Spatial econometrics: transport infrastructure development and real estate values in Budapest

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Over the last few decades, the M4 metro line has been the largest transport infrastructure project in Budapest. Despite the size and importance of the project, there has been no evaluation of its economic impacts in the scientific literature. This paper addresses this gap and expands the scientific discourse on spatial econometrics, cohesion policy, and sustainable urban development by exploring the impact of the new metro line on real estate prices.

To assess the economic effect of the M4 project on the value of nearby properties, the authors use counterfactual impact evaluation along with a measurement of the utility increase in the change in property prices. The research database has been provided by the National Tax and Customs Administration.

Sustainable and useful public infrastructure developments will have a positive effect on the value of nearby properties. It is reasonable to assume that easier access to downtown areas can be an added value; however, the increased traffic, crowds, or noise may outweigh these positive impacts. In case of M4, the authors find no significant effects of the stations on the Pest side.

Only the new stations that were not connected directly to existing underground lines exert a positive effect on nearby real estate properties. It is worth using this information when making decisions on further transport development in Budapest.

This paper presents original research on the economic effects of the M4 transport project. It determines the factors that increase or decrease the economic effects of the stations. As has been shown, several stations have failed to generate additional economic value. This information is highly useful for the planning of future transport infrastructure projects.

Keywords:
public infrastructures,
urban transportation analysis,
sustainability

Introduction

The cohesion policy of the European Union strengthens economic, social, and territorial cohesion within the Union, and aims to reduce regional disparities. Realistic regional convergence also requires the elimination of obstacles such as the development level of basic transport infrastructure. This objective is frequently fulfilled through the development of urban public transport systems and facilities (Guzik et al. 2017, Bodnár–Csomós 2018, Konecka-Szydłowska et al. 2018).

In addition to their undoubted effects on mobility (Varga et al. 2016, Kiss–Szalkai 2018), these interventions can alter the spatial distribution of urban property values. Studies suggest that economic impacts can vary significantly depending on the type of interventions, the locations and geographical areas served, pre-existing market conditions, and other policy and planning factors. The impact of urban infrastructural developments has been studied in other countries with special attention paid to underground projects. Research on sustainability and market value has received considerable attention in recent years, which has led to a rapidly evolving body of research. The literature presents several methodologies from the domain of spatial econometrics for the measurement of real estate values (Ibeasa et al. 2012).

In 2014, a new metro line was opened in Budapest. The project was co-financed by European development funds. The new line is seen as a milestone for the Hungarian capital; however, its economic impacts have not been investigated in detail. This paper addresses this research gap and expands the scientific discourse of spatial econometrics and cohesion policy by examining the impact of the new metro on real estate prices. The new metro line also intended to steer the surface, non-line infrastructure public transport traffic underground[1]. Increasing accessibility of remote parts of the city and decreasing the pollution from urban transport are particularly important aspects in the sustainable development of Budapest. This paper presents a method to monetise these effects by measuring the change in real estate prices.

Conceptual background

The efficiency of public spending has always been an important issue, and in the current economic and financial climate, the questions of what and how the scarce resources available are used, and the impact of this spending are of particular significance. The issues of whether the use of public funds is justified, which areas require development, and where the best result can be ensured (value for money principle) (Nyikos 2011, 2013) are extremely important. Greater welfare can be achieved by increasing the gross domestic product (GDP) components and increasing state or corporate capital is one type of investment intervention in infrastructure. The objec-

[1] See the official website of Metro4 (http://www.metro4.hu/en/what-will-metro4-be-like)

tive of the cohesion policy is to enhance regional economic performance (Nyikos 2013, p. 164), particularly with respect to GDP, employment, productivity, investments, and the foreign trade equilibrium. Within the policy framework, significant amounts of public funds are utilised to support the necessary infrastructure and to stimulate private investment, which could significantly speed up the convergence process. Realistic convergence requires the elimination of growth obstacles such as the development level of basic infrastructure and the need to increase mobility. Thus, one of the efficient channels of the medium- and long-term sustainable impacts of EU cohesion policy is the funding of broadly interpreted public infrastructural investments (Nyikos 2013). The European Union's structural and cohesion funds play a major role in the funding of Hungarian economic agents (Egri–Kőszegi 2018).

The effect of infrastructure investment could be multidirectional and, in several cases, controversial (Horkay et al. 2006). Transportation infrastructure is known to affect the value of real estate property due to changes in accessibility. The impact of transportation facilities is also highly localised, and the capitalisation of accessibility may lead to spillover effects (Dorantes et al. 2011).

Public mass transit systems can alter the spatial distribution of urban property values. The magnitude of this effect is likely to be highly parcel-specific, and changes in real estate values may occur both prior to and after a transit system's construction. In the US, access to the transit system and the implementation schedule of metro line construction were found to be significant determinants of parcel transaction prices (Lerman et al. 1978). In other cases, the literature on the impact of transit on land values reports mixed results concerning the economic benefits of accessibility to subway stations, specifically in the context of commercial properties (Kim–Zhan 2005). A Korean study suggests the discrimination impact of transit on land values by location, in a built-up urban area as a possible explanation for the mixed results. A Scandinavian study argues that the distance to the city centre and the proximity of metro stations constitute two of the factors that significantly affect the market price of dwellings. This means that the positive and negative effects of the recently constructed metro line have capitalised the market value of property in the vicinity and in feeder transport areas (Laakso 1992). A Spanish case study indicated that better accessibility to MetroSur stations (Madrid) had a positive impact on real estate values, and that this effect was marked in cases in which a house was put up for sale. The results also revealed the presence of submarkets, well defined by geographic boundaries and transport fares, which implied that the economic benefits differed across municipalities (Dorantes et al. 2011). The results of a Portuguese study (Martínez–Viegas 2009) and a Polish study (Bazyl 2009) also suggest that the proximity to one or two metro lines leads to significant changes in property values. However, an important factor is that, as in the case of the Jubilee Line Extension and the Madrid MetroSur, positive economic benefits occurred most frequently around the stations where enforceable land use plans and complementary policies has already been in place to increase urban densities and encourage mixed land uses, alongside restricted car access and good pedestrian access to stations (Mejia-Dorantes–Lucas 2014).

The literature presents several methodologies for the measurement of real estate values. Hedonic multiple linear regression models, spatial autoregressive hedonic models, spatial autoregressive hedonic in the error term models and spatial Durbin hedonic models are used to estimate housing price variations in metropolitan areas as a result of changing environmental and accessibility conditions (Ibeasa et al. 2012).

Research suggests that economic impacts can vary significantly depending on the type of interventions, the locations and geographical areas served, pre-existing market conditions, and other policy and planning factors. However, another issue for evaluation is the extent to which the different studies that are available are comparable in terms of their methodologies, which makes the synthesis of research findings across different case studies extremely difficult (Mejia-Dorantes–Lucas 2014).

The relationship between sustainability and market value has also received considerable attention. Most studies that investigate the relationship between sustainability and value have been categorised into the following themes to allow critical analysis and examine the applicability of the theory or research for valuation practice:

- discussion and analysis of stakeholders' perceptions and sentiments;
- normative studies that suggest the relationship 'should' be present;
- case studies used to demonstrate normative theory; and
- quantitative studies to quantify the effect of sustainability (Warren-Myers 2012).

Methodology

Measuring the utility of large transport infrastructural projects is a challenge in cohesion policy. The standard tools are cost-benefit analysis and passenger counting, however these techniques often fail to measure the real value-added of these types of projects[2].

The main challenge is to construct a solid counterfactual analysis exploring what would have happened if there were a lack of investment. Our idea was to borrow a widely used technique of counterfactual impact evaluation from human development and SME development evaluations. This method (Khandker et al. 2010) was

[2] Statistical methods are designed to answer large sample-based research questions. Large infrastructural projects often fail to build a well-based counterfactual situation (i.e. what would have happened without the development). Our approach attempts to combine the evaluation of territorially focused infrastructure development with large sample statistical hypothesis testing and counterfactual impact evaluation.

combined with Lucas' (1988) concept of measuring the utility increase using the change in property prices. According to this research methodology, useful public infrastructural developments have a positive effect on the value of nearby properties. It is reasonable to assume that easier access to downtown areas can be a value-added, but the increased traffic, crowds, or noise may outweigh these positive impacts. To explore the economic impacts of the M4 project, this research uses the following methodological steps.

The **research database** has been provided by the National Tax and Customs Administration. The initial dataset contained the location data of properties sold in the capital. These data were used to estimate one of the research variables: the **distance** of dwellings from the metro stations. However, two difficulties arose. First, due to data protection requirements, the records of the dataset included ZIP codes, city, and street names without house numbers. Second, the addresses were provided in a semi-structured format (free text fields) that contained many abbreviations and typos to be unified in some degree. In the absence of house numbers, it was necessary to apply a simplification to ensure adequate granularity. To manage these, a list of ZIP codes and unique addresses was created, excluding undefinable cases. To address the second challenge, street midpoints were used for distance measurement. For addresses concerning more than one ZIP code, ZIP code level midpoints were calculated to improve accuracy. This approach may result in some inaccuracies; it has been assumed that such approximations can fit the purpose of the research[3]. To obtain accurate distance measurement, it was necessary to convert addresses to geo-coordinates. The list of street midpoints was used for geocoding via the HERE Geocoder API using a Python script. This step provided X and Y coordinates for all street midpoints to enable distance measurement. The calculation of distances was based on Euclidean distances (Jóna 2018) between stations and street midpoints[4]. The Haversine formula was used to provide distance variables in metres (van Brummelen 2013). Going one step further, the shortest distance between metro stations and street midpoints was defined.

We choose to use a double propensity score matching (for the propensity score matching technique, see Rosenbaum–Rubin 1983) technique **to evaluate the utility** of the M4 metro line development in Budapest through the change in property values. We created a 'treated' group, from sold properties close to the metro stations (we estimated a walking distance of seven minutes from the new metro stations as the treated area, which is approximately 580 m)[5], and created a 'control' group on which the new metro stations had no effect (more than 15 minutes' walking distance from any of the newly built metro stations, which is approximately 1,250 m).

[3] Due to data protection measure, imposed by the National Tax Authority, we could not obtain more accurate geopoints.

[4] As we used a large sample, the possible errors have been eliminated through aggregation.

[5] According to the Cohesion Policy regulation.

We compared the change in the property prices before and after the investment. The main challenge here is that properties are rarely sold twice (before and after the investment); we first created pairs of properties with very similar characteristics in the treatment and control groups, sold before and after the investment. This was done using a one-to-one nearest neighbour propensity score matching.

To find the average treatment effect on the treatment group, we analysed the results of three models:

1. a one-to one nearest neighbour matching without the per square metre starting property prices;
2. kernel matching with the per square metre starting property prices;
3. kernel matching without the per square metre starting property prices.

Discussion

The new subway line in Budapest

The newest M4 metro line in Budapest has been on the political agenda since 1990. However, the plans are even older; the majority of them were created in the 1970s. There were extensive discussions as to whether the metro line would fit either into the structure of the existing Budapest public transportation network or into the reasonable future development scenarios. The aim of the M4 project was to establish a metro line with modern, automated, air-conditioned trains that run even every 1.5 minutes, with modern, airy, and less draughty stations where passengers can wait for the new metro trains on uniquely built platforms. The investment has to facilitate the reconstruction of the surroundings of every station and change the life of Budapest (DBR Metró Projekt Igazgatóság 2018). Metro 4 is a relatively short line (7.34 km), connecting two major railway terminals with a major metro line. The overall budget of the first section included the creation of 10 stations to relieve the downtown area and connect Kelenföld with Baross Square, that is, south Buda with north Pest. The Cohesion Fund application of the project referred to this first section.

Table 1

Comparison of the four metro lines in Budapest

Description	Millennial Underground Metro line	Line 2 (East-West)	Line 3 (North-South)	Line 4 (DBR)
Surface section length (km)	0	1.4	1.3	0
Line length (useful, km)	4.2	10.1	16.6	6.7
Line length (total [from terminal to terminal], km)	4.4	10.3	17.1	7.4
Number of stations	11	11	20	10
Vehicle number (cars)	23	135	252	64
Transport capacity in peak hours (capacity/hour/direction)	6,185	23,790	26,326	20,100
Highest number of passengers in peak hours (passengers/hour/direction)	5,170	14,755	16,710	15,700
Highest number of passengers in peak hours (passengers/abs. peak hour/direction)	5,170	15,885	17,300	16,480
Train pairs per hour running in peak hours	32.7	26.66	24.0	30.0
Daily number of trips taken (thousand passengers/working day)	107	425	610	421

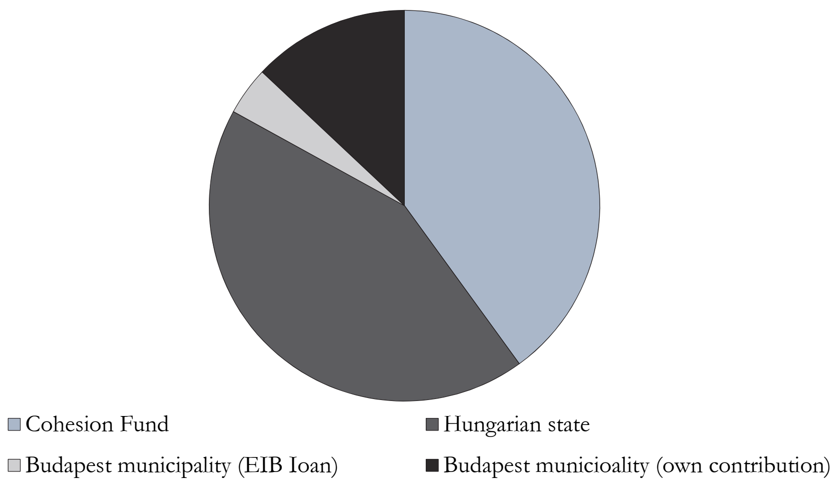
Note: DBR – South Buda-Rákospalota.
Source: DBR Metró Projekt Igazgatóság.

The overall project budget was HUF 353 billion, from which the eligible[6] amount was HUF 292 billion, and Budapest requested EU financial assistance of HUF 224 billion. (DBR Metró Projekt Igazgatóság 2018). The detailed budget is presented in Figure 1.

[6] According to the Cohesion Policy regulation.

Figure 1

M4 construction budget (billion HUF)



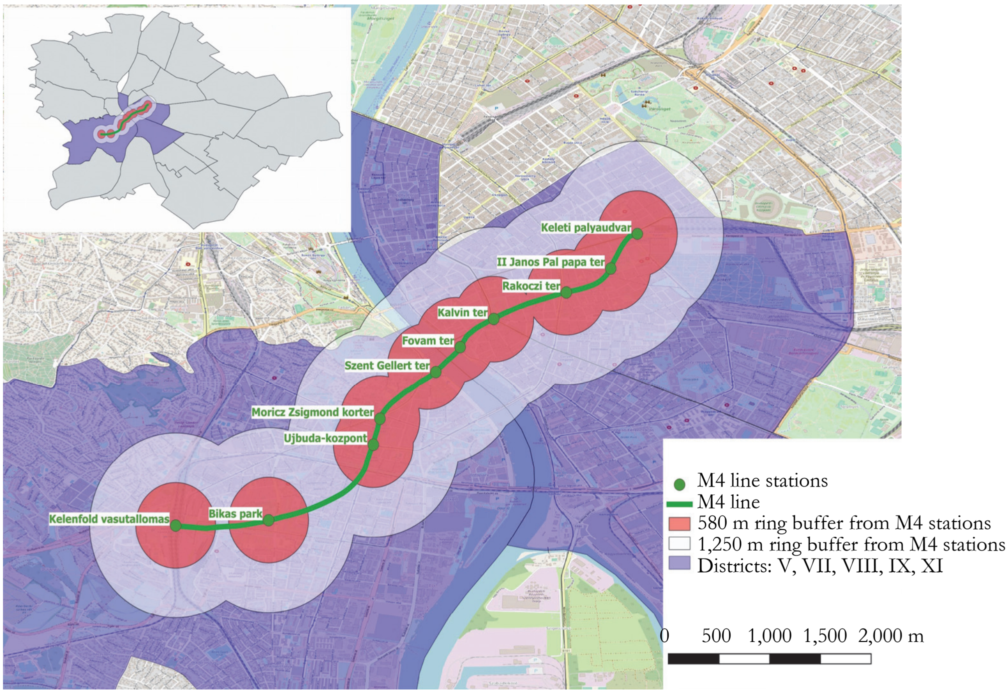
The construction of the first section of Metro 4 line eventually received HUF 180.8 billion in EU funding, which, although not the expected maximum amount, is a significant amount of financing to assist the project.

We examined the economic effects of the M4 project and the change in property prices using the following steps:
The first matching was based on the location (district) and the size (in square metres) of the apartments. We matched property selling transactions for the 'before investment' period (2007–2008) with the 'after investment' period (2015–2015)[7]. The new metro line affected five districts in Budapest: V, VII, VIII, IX, and XI. We chose to set the treated area to within a radius of 580 m of the new stations and the control area as a radius of more than 1,250 m from the stations, but within the affected districts. To include a neutral area, we also set up an area between 580 m and 1,250 m of the stations; the effect of the prices was not measured in this area (see Figure 2). Along with the new stations, the undertaking of major surface level developments and restorations in some of the most deprived urban areas (e.g. Rákóczi Square and II. János Pál pápa Square) must also be noted.

[7] The chosen methodology of counterfactual impact evaluation is designed to capture and eliminate the general macroeconomic effects that affected all the real estates. The general growth in real estate prices has been excluded using the diff-in-diff methodology. See Wooldridge (2012).

Figure 2

Map of the new metro stations



We obtained 13,805 observations for the treated properties (5,222 property prices before and 8,583 after the M4 investment) and 13,935 observations for the control properties (5,370 property prices before and 8,565 after the M4 investment). We identified 5,214 matches in the treated and 5,369 matches in the control groups.

Table 2 shows that for the treated properties, the percentage share of the sold apartments between the different districts was very similar before and after the M4 investment, but the average size of the sold apartments increased significantly. This phenomenon is not surprising as the selection of the treated properties was based on their distance from the new metro stations before and after the investment. For the control properties, both the geographical location and the size of the apartments were significantly different.

Table 2

The results of the one-to-one propensity score matching before and after the M4 investment

Variable	Treated property		Control property	
	Coefficient (standard error)	*p*-value	Coefficient (standard error)	*p*-value
Constant	–0.2241 (0.0458)	0.000	–0.3763 (0.0395)	0.000
Size of the apartment (m^2)	–0.0019 (0.0004)	0.000	–0.0008 (0.0004)	0.044
District VII dummy	0.0170 (0.0463)	0.713	1.3197 (0.2811)	0.000
District VIII dummy	0.0264 (0.0417)	0.528	0.1581 (0.0443)	0.000
District IX dummy	0.0399 (0.0563)	0.478	0.0931 (0.0327)	0.004
District XI dummy	0.0237 (0.0425)	0.577	0.2348 (0.0340)	0.000

Table 3

Comparison of the before and after matching values for the treated properties

Variable	Before matching			After matching		
	mean – before investment (standard error)	mean – after investment (standard error)	*p*-value (Wald test)	mean – before investment (standard error)	mean – after investment (standard error)	*p*-value (Wald test)
Size of the apartment (m^2)	56.78 (0.3981)	59.46 (0.3298)	0.0000	56.57 (0.3856)	56.51 (0.3826)	0.9131
District V dummy	0.0816 (0.0038)	0.0880 (0.0031)	0.1817	0.0813 (0.0038)	0.0846 (0.0039)	0.5462
District VII dummy	0.1676 (0.0052)	0.1672 (0.0040)	0.9551	0.1676 (0.0052)	0.1669 (0.0052)	0.9164
District VIII dummy	0.3734 (0.0067)	0.3696 (0.0052)	0.6497	0.3736 (0.0067)	0.3759 (0.0067)	0.8082
District IX dummy	0.0672 (0.0035)	0.0664 (0.0027)	0.8543	0.0667 (0.0035)	0.0641 (0.0034)	0.5793
District XI dummy	0.3102 (0.0064)	0.3087 (0.0050)	0.8557	0.3107 (0.0064)	0.3086 (0.0064)	0.8158

Table 4

Comparison of the before and after matching values for the control properties

Variable	Before matching			After matching		
	mean – before investment (standard error)	mean – after investment (standard error)	*p*-value (Wald test)	mean – before investment (standard error)	mean – after investment (standard error)	*p*-value (Wald test)
Size of the apartment (m^2)	55.93 (0.3895)	57.43 (0.3119)	0.0025	55.88 (0.3869)	55.48 (0.3766)	0.4583
District V dummy	0.1423 (0.0048)	0.1794 (0.0041)	0.0000	0.1421 (0.0048)	0.1429 (0.0048)	0.9121
District VII dummy	0.0041 (0.0009)	0.0006 (0.0003)	0.0001	0.0041 (0.0009)	0.0041 (0.0009)	1.0000
District VIII dummy	0.1058 (0.0042)	0.0998 (0.0032)	0.2619	0.1058 (0.0042)	0.1039 (0.0042)	0.7528
District IX dummy	0.4196 (0.0067)	0.4427 (0.0054)	0.0071	0.4196 (0.0067)	0.4215 (0.0067)	0.8450
District XI dummy	0.3283 (0.0064)	0.2774 (0.0048)	0.0000	0.3284 (0.0064)	0.3276 (0.0064)	0.9345

The initial significant differences between the before and after M4 investment property characteristics disappeared after the matching.

We took the pairs of the sold properties before and after the M4 investment and obtained second propensity scores using three different models. In the models, the treatment variable was always the distance from the new stations (1 if within 580 m and 0 if more than 1,250 m but within the affected districts).

Table 5

Models of the secondary propensity score matching

Model 1 Nearest neighbor matching with the covariates	Model 2 Kernel matching with the covariates	Model 3 Kernel matching with the covariates
apartment size (m^2) district VII dummy district VIII dummy district IX dummy district XI dummy	apartment size (m^2) the before investment per m^2 property prices district VII dummy district VIII dummy district IX dummy district XI dummy	apartment size (m^2) district VII dummy district VIII dummy district IX dummy district XI dummy

The treatment effect was measured in the change of the per square meter property prices before and after the M4 investment (results of the three measurement scenarios are shown in Tables 6–8).

Table 6

Model 1 – The effects of the M4 metro stations on property prices: per square meter price growth of the properties near the new metro stations and the controls, 2007–2014 *

Effect/Metro station	Properties near the stations	Controls	Difference	Standard error	*t*-statistic	Number of observations	Number of treated properties
	in HUF						
Overall effect	45,931	–7,250	53,182**	53,182	2.20	10,583	5,125
Kelenföld	179,199	–16,133	195,333***	63,859	3.06	3,385	301
Bikás Park	105,911	–12,364	118,276*	65,997	1.79	2,180	420
Újbuda-Centre	88,622	–35,798	124,421***	27,145	4.58	3,854	770
Móricz Zsigmond Square	75,009	–12,926	87,935***	23,172	3.79	3,741	656
Szent Gellért Square	108,016	46,215	61,801*	33,682	1.83	4,910	121
Fővám Square	75,425	30,051	45,374*	25,265	1.80	6,040	671
Kálvin Square	60,593	25,145	35,447*	19,724	1.80	6,290	921
Rákóczi Square	–1,790	–22,275	20,485	20,504	1.00	6,727	1,355
II. János Pál pápa Square	–2,300	–25,123	22,823	20,761	1.10	6,704	1,332
Keleti Railway Station	18,618	32,725	–14,107	109,834	–0.13	4,524	854

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

* As described in the Tables 6–8, the three models differ in the number of covariates and the corresponding methods.

Table 7

Model 2 – The effects of the M4 metro stations on property prices: per square meter price growth of the properties near the new metro stations and the controls, 2007–2014

Effect/Metro station	Properties near the stations	Controls	Difference	Standard error	*t*-statistic	Number of observations	Number of treated properties
	in HUF						
Overall effect	45,296	51,813	–6,517	8,502	–0.77	10,583	5,139
Kelenföld	179,199	132,966	46,233***	9,073	5.10	3,385	301
Bikás Park	105,472	120,028	–14,555*	8,448	–1.72	2,180	421
Újbuda-Centre	88,622	98,984	–10,362	6,940	–1.49	3,854	770
Móricz Zsigmond Square	75,009	91,676	–16,667**	7,218	–2.31	3,741	656
Szent Gellért Square	108,016	81,297	26,719	21,752	1.23	4,910	121
Fővám Square	75,635	11,506	64,129***	14,464	4.43	6,040	670
Kálvin Square	61,014	48,719	12,294	10,174	1.21	6,290	920
Rákóczi Square	–225	25,086	–25,311***	8,395	–3.01	6,357	1,296
II. János Pál pápa Square	–2,290	22,179	–24,469***	8,593	–2.85	6,704	1,329
Keleti Railway Station	12,254	17,132	–4,878	32,926	–0.15	4,524	737

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 8

Model 3 – The effects of the M4 metro stations on property prices: per square meter price growth of the properties near the new metro stations and the controls, 2007–2014

Effect/Metro station	Properties near the stations	Controls	Difference	Standard error	*t*-statistic	Number of observa-tions	Number of treated properties
	in HUF						
Overall effect	46,089	35,356	10,732	13,028	0.82	10,583	5,119
Kelenföld	179,199	64,928	114,271***	8,135	14.05	3,385	301
Bikás Park	105,911	72,717	33,914***	7,333	4.53	2,180	420
Újbuda-Centre	88,622	62,606	26,016***	6,968	3.73	3,854	770
Móricz Zsigmond Square	75,009	62,040	12,968*	7,259	1.79	3,741	656
Szent Gellért Square	108,016	59,080	48,936**	22,249	2.20	4,910	121
Fővám Square	75,715	43,429	32,285**	14,620	2.21	6,040	670
Kálvin Square	61,014	41,750	19,263	11,853	1.63	6,290	920
Rákóczi Square	–1,533	20,919	–22,452	16,123	–1.39	6,727	1,308
II. János Pál pápa Square	–2,350	18,907	–21,257	16,148	–1.32	6,704	1,316
Keleti Railway Station	12,254	17,132	–4,878	32,926	–0.15	4,524	737

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

In Model 1, the growth difference of the treated and control property prices was significant overall. After analysing the effects of the individual metro stations, we found that the stations on the Buda side had more significant **positive** effects on property prices **than on the Pest side**. The effect of three stations were significant (at least 5%):

– Kelenföld – this station is the Buda side terminus of the M4 metro line with direct connection to the Hungarian Railways. This station seems to have the most value-added as it connects the surrounding area to Budapest downtown.
– Újbuda-Központ and Móricz Zsigmond Square are still on the Buda side of the metro line with relatively good surface connections; these are the terminuses of the largest tramlines.

We found no significant effects of the stations on the Pest side.

In Model 2, we controlled for the before investment apartment prices and used a kernel matching method. The effect of the M4 investment on the overall price changes was not significant, but we identified two significantly positive and three significantly negative effects:

– Kelenföld has already been mentioned; Fővám Square is the first M4 station on the Pest side of the town.
– For Móricz Zsigmond Square, we found significantly negative effects, probably due to the special composition of the sold apartments. The apartments

here are larger than the average size (around 64 m^2 instead of 55 m^2), and the price of these apartments in the control area increased dramatically. Rákóczi Square and II. János Pál pápa Square are two of the most deprived areas of Budapest, and even the new metro stations do not seem to have outweighed the negative processes.

We believe Model 3, where we applied the kernel matching method without using the starting apartment prices, is the most reliable. In this model, we found less significant effects when moving from the Buda to the Pest side of the city, which has better links with the Budapest underground network (especially the M2 and M3 lines).

Our results reveal that the new stations have significant positive effects on housing prices in the areas that had not been connected to existing metro lines (especially in the Buda area).

Although it may bring benefits, quantifying and assessing a relationship between sustainability and market value is somewhat more difficult. Sustainability presents a rapidly changing dynamic that has varying, complex assessment criteria (Warren-Myers 2012). Accordingly, to assess a relationship between sustainability and market value of property, there is a need for extensive analysis of unbiased, evidence-based research in individual and broader markets to provide guidance, evidence, and knowledge of the implications of sustainability in the valuation of real estate.

Conclusion

Useful public infrastructural developments have a positive effect on the value of nearby properties. It is reasonable to assume that easier access to downtown areas can be an added value, but the increased traffic, crowds, or noise may outweigh these positive impacts. Economic impacts can vary significantly depending on the type of interventions, the locations and geographical areas served, pre-existing market conditions, and other policy and planning factors. Increased economic effects are possible; we integrated development projects where the transport development initiative is linked to housing or other real estate development projects.

When examining the nearby properties at the M4 metro line stations in Budapest, we have found mixed results for the property prices. The new stations exert a positive effect only in those areas that were not connected directly to existing underground lines (especially in the southern Buda area). Our results support the arguments that the new stations on the Pest side of the city are too close to each other and to the existing and functioning transport network, so their additional value is questionable.

Even though the results provide valuable information for planning forthcoming transport infrastructure in Budapest, there is room for developing this analysis further. For example, using walking distances instead of ‘as the crow flies’ distance;

using more sophisticated data regarding the quality of the apartments; or further examination of other, especially private development processes, besides the metro investment can provide more detailed findings.

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