is the coefficient of the spatial lag and $\boldsymbol{W}$, as before, is a spatial weight matrix that defines the spatial relations among the properties.

The models are usually estimated using maximum likelihood estimator (Anselin, 1988). Both models use $\boldsymbol{W}$, the spatial weight matrix, to account for the spatial linkages among the properties. The spatial weight matrix is obtained using the geographical coordinates of the properties and the neighborhood-based matrix (nearest neighbors method).

We note that in our data properties and their prices are observed in different data points, which has important implications for the construction of the spatial weight matrix. To be specific, the weight matrix could contain "spurious" spatial relations, which would appear due to the time dimension that is present in our data. For example, it is possible that several properties that are located in the same location defined by the geographical coordinates, but which are observed in different time points, are treated as "neighbors" and are assigned a greater value in the weight matrix. To account for this, we simplify our data structure and keep in the dataset only the first occurrence of each location in time.[9] This means that each location is observed only once but different locations can be observed in different time points (e.g. years).[10] We control for time dimension using time fixed effects. Based on this subset of the initial dataset we deliver all three models – the hedonic pricing model estimated with the OLS, the SEM and the SAR models estimated using maximum likelihood estimation.

4. Results

The results obtained from the estimation of the main model represented by equation (1) are shown in Table 4. The table present the main coefficients obtained for distance related variables; the coefficients obtained for other variables that are included in the model are presented in Appendix Table A.1. The table shows both the results obtained from OLS model with standard errors clustered at the district level and the results obtained from spatial models that account for the spatial dependence. Because for SAR model the marginal effects are not equal to the estimated α coefficients, as in case of OLS and SEM models, for SAR model we also present tables (Tables 5 and 7 and Appendix tables A.2 and A.4) showing direct, indirect and total effects. The formulas for the direct and indirect effects may be found for example in Golgher and Voss (2015). While the direct effect should be understood as an impact on a price level in a given location resulting from a change in metro proximity in that location, the indirect (spillover) effect should be interpreted as an impact on a price level in a given location resulting from a change in metro proximity in some other location, and the total effect as the sum of the above. In order to compare the results with the OLS results, one should consider the total effects.

The results indicate that the metro is associated with a significant increase in property prices if it is located no farther than 1.5 km from the property (which is a base category in all the models). We observe a comparably high increase in property prices caused by metro if it is located within 0-400 and within 400-800 meters from the property. In both cases the price increase caused by metro is around 13 per cent – which is confirmed by all three models. For the metro proximity of 800-1500 meters, the associated increase in the property price is also high and equals to around 10-11 per cent.

The analysis additionally shows that both bus and tram are associated with a lower selling price of the property if they are located in a close proximity. For bus we see 3-5 per cent lower property prices if the bus is up to 100 meters from the property; for tram the reduction in property prices is

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[9] This leads to a significant reduction in the number of observations (29 915 vs. 5 576). Yet, the resulting sample size is more than 5 500 observations, which is large enough for the models' estimation.

[10] We also run a robustness analysis restricting the sample to one year only (we choose a year that contains the largest number of observations, which is a year 2008). The main results are consistent with the ones presented in the text, but the specific estimates slightly differ. The results are available upon a request.

3-5 per cent in case it is located within 200 meters. The negative impact of a close proximity of bus and tram stops on the property selling price might be related to the noise caused by both bus and tram, which as opposed to metro (which in Warsaw is entirely located underground) operate on regular roads. As expected, close proximity to the city center of up to 3 km is associated with the highest property selling prices; such properties are even by 26 per cent more expensive than similar properties located at the city's peripheries (more than 10 km away from the city center).

Table 4. **Estimation results using OLS, SEM and SAR methods**

Method: **Variable:**	**OLS** **coef/se**	**SEM** **coef/se**	**SAR** **coef/se**
Metro: 0 - 400 m	0.131***	0.131***	0.084***
	(0.025)	(0.020)	(0.014)
Metro: 400 - 800 m	0.132***	0.133***	0.088***
	(0.026)	(0.017)	(0.012)
Metro: 800 - 1500 m	0.108***	0.110***	0.069***
	(0.021)	(0.017)	(0.013)
Metro: >1500 m	(base)	(base)	(base)
Bus: 0 -100 m	-0.044**	-0.027	-0.031**
	(0.023)	(0.020)	(0.016)
Bus: 100 - 250 m	-0.019	-0.001	-0.007
	(0.020)	(0.019)	(0.015)
Bus: 250 - 400 m	-0.006	0.007	0.003
	(0.018)	(0.019)	(0.016)
Bus: >400 m	(base)	(base)	(base)
Tram: 0 - 200 m	-0.049***	-0.032*	-0.030***
	(0.018)	(0.016)	(0.012)
Tram: 200 - 400 m	-0.006	0.003	0.002
	(0.018)	(0.015)	(0.011)
Tram: 400 - 800 m	0.045**	0.044***	0.035***
	(0.019)	(0.014)	(0.010)
Tram: >800 m	(base)	(base)	(base)
Centrum: 0 - 3 km	0.250***	0.251***	0.173***
	(0.051)	(0.028)	(0.021)
Centrum: 3 - 5 km	0.212***	0.209***	0.152***
	(0.047)	(0.023)	(0.017)
Centrum: 5- 7 km	0.126***	0.118***	0.092***
	(0.033)	(0.020)	(0.014)
Centrum: 7 - 10 km	0.103***	0.104***	0.078***
	(0.034)	(0.016)	(0.011)
Centrum: >10 km	(base)	(base)	(base)
Constant	8.348***	8.346***	5.431***
	(0.129)	(0.050)	(0.142)
No. of observations	**5 576**		

Notes: *** p<0.01, ** p<0.05, * p<0.1. The models control for: usable area, floor location, ownership, age of the building, parking place, type of the market, district characteristics (living conditions index, population density, share of green and recreational areas, crime rate and childcare availability), and year fixed effects.

Table 5. **Direct, indirect and total effects derived for SAR model**

	Direct	**Indirect**	**Total**
Metro: 0 - 400 m	0.086	0.041	0.127
Metro: 400 - 800 m	0.090	0.043	0.133
Metro: 800 - 1500 m	0.071	0.033	0.104
Bus: 0 -100 m	-0.032	-0.015	-0.047
Bus: 100 - 250 m	-0.007	-0.003	-0.011
Bus: 250 - 400 m	0.003	0.001	0.004
Tram: 0 - 200 m	-0.031	-0.015	-0.046
Tram: 200 - 400 m	0.002	0.001	0.003
Tram: 400 - 800 m	0.036	0.017	0.052

Centrum: 0 - 3 km	0.176	0.083	0.260
Centrum: 3 - 5 km	0.155	0.074	0.229
Centrum: 5- 7 km	0.094	0.044	0.138
Centrum: 7 - 10 km	0.079	0.038	0.117

The coefficients obtained on variables measuring physical characteristics of the properties are in line with the theoretical predictions and expectations (see Appendix Table A.1). First, the most expensive properties are the smallest ones (0-35 square meters). Second, the floor location matters for the price: compared to the price of the properties located on the ground floor, the price of properties located up to the 7th floor are higher. Perpetual ownership is also associated with a higher selling price of the property (of around 3 to 5 per cent). Compared to properties located in old buildings (more than 50 years old), the properties located in new buildings aged up to 2 years are by around 12-18 per cent more expensive, and properties located in buildings aged 2-10 by even 16-24 per cent more expensive. We also observe that the selling price per square meter is by around 7-10 per cent lower at the primary market than at the secondary one. Importantly, the coefficients obtained on spatial parameters in SEM and SAR models (see Appendix Table A.1) are significant and reveal an existence of the spatial dependency between the neighboring properties.

Finally, we assess how the proximity to other means of transportation (bus or tram) affects the uncovered relationship between metro accessibility and the prices of nearby properties. To do that we interact variables reflecting metro proximity with the variable MOT measuring the relative distance between metro and other means of transportation. The main results on the interaction terms are presented in Table 6 (Appendix Table A.3 gives the full set of coefficients). The MOT variable is interacted with variables indicating that metro is within 0-400 and 400-800 meters but not with the variable indicating that it is within 800-1500 meters. This is because of the definition of MOT variable, which takes a value of 1 if other means of transport (bus or tram) are closer to the property than the nearest metro station and the relative distance between them is more than 250 meters. If metro is located within 800-1500 meters from the property it is very unlikely that there are no other transports that are closer to the property; in other words in this case the MOT variable nearly always takes a value of 1.

The results obtained from the model with the interactions show that if the nearest metro station is very close to the property – within 0-400 meters – the fact that other means of transport are closer relative to metro does not matter for the property price, as indicated by the insignificant and close to zero interaction term between metro 0-400 and MOT variables in all three models. Even if other means of transport are closer than metro, the fact that metro is within 0-400 meters from the property increases its selling price by 13 per cent. As for the metro proximity of 400-800 meters the results indicate that when the nearest metro is within 400-800 meters and other means of transport are even further away or are in a close proximity to metro (variable MOT takes a value of 0), the presence of metro has a high and significant impact on the price of the property of 14 per cent to even 18 per cent (depending on the model used). On the other hand, if the nearest metro is within 400-800 meters and the bus or tram is closer than metro (and at the same time metro is quite far away compared to bus or tram, i.e. more than 250 meters), the importance of the presence of metro for the property price is lowered by around 1-5 per cent. This result is, however, significant at 5% significance level only in the case of OLS model; for other two models we also find negative coefficients but they are not statistically significant. The OLS results thus show that if the nearest metro is relatively far (400-800m) and there are other transports that are much closer, we may not expect as high increase in property prices caused by metro as in the case when there are no other transports that are closer than metro or other transports are nearly as far as the metro is (i.e. the distance between metro and tram/bus is less than 250 meters).

Table 6. **Estimation results with the interactions: OLS, SEM and SAR methods**

Method: **Variable:**	**OLS** **coef/se**	**SEM** **coef/se**	**SAR** **coef/se**
Metro: 0 - 400 m	0.130***	0.132***	0.084***
	(0.026)	(0.021)	(0.015)
Metro: 0 - 400 m x MOT	0.001	-0.006	-0.002
	(0.025)	(0.038)	(0.036)
Metro: 400 - 800 m	0.181***	0.143***	0.115***
	(0.034)	(0.032)	(0.028)
Metro: 400 - 800 m x MOT	-0.055**	-0.011	-0.030
	(0.025)	(0.032)	(0.013)
Metro: 800 - 1500 m	0.108***	0.110***	0.069***
	(0.021)	(0.017)	(0.029)
No. of observations	**5 576**		

Notes: the same as in Table 4; Variable MOT is defined as a dummy variable equal to 1 if the nearest metro station is further away than 250 meters from other transport (bus or tram) and 0 if the nearest metro station is closer than 250 meters from other transport (bus or tram).

Table 7. **Direct, indirect and total effects derived for SAR model with interactions**

	Direct	**Indirect**	**Total**
Metro: 0 - 400 m	0.086	0.041	0.127
Metro: 0 - 400 m x MOT	-0.002	-0.001	-0.003
Metro: 400 - 800 m	0.117	0.055	0.172
Metro: 400 - 800 m x MOT	-0.030	-0.014	-0.045
Metro: 800 - 1500 m	0.071	0.033	0.104

5. Conclusion

This paper provides quantitative evidence on how the proximity to metro affects selling prices of properties in Warsaw. The relation was assessed using AMRON-SARFiN 2006-2013 data and three estimation methods: OLS regression with clustered standard errors, SEM and SAR models.

We found that metro proximity matters for the property prices and properties that are located close to the metro stations are valued more by the market. The positive impact of metro on prices of nearby properties – that are located up to 800 meters from the metro - is estimated to be 13 per cent. The positive effect is revealed in all three models and the two spatial models – SEM and SAR – additionally show spatial dependency of the neighboring properties. The effect is considerably higher than the findings received from meta-analyses of existing studies on the topic, which report virtually zero effect. As opposed to previous studies that analyzed the situation in cities with well-developed metro infrastructure, the current study shows how metro affects prices of nearby properties in Warsaw, in which the metro system is far less developed. The high positive effect of metro availability on property prices that has been uncovered suggests that the impact of metro is much larger when it is not easily accessible and is not considered as the main public transportation mode. Furthermore, the fact that housing affordability in Warsaw is low may also lead to a greater differentiation in property prices, with relatively more expensive properties having highly valued characteristics, such as easy access to metro system.

At the same time, the obtained results are somehow lower than the ones provided for Warsaw by Bazyl (2009). This difference may stem from the fact that in the present study we use transaction prices, while the analysis in Bazyl (2009) is based on asking prices. In consequence, higher positive effects of metro found with the use of asking prices than actual transaction prices suggests that metro is perceived as highly valuable and it is expected to be capitalized in the prices of residential properties even by a higher value.

Finally, because Warsaw public transportation system may be characterized by poor metro infrastructure but rich system of other public transports, we also analyze how the availability of other means of transport affects the uncovered high positive impact of metro. The results obtained from all three models suggest that the fact that other transports are closer than metro is not important for the high increase in the property selling price associated with metro if metro is close enough to the property (within 0-400 meters). As for the metro proximity of 400-800 meters from the property, the results suggest that other means of transport that are closer than metro lower the high positive impact of metro. The significant finding is, however, found only for OLS model.

Several comments concerning the data and the analysis are called for. Given that the available data covered property transactions during 2006-2013 period, the present analysis examined the impact of metro proximity on property prices in Warsaw focusing on the first metro line. Since 2015 Warsaw metro network has been extended and a second metro line is now in operation. The results presented in this paper could be re-assessed by additionally including data from 2015 onwards to see whether the uncovered relations hold. An interesting future extension would be the comparison of the impacts of newly opened and the existing metro stations on property prices. Other possible extension could include the analysis of selected districts to reveal the regional heterogeneity in the estimated effect of metro proximity on property prices.

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Appendix

Table A.1. Full estimation output for the main model using OLS, SEM and SAR methods

Method: **Variable:**		**OLS** **coef/se**	**SEM** **coef/se**	**SAR** **coef/se**
Distance variables	Metro: 0 - 400 m	0.131***	0.131***	0.084***
		(0.025)	(0.020)	(0.014)
	Metro: 400 - 800 m	0.132***	0.133***	0.088***
		(0.026)	(0.017)	(0.012)
	Metro: 800 - 1500 m	0.108***	0.110***	0.069***
		(0.021)	(0.017)	(0.013)
	Centrum: 0 - 3 km	0.250***	0.251***	0.173***
		(0.051)	(0.028)	(0.021)
	Centrum: 3 - 5 km	0.212***	0.209***	0.152***
		(0.047)	(0.023)	(0.017)
	Centrum: 5- 7 km	0.126***	0.118***	0.092***
		(0.033)	(0.020)	(0.014)
	Centrum: 7 - 10 km	0.103***	0.104***	0.078***
		(0.034)	(0.016)	(0.011)
	Tram: 0 - 200 m	-0.049***	-0.032*	-0.030***
		(0.018)	(0.016)	(0.012)
	Tram: 200 - 400 m	-0.006	0.003	0.002
		(0.018)	(0.015)	(0.011)
	Tram: 400 - 800 m	0.045**	0.044***	0.035***
		(0.019)	(0.014)	(0.010)
	Bus: 0 -100 m	-0.044**	-0.027	-0.031**
		(0.023)	(0.020)	(0.016)
	Bus: 100 - 250 m	-0.019	-0.001	-0.007
		(0.020)	(0.019)	(0.015)
	Bus: 250 - 400 m	-0.006	0.007	0.003
		(0.018)	(0.019)	(0.016)
Physical characteristics	Square meters: 0-35	0.054***	0.055***	0.052***
		(0.011)	(0.010)	(0.010)
	Square meters: 60-90	0.000	-0.009	-0.005
		(0.010)	(0.008)	(0.008)
	Square meters: >90	0.011	-0.002	0.003
		(0.043)	(0.011)	(0.010)
	Floor 1	0.047***	0.038***	0.038***
		(0.018)	(0.011)	(0.011)
	Floor 2	0.036*	0.020*	0.025**
		(0.022)	(0.011)	(0.011)
	Floor 3	0.034*	0.019*	0.024**
		(0.020)	(0.011)	(0.011)
	Floor 4	0.041*	0.033***	0.034***
		(0.024)	(0.012)	(0.012)
	Floor 5-6	0.044**	0.034***	0.035***
		(0.022)	(0.013)	(0.013)
	Floor 7-9	0.024	0.024	0.021
		(0.024)	(0.017)	(0.017)
	Floor >=10	0.053	0.068***	0.056**
		(0.033)	(0.024)	(0.024)
	Perpetual ownership	0.033***	0.033***	0.032***
		(0.012)	(0.009)	(0.008)
	Other type of ownership	-0.001	0.019	0.018
		(0.044)	(0.052)	(0.050)
	Parking	0.001	0.007	0.005
		(0.011)	(0.008)	(0.008)
	Age of the building: 0-2	0.129***	0.135***	0.119***
		(0.020)	(0.014)	(0.013)
	Age of the building: 2-10	0.177***	0.171***	0.157***

		(0.020)	(0.013)	(0.013)
	Age of the building: 10-50	-0.014	0.002	-0.005
		(0.016)	(0.010)	(0.010)
	Primary market	-0.082***	-0.069***	-0.065***
		(0.019)	(0.011)	(0.011)
Neighborhood characteristics	Living condition index	0.169	0.219***	0.122***
		(0.110)	(0.065)	(0.047)
	Population density (thousands/m2)	-0.009	-0.013***	-0.008***
		(0.006)	(0.004)	(0.003)
	Share of green areas	-0.001	-0.001***	-0.001**
		(0.001)	(0.001)	(0.000)
	Share of recreational areas	0.006***	0.006***	0.005***
		(0.002)	(0.001)	(0.001)
	Crimes per 1000 inhabitants	-0.000	-0.001**	-0.001**
		(0.001)	(0.001)	(0.000)
	Children per 1000 children in kindergartens	0.000	0.000	0.000*
		(0.000)	(0.000)	(0.000)
Constant		8.348***	8.346***	5.431***
		(0.129)	(0.050)	(0.142)
Lambda			0.366***	
			(0.017)	
Rho				0.335***
				(0.016)
Number of observations		5576		

Table A.2. **Direct, indirect and total effects derived for full estimation output for SAR model**

		Direct	Indirect	Total
Distance variables	Metro: 0 - 400 m	0.086	0.041	0.127
	Metro: 400 - 800 m	0.090	0.043	0.133
	Metro: 800 - 1500 m	0.071	0.033	0.104
	Centrum: 0 - 3 km	0.176	0.083	0.260
	Centrum: 3 - 5 km	0.155	0.074	0.229
	Centrum: 5- 7 km	0.094	0.044	0.138
	Centrum: 7 - 10 km	0.079	0.038	0.117
	Tram: 0 - 200 m	-0.031	-0.015	-0.046
	Tram: 200 - 400 m	0.002	0.001	0.003
	Tram: 400 - 800 m	0.036	0.017	0.052
	Bus: 0 -100 m	-0.032	-0.015	-0.047
	Bus: 100 - 250 m	-0.007	-0.003	-0.011
	Bus: 250 - 400 m	0.003	0.001	0.004
Physical characteristics	Square meters: 0-35	0.053	0.025	0.079
	Square meters: 60-90	-0.005	-0.002	-0.007
	Square meters: >90	0.003	0.002	0.005
	Floor 1	0.039	0.018	0.057
	Floor 2	0.026	0.012	0.038
	Floor 3	0.025	0.012	0.037
	Floor 4	0.035	0.016	0.051
	Floor 5-6	0.036	0.017	0.053
	Floor 7-9	0.021	0.010	0.032
	Floor >=10	0.058	0.027	0.085
	Perpetual ownership	0.033	0.015	0.048
	Other type of ownership	0.018	0.009	0.027
	Parking	0.005	0.002	0.008
	Age of the building: 0-2	0.122	0.058	0.179
	Age of the building: 2-10	0.161	0.076	0.237
	Age of the building: 10-50	-0.005	-0.002	-0.008
	Primary market	-0.066	-0.031	-0.098

Neighborhood characteristics	Living condition index	0.125	0.059	0.184
	Population density (thousands/m2)	-0.008	-0.004	-0.012
	Share of green areas	-0.001	0.000	-0.001
	Share of recreational areas	0.005	0.002	0.008
	Crimes per 1000 inhabitants	-0.001	0.000	-0.001
	Children per 1000 children in kindergartens	0.000	0.000	0.000

Table A.3. **Full estimation output for the model with interaction terms using OLS, SEM and SAR methods**

Method: **Variable:**		**OLS** **coef/se**	**SEM** **coef/se**	**SAR** **coef/se**
Distance variables	Metro: 0 - 400 m	0.130***	0.132***	0.084***
		(0.026)	(0.021)	(0.015)
	Metro: 0 - 400 m x MOT	0.001	-0.006	-0.002
		(0.025)	(0.038)	(0.036)
	Metro: 400 - 800 m	0.181***	0.143***	0.115***
		(0.034)	(0.032)	(0.028)
	Metro: 400 - 800 m x MOT	-0.055**	-0.011	-0.030
		(0.025)	(0.032)	(0.029)
	Metro: 800 - 1500 m	0.108***	0.110***	0.069***
		(0.021)	(0.017)	(0.013)
	Centrum: 0 - 3 km	0.251***	0.251***	0.173***
		(0.051)	(0.028)	(0.021)
	Centrum: 3 - 5 km	0.213***	0.209***	0.153***
		(0.046)	(0.023)	(0.017)
	Centrum: 5- 7 km	0.126***	0.118***	0.092***
		(0.033)	(0.020)	(0.014)
	Centrum: 7 - 10 km	0.104***	0.104***	0.078***
		(0.033)	(0.016)	(0.011)
	Tram: 0 - 200 m	-0.048***	-0.032*	-0.030**
		(0.018)	(0.016)	(0.012)
	Tram: 200 - 400 m	-0.006	0.003	0.002
		(0.018)	(0.015)	(0.011)
	Tram: 400 - 800 m	0.045**	0.044***	0.035***
		(0.019)	(0.014)	(0.010)
	Bus: 0 -100 m	-0.042*	-0.026	-0.030*
		(0.021)	(0.020)	(0.016)
	Bus: 100 - 250 m	-0.016	-0.001	-0.006
		(0.019)	(0.019)	(0.015)
	Bus: 250 - 400 m	-0.006	0.007	0.003
		(0.018)	(0.019)	(0.016)
Physical characteristics	Square meters: 0-35	0.054***	0.055***	0.052***
		(0.011)	(0.010)	(0.010)
	Square meters: 60-90	0.001	-0.009	-0.005
		(0.010)	(0.008)	(0.008)
	Square meters: >90	0.011	-0.002	0.003
		(0.043)	(0.011)	(0.010)
	Floor 1	0.047***	0.038***	0.038***
		(0.018)	(0.011)	(0.011)
	Floor 2	0.036*	0.020*	0.025**
		(0.022)	(0.011)	(0.011)
	Floor 3	0.033*	0.019*	0.024**
		(0.020)	(0.011)	(0.011)
	Floor 4	0.041*	0.032***	0.034***
		(0.024)	(0.012)	(0.012)
	Floor 5-6	0.044**	0.034***	0.035***
		(0.022)	(0.013)	(0.013)
	Floor 7-9	0.024	0.024	0.021

		(0.024)	(0.017)	(0.017)
	Floor >=10	0.053	0.068***	0.056**
		(0.033)	(0.024)	(0.024)
	Perpetual ownership	0.033***	0.033***	0.032***
		(0.012)	(0.009)	(0.008)
	Other type of ownership	0.001	0.019	0.019
		(0.045)	(0.052)	(0.050)
	Parking	0.002	0.007	0.005
		(0.011)	(0.008)	(0.008)
	Age of the building: 0-2	0.129***	0.135***	0.119***
		(0.020)	(0.014)	(0.013)
	Age of the building: 2-10	0.177***	0.171***	0.157***
		(0.020)	(0.013)	(0.013)
	Age of the building: 10-50	-0.014	0.002	-0.005
		(0.016)	(0.010)	(0.010)
	Primary market	-0.082***	-0.069***	-0.065***
		(0.019)	(0.011)	(0.011)
Neighborhood characteristics	Living condition index	0.169	0.219***	0.122***
		(0.110)	(0.065)	(0.047)
	Population density (thousands/m2)	-0.009	-0.013***	-0.008***
		(0.006)	(0.004)	(0.003)
	Share of green areas	-0.001	-0.001***	-0.001**
		(0.001)	(0.001)	(0.000)
	Share of recreational areas	0.006***	0.006***	0.005***
		(0.002)	(0.001)	(0.001)
	Crimes per 1000 inhabitants	-0.000	-0.001**	-0.001**
		(0.001)	(0.001)	(0.000)
	Children per 1000 children in kindergartens	0.000	0.000	0.000*
		(0.000)	(0.000)	(0.000)
Constant		8.344***	8.345	5.435***
		(0.129)	(0.050)	(0.143)
Lambda			0.366***	
			(0.017)	
Rho				0.335***
				(0.016)
Number of observations		5576		

Table A.4. Direct, indirect and total effects derived for full estimation output for SAR model with interactions

		Direct	Indirect	Total
Distance variables	Metro: 0 - 400 m	0.086	0.041	0.127
	Metro: 0 - 400 m x MOT	-0.002	-0.001	-0.003
	Metro: 400 - 800 m	0.117	0.055	0.172
	Metro: 400 - 800 m x MOT	-0.030	-0.014	-0.045
	Metro: 800 - 1500 m	0.071	0.033	0.104
	Centrum: 0 - 3 km	0.177	0.084	0.261
	Centrum: 3 - 5 km	0.156	0.074	0.230
	Centrum: 5- 7 km	0.094	0.044	0.139
	Centrum: 7 - 10 km	0.080	0.038	0.118
	Tram: 0 - 200 m	-0.030	-0.014	-0.045
	Tram: 200 - 400 m	0.002	0.001	0.003
	Tram: 400 - 800 m	0.036	0.017	0.053
	Bus: 0 -100 m	-0.030	-0.014	-0.045
	Bus: 100 - 250 m	-0.006	-0.003	-0.009
	Bus: 250 - 400 m	0.003	0.001	0.004
Physical characteristics	Square meters: 0-35	0.053	0.025	0.079
	Square meters: 60-90	-0.005	-0.002	-0.007
	Square meters: >90	0.003	0.002	0.005
	Floor 1	0.039	0.018	0.057
	Floor 2	0.026	0.012	0.038
	Floor 3	0.025	0.012	0.036
	Floor 4	0.034	0.016	0.051
	Floor 5-6	0.036	0.017	0.052
	Floor 7-9	0.021	0.010	0.032
	Floor >=10	0.058	0.027	0.085
	Perpetual ownership	0.033	0.016	0.048
	Other type of ownership	0.019	0.009	0.029
	Parking	0.005	0.003	0.008
	Age of the building: 0-2	0.122	0.058	0.179
	Age of the building: 2-10	0.161	0.076	0.236
	Age of the building: 10-50	-0.005	-0.002	-0.008
	Primary market	-0.066	-0.031	-0.098
Neighborhood characteristics	Living condition index	0.125	0.059	0.184
	Population density (thousands/m2)	-0.008	-0.004	-0.012
	Share of green areas	-0.001	0.000	-0.001
	Share of recreational areas	0.005	0.002	0.007
	Crimes per 1000 inhabitants	-0.001	0.000	-0.001
	Children per 1000 children in kindergartens	0.000	0.000	0.000