

NATIONAL RESEARCH UNIVERSITY
HIGHER SCHOOL OF ECONOMICS
International College of Economics and Finance

Andrei Ilin

Socio-economic Consequences of the Improvement of Public Spaces

Master's Thesis

38.04.01 ECONOMICS

Master's Programme "**Financial Economics**"

Referee

PhD,

Associate Professor at International
College of Economics and Finance

Anna Yurko

Scientific advisor

Candidate of Sciences (PhD),

Assistant Professor at Faculty of
Economic Science

Timur Natkhov

Moscow 2024

Table of Contents

	Page number
Introduction	4
1. Literature review	6
2. Data description	13
3. Methodology	20
4. Results	21
Conclusion	28
List of References	30
Annexes	36

The master's thesis studies how Moscow street improvement program impacted business. The data on the number of opened minus the number of closed shops and amenities on the streets in the center of Moscow was collected, normalized to the length of the street and used as the main dependent indicator. The comprehensive difference-in-difference regression analysis showed that street improvement had a significant positive impact on the chosen measure. In addition, the positive effects turned out to increase over time. Moreover, street improvement construction works did not have significant negative impacts on the target metric. These results prove the economic efficiency of improving streets and public spaces and confirms the prospects for further modeling the impact of public space improvement projects on the urban socio-economic indicators.

1. Introduction

For many years in Russia, it was believed that streets should serve, first of all, motorists. The city officials were engaged in expanding roadways and maximizing the number of parking spaces, ignoring the pedestrian environment. In the 2010s the paradigm changed. Every year more and more attention has been paid to improving public spaces. Since 2018 creating a comfortable urban environment has become one of the key goals of the Russian government (“Strategic development direction "Housing and Communal services and the urban environment", 2023).

Moscow authorities made one of the biggest contributions to promoting the need to improve public spaces in Russia. The new Moscow government with the mayor Sergei Sobyenin came into power in 2010 and immediately prioritized the development of urban environment. The authorities began to implement the streets and public spaces improvement projects. Initially, the Moscow officials drew the main attention to the streets in the central districts of the city. By now the majority of the streets in the city center have been improved. Each year the expenditures for the streets and public spaces improvement in Moscow grew and began to exceed 12% of the budget since 2017 (“The improvement of Moscow this year turned out to be more expensive than the Crimean Bridge”, 2019). Subsequently, the improvement of streets and public spaces in Moscow were implemented within the comprehensive programs. My Street (“Moya Ulitsa”) was among the largest such programs. It was implemented in Moscow in the period from 2015 to 2018, after which it was transformed into the My District (“Moi Raion”) program. One of the main goals of the program was the renovation of the street and road network, creating a favorable environment for citizens and guests of Moscow. While in 2010 there was one pedestrian zone – the Arbat street, today there are dozens of comfortable spaces to walk in all the districts of city center. The comprehensive street improvement program required the rules governing the future projects. The law of the City of Moscow "Landscaping in the city of Moscow" dated April 30, 2014 regulated street and public spaces improvement works in Moscow. One of the principles of the program was that pedestrians, not cars, are the main streets users in the city center, which implied creating a comfortable infrastructure for pedestrians and cyclists and reducing the number of traffic lanes and parking spaces for cars. The improved streets undergone considerable external changes. Thus, the sidewalks on these streets were significantly expanded and paved with tiles, which created more space to install summer cafes and benches for recreation. The bicycle infrastructure was developed on some streets. The works solved the problems of low street lighting, visual clutter with overhead cables and wires and unregulated advertising signs. The streets reconstruction usually involved

their landscaping with the planting of trees, shrubs, flowers and lawns. In addition, street navigation was noticeably improved by installing additional information stands.

In 2012-2014 trial street improvement projects were implemented, after which the comprehensive program began. From 2015 to 2022 more than 300 of streets and public spaces located in the Central Administrative Okrug of Moscow were complexly improved. The most crowded central streets and adjacent alleys were improved during the first three years of the program. Afterwards, the focus was shifted to less congested streets. Almost no street improvement work was carried out in the city center in 2018, when Russia hosted the Football World Cup, and in 2020, due to the Covid-19 pandemic. The Moscow authorities do not plan to stop there and have already announced ambitious street improvement work plans for the coming years, stating that the public spaces improvement program will be endless (“The Moscow authorities promised never to stop “My Street” program”, 2017).

Street and public spaces improvement projects undoubtedly enhance the appearance of the city and its convenience for pedestrians. However, their economic effectiveness remains a matter for study. Although Moscow officials report a return on investment in urban improvement projects within 1-2 years due to growing tax deductions (“Answers to questions about landscaping”, 2017), the question remains nearly unexplored in the literature. Given that Moscow spends half of the funds dedicated to street and public spaces improvement in Russia, the lack of evidence that such large expenditures are effective causes debate about their expediency. Despite everything, street improvement projects continue to be implemented throughout Russia, which makes the study of their economic effects a relevant task.

2. Literature review

The street and public spaces improvement policy is a complex issue. Its study is in the context of different scientific fields: urban policy, design, ecology, sociology, economics and others. Most of the research on this topic is devoted to the rules of street design, the importance of urban environment development for the city ecology and health of the citizens, and transport aspects of urban policy. At the same time, not so many research papers are devoted to the economic efficiency of street development, especially those that consider comprehensive urban environment development programs. In addition, works dedicated to the Russian cities are very scarce.

A high share of the relevant articles addresses Complete Streets policy and its implementation in the cities of the United States and Canada. The U.S. Department of Transportation (2015) defines Complete Streets as an approach aimed at making streets safer and more comfortable for all users. Unlike traditional ways of organizing streets, when priority is given to motorists, Complete Streets support pedestrians, cyclists and public transport users. The program obliges the city authorities to create the necessary infrastructure for users of alternative modes of transport, such as bicycle paths and zebra crossings. Numerous positive aspects of realizing Complete Streets projects are discussed in the literature, including the beneficial economic effects.

There are two main groups of articles devoted to the economic consequences of the Complete Streets projects: the works that examine how Complete Streets impact sales, employment and other indicators of the nearest business, and the articles that focus on the effects on property values. Sales tax revenue is usually the main indicator in the first group of papers while employment and the emergence of businesses can also be considered. Separate businesses, streets and jurisdictions can act as research objects. In the earliest works, the usual data analysis method was a trend comparison between improved and control streets. It was found that Complete Streets positively impact aggregated sales tax data (New York City Department of Transportation, 2013), employment, new businesses creation (Anderson et al., 2015) and job growth (Perk et al., 2015).

Recently studies are mainly based on more sophisticated econometric techniques such as difference-in-difference and time series analysis. Researchers have begun to address more specific issues related to Complete Streets. For instance, Liu and Shi (2020) explored how transport infrastructure improvement projects in several American cities impacted small businesses and found that these renovations had strong positive effects on foodservice businesses, while the influence on other industries was weaker. Survey-based studies usually contradict the results of

real data analysis. Thus, the poll conducted by Phinney et al. (2020) among entrepreneurs showed that most respondents believe that Complete Streets programs decrease business sales. This is a common viewpoint of entrepreneurs, still it is usually refuted by the data.

A significant part of the recent works explores how bicycle paths construction impacts business performance. Most studies show that the effect is either positive or negligible. It is argued that a developed bicycle infrastructure encourages cyclists to spend more money on nearby businesses. For example, McCornick (2012) analyzed a project in Los Angeles when a part of the car lanes was replaced with bike lanes and found that this improvement led to an increase in sales data. Similarly, Poirier (2018) found that comparable lane interventions had a significant positive impact on the sales of nearby businesses. Arancibia et al. (2019) studied the bike lane construction projects in Toronto and found an increase in visitor spendings, the number of customers and the frequency of visits.

Overall, these articles show that Complete Streets projects have a positive impact on sales and other business indicators. The effects may depend on the business industry and project features. However, many articles use simple econometric techniques of data analysis that sometimes do not control for external conditions and selection bias, which questions the obtained results.

In addition to stimulating business development, Complete Streets projects can increase the property values by upgrading nearby infrastructure, improving the environment and creating leisure opportunities. The rising values enhance the well-being of residents, their income from renting out property and, as a result, tax deductions to the budget. The impact of Complete Streets projects on property values measures, such as housing prices and commercial real estate rents, is a study subject in several articles.

The existing literature do not unequivocally confirm that there is a significant positive relationship between Complete Streets and property values. Thus, on the one hand, Yu et al. (2017) showed that the single-family homes near improved streets were worth eight percent more than the houses from the control group, but the authors did not check the result for statistical significance. On the other hand, Phinney et al. (2020) and Vandegrift and Zanoni (2018) using difference-in-difference analysis method did not reveal any significant evidence that Complete Streets projects contributed to property value growth. However, the Smart Growth America study (2015) found that Complete Streets projects increased real estate values in most of the explored cases. The authors expressed concern that Complete Streets program could decrease housing affordability in

the area and lead to gentrification and displacement of the population. Residential displacement was found in several similar studies especially when Complete Streets works involved adding new bike lanes. Only in a few works, for example in the article by Ferenchak and Marshall (2021), no connection between the construction of bicycle paths and residential displacement was found.

To summarize, most recent papers that examine the impact of Complete Streets policy on property values are based on sophisticated econometric data analysis methods, but they found little evidence that there are significant effects of this kind. However, Complete Streets projects increased the property values in some cities, which encourages researchers to continue studying this issue.

The long-term economic consequences of the Complete Streets policy have been described above, but there are also short-term negative effects caused by the construction process. The temporary limitations for businesses include loss of parking spaces, restrictions on the movement of pedestrians and vehicles, shutdowns of public services, significant increase in noise and dust, vibration and dirt, visual obstacles (Radin and Ray, 2011). Long periods of works and lack of signage can exacerbate these problems (CH2M Hill, 2009). The street construction works can deeply decrease business sales, reduce employment, and even cause the closure of some businesses. The probable business losses are rather severe, so many studies consider the short-term negative impacts caused by urban construction works when evaluating the Complete Streets economic effectiveness.

There are a number of articles that examine the effects of road construction on nearby businesses. For example, Buffington and Wildenthal (1998) explored highway expansion projects in several American cities and their impact on sales data and showed that construction works on average led to a decrease in the measure by 5 percent. Later, Young et al. (2005) studying how road construction affects business sales in different spheres found that food retailing, general maintenance, gas supply and professional industrial services are the most susceptible to losses due to road construction works. The research based on polls of business owners reveals that business perception of losses from the road construction works usually corresponds to the results of real data analysis. Buddemeyer et al. (2008) considered similar road projects and found that the observed decrease in sales data during the construction period was mainly due to some large enterprises. The exclusion of these businesses practically nullified the negative effects. More recently, Ray (2017) studied the transit construction projects and their impacts on sales and received mixed results.

Although the logit model proved that the effects were severely negative, the difference-in-difference analysis did not reveal any significant impact on sales. Finally, Concas (2018) investigated how the road rehabilitation project in Tampa Bay, Florida, affected sales of nearby small businesses, and showed that construction works lasting 2 years led to a 2-6 percent decrease in business sales.

Thus, various studies show that road works can negatively impact the sales of nearby businesses, although the estimates of such effects vary from article to article. The extent of these impacts may differ depending on the duration of construction works, industry of the business and customer base, as well as for other reasons. Although the study focuses on the long-term effects of street improvement projects on business development, the existence of short-term effects of construction works on businesses will also be considered.

The research above is mainly devoted to the Complete Streets projects implemented in the USA and Canada. In these countries the motorization is traditionally high, which makes it more important for the authorities to understand the economic effects of pedestrianization projects. However, the real pioneers in the field of street and public spaces improvement are the European countries, where the trend towards transforming urban spaces to meet the needs of pedestrians and users of alternative modes of transport began long before the rest of the world. Today, one of the main drivers of urban transformation in the countries of Europe is the environmental factor (Nieuwenhuijsen and Khreis, 2016). The twentieth century was the century of automobiles in Europe (Gilroy, 2001), but over time it became clear that the European cities could not cope with the infinitely increasing number of cars. In addition, cars emit CO₂ and other greenhouse gases, worsening the urban environmental situation (HEI, 2010). Many cities such as Hamburg, Helsinki and Madrid have announced their intention to become partially car-free cities (Cathkart-Keays, 2015). Even more cities are implementing various measures to reduce car traffic including investments in cycling infrastructure and pedestrianization. Such initiatives clearly improve the environmental situation of the cities, reduce noise pollution, and favorably affect the health of citizens (Nieuwenhuijsen et al., 2016, Khreis et al., 2016).

Despite the numerous positive aspects of the pedestrian zones development, such initiatives meet the opposition from some entrepreneurs who complain that such projects create new difficulties for them (Hass-Klau, 1993). Many fear that street pedestrianization complicates the delivery of products to businesses, which increases costs. Some even believe that the lack of a

highway nearby negatively affects business attractiveness. However, various research results suggest otherwise. A number of case studies demonstrate that pedestrianization increases the number of businesses (Chiquetto, 1997; Yiu, 2011) and does not create logistical problems (Whitehead et al., 2006; Muñuzuri et al., 2012).

The improvement of streets and public spaces is an instrument how the authorities could achieve various socio-economic objectives. These goals may include increasing the satisfaction of residents with their town, encouraging their involvement in developing and maintaining the urban environment and others (Mehdipanah et al., 2018; Jackson et al., 2019). Revitalization is especially important for the places where the population is actively leaving, for example, in small towns. Under global urbanization small towns and historical settlements are losing their appeal and face the problem of retaining people, as a result young people actively migrate from towns to megapolises (Karwińska et al., 2018; Bieda, 2017). The development of public spaces in small towns solves several tasks at once. Firstly, such projects develop the urban green infrastructure for citizens, improve green spaces (Kothencz et al., 2017; Jančová, 2019). This betters the local ecology and creates pleasant spaces for walking. Secondly, revitalization is a chance to breathe new life into the historical centers of towns, adapt them to modern needs, which stimulates the growth of tourism and businesses (Zagroba, 2016; Kramarova and Kankovsky, 2020; Szaja, 2018; Jayne et al., 2010; Lorentzen, 2011). Thirdly, urban renewal programs increase the mobility in the public spaces of small towns (Evans-Cowley, 2006; Hu et al., 2018) and develop bicycle infrastructure (Handy et al., 2012; Xing et al., 2010; Audikana et al., 2017; Jaszczak et al., 2020). Cittaslow movement, which includes small and medium-sized cities in Europe, is one of the striking examples of the renewal of small towns. One of the purposes of this initiative is the socio-economic development of the participating towns. In the mid-2010s this movement implemented a major program to renovate small towns in Poland, under which more than 80 streets and public spaces improvement projects were carried out (International Network of Cities Where Living is Good, 2017). The subsequent studies confirmed that the revitalization in towns noticeably enhanced the quality of the urban environment and the ecological situation (Jaszczak et al., 2021). However, the socio-economic effects turned out to be weak, which indicates the low elaboration of the projects. The researchers point out that the race for the number of urban improvement projects often reduces their quality, although quality should be given priority.

As well as American researchers, European scientists have long been interested in how street design affects city economy, although recently the focus has shifted to the environmental

consequences of urban improvement. Even the first works dedicated to the problem showed that pedestrianization has a significantly positive effect on business indicators, primarily on retail turnover (TEST, 1989). An even earlier OECD study (1978) found a 60% increase in business turnover in the well-maintained urban centers of Western Europe and Scandinavia. Further research confirmed that the number of customers and the turnover of retail and services directly depends on the number of pedestrians in the area under consideration (Hall and Hass-Klau, 1985; Monheim, 1980). Some studies have found links between retail footfall and turnover and urban quality improvement (Pearson, 2020; Newby, 1992; EFTE, 2002; Whitehead et al., 2006; Sinnett et al., 2011). However, pedestrianization usually leads not only to an increase in the turnover, but also to the growing costs of renting premises (Brambilla et al., 1977). Rental growth in some European cities could exceed 600%, which balances the profits of businesses, and sharply increases tax revenues to the local budget. Pedestrianization impacts both retail rents (Colliers Erdman Lewis, 1995; Hass-Klau and Crampton, 2002) and office rents (ECOTEC, 1996; Wood and Handley, 1999; Lerner and Poole, 1999). The growing number of potential buyers encourages businesses to compete for commercial space adjacent to improved streets. This leads to the replacement of weaker businesses with stronger ones, and an increase in the share of luxury goods stores. In addition, the occupancy rate of rental space is increasing, which leads to the growing number of jobs in the district. As a result, there is a rising employment rate in the surrounding areas. Thus, most case studies show that European cities pedestrianization impacts business performance positively. However, the quantitative research aimed at finding links between streets and public spaces improvement and business development which could be easily used in economic forecasting is still rare.

Recently, researchers in developing countries have also begun to study how street design impacts business activity. The rapid urbanization of recent years has made the issue how to organize cities properly more relevant in developing world. However, the number of works devoted to the impact of street improvement on small businesses in developing countries is still small. The majority of articles also rely on the case study analysis. The available results correlate with those obtained in European and American studies. For example, it was found that a street pedestrianization project in Hong Kong led to a 17% increase in the cost of renting premises in adjacent buildings (Yiu, 2011). Another study devoted to street improvement projects in Beirut, carried out on the streets that never were the centers of trade or recreation before, found a slight surge in commercial activity on improved streets with a strong increase in the number of

pedestrians (Said, 2020). It is worth noting that in the cases under consideration, local entrepreneurs also expressed concerns that reducing the number of parking spaces and prioritizing the interests of pedestrians would decrease the revenue of their businesses, which is a global fear of business managers. However, the data show the positive impact of urban improvement projects on business performance all over the world.

Thus, the issue how the streets and public spaces organization impacts business development is gaining popularity. Works studying street improvement projects in different countries demonstrate their positive effects on various economic measures. However, the topic is still poorly studied and has many unexplored sides. Firstly, the literature mainly considers separate projects that improve the urban environment, leaving complex urban programs like My Street program in Moscow practically untouched. Secondly, very few studies are based on Russian data, despite the fact that more and more projects are being implemented in the country to improve the urban environment. Thirdly, there are almost no practical models suggested by research that could be used in forecasting the economical effectiveness of the projects. This work addresses the mentioned gaps in the literature.

3. Data description

The dataset of this work was assembled personally and is therefore unique. The involved data sources include cartographic databases and services, as well as the websites of the Moscow authorities. The collected dataset comprehensively describes the studied streets and the business located on them. The data covers the majority of the streets in the Central Administrative Okrug of Moscow for the period from 2012 to 2019 (before the Covid-19 pandemic). The streets where the number of businesses did not change in the considered period, for example, some embankments and small alleys, were excluded from the sample. The lists of the streets improved by year were taken from the websites of the mayor (sobyanin.ru) and the Government (mos.ru) of Moscow. Based on these data, a post-treatment dummy is derived, equal to 1 for all years after street improvement was completed. The streets improved in 2013-2014 or entered the My Street program in 2015-2018 formed the treatment group, while the remaining streets are in the control group. Given that very few streets were excluded from the sample, the final dataset includes 660 streets, 150 of which were improved: 10 in 2013 (thus, streets are considered treated since 2014), 4 in 2014, 22 in 2015, 42 in 2016, 54 in 2017, 10 in 2018 (table 1). The remaining 510 streets were not involved in the Moscow improvement program in 2015-2018 or improved before and they have made up a control sample of this study.

Table 1. The streets distribution depending on the year of improvement.

Treatment group	2013	2014	2015	2016	2017	2018	Control
Number of streets	10	4	22	42	54	10	510

The historical data on amenities and shops that were opened and closed on the considered streets were taken from the openstreetmap.org change history database. Website openstreetmap.org is one of the largest mapping services in Russia and the world. This source operates on the principle of open data, so that its data can be applied by any user without special access. What is more, hundreds of volunteers and professional cartographers regularly update the map and its attributes, which increases the relevance of the data. The openstreetmap.org communities in social networks allow to learn map filling details directly from the editors, for instance, the frequency of data updates and the peculiarities of map attributes. The resource enables both to obtain the information about the opening and closing dates of amenities and shops in Moscow, and get other necessary

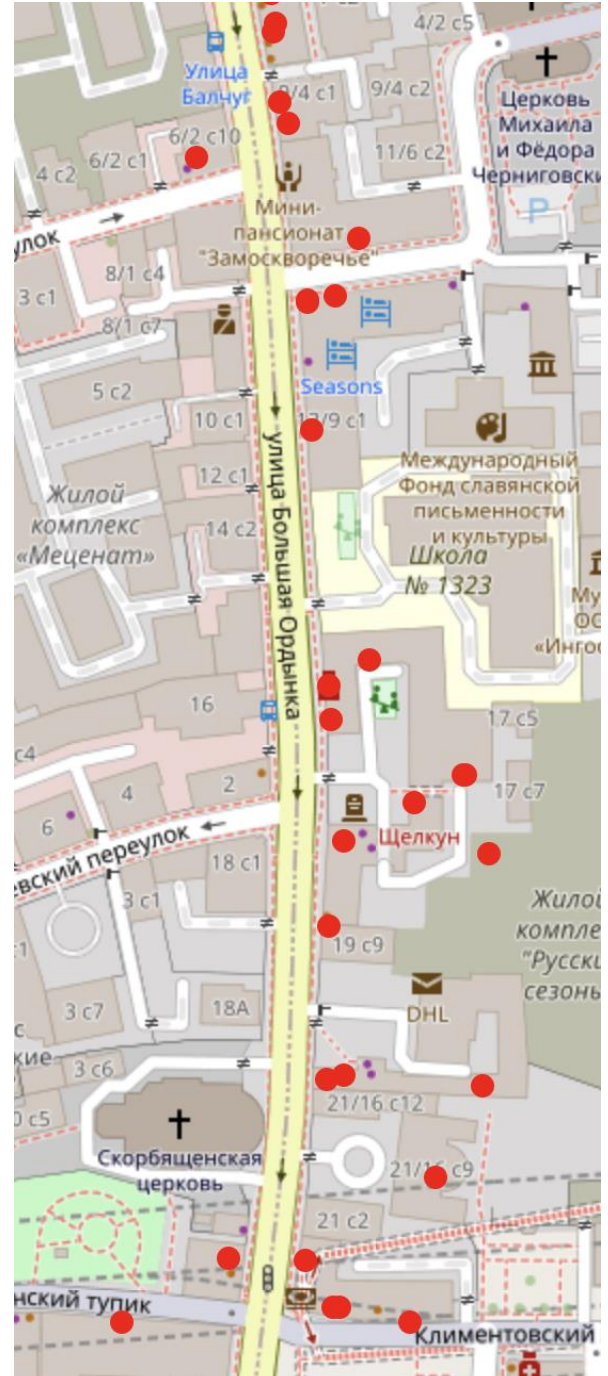
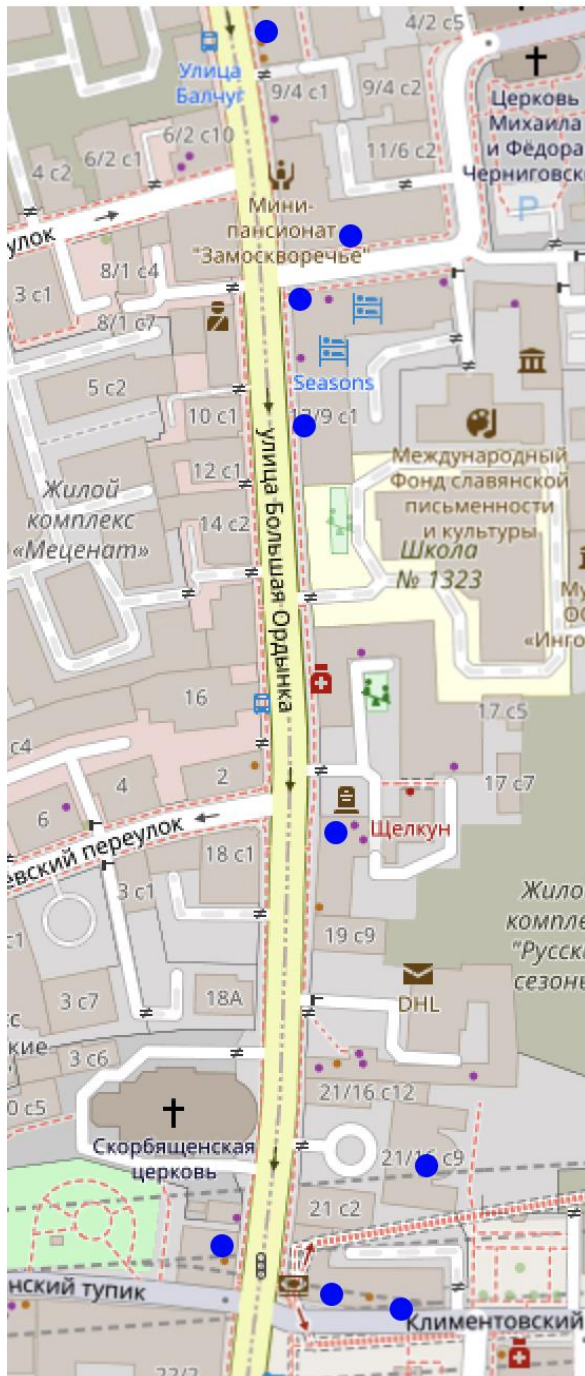
attributes, such as the coordinates of each object. In addition, the internal tag and key system facilitates filtering the determined nodes categories. The table 2 lists the categories of amenities (fast food, pubs, restaurants), food shops (greengrocer, wine) and non-food shops (beauty, clothes, jewelry) which were used to filter the nodes. Amenities and shops that belong to the categories that should not have been affected by the street improvement projects, such as schools, universities, government institutions, have made up a sample for the placebo test.

Table 2. Openstreetmap.org nodes categories included in the sample.

Amenity	Shop (food)	Shop (non-food)
<ul style="list-style-type: none"> • Bar • Café • Fast food • Food court • Pharmacy • Pub • Restaurant 	<ul style="list-style-type: none"> • Alcohol • Bakery • Greengrocer • Wine 	<ul style="list-style-type: none"> • Beauty • Books • Boutique • Clothes • Convenience • Cosmetics • Florist • Gift • Hairdresser • Jewelry • Shoes • Toys

Figure 1 demonstrates a fragment of the data used in the work. A piece of Bolshaya Ordynka Street as well as shops and amenities that existed on the street in the period from 2010 to 2019 are illustrated there. The businesses are mapped with colored dots. The blue dots indicate the places opened on this street by 2015 (the year of street improvement). The red dots specify amenities and shops that were added to the map by 2019. The figure shows that a cluster of cafes, restaurants and other small businesses formed on the demonstrated part of Bolshaya Ordynka Street after this location was improved. The presented map is based on the openstreetmap.org points geolocation and their matching to the street names.

Figure 1. Shops and amenities opened on Bolshaya Ordynka Street by 2015 (blue dots) and by 2019 (red dots).



The net number of shops and amenities opened (opened minus closed) per kilometer of the street during the year is the main dependent variable of this work. This indicator demonstrates the changing attractiveness of the street for small businesses. Location is very important for small businesses in retail and services, as it affects both their traffic and revenues. The Nominatim service was used to match shops and amenities geolocation to the corresponding street names. The target measure is obtained by aggregating points by street and year.

The length of the street was used to normalize the target measure. The considered streets were measured only within the Central Administrative Okrug of Moscow based on Yandex Maps data. This parameter is an excellent proxy for the number of buildings belonging to the street, and therefore for the number of premises available for business to rent. The lengths of the streets in the center Moscow may vary several times, which should affect the absolute number of opened minus number of closed shops and amenities. Standardization makes the target measure comparable for the streets of different lengths.

The streets from the sample are located in 10 districts of the Central Administrative Okrug of Moscow. The policy of the district officials could greatly influence business development. First of all, the rules for placing businesses on the ground floors of the buildings may differ from district to district, which affects the maximum rental area that can be given over to a business. Moreover, there is a clear trend in the Central Administrative Okrug of Moscow that some district authorities are aimed at maximize living space in the area, while others are actively developing clusters of cafes, restaurants and other businesses. However, in the applied model, the impact of the district takes over a time-invariant fixed effect. For demonstration purposes the distribution of streets in the sample by districts of Moscow is shown in Table 3.

Table 3. The distribution of streets in the sample by districts of Moscow.

Area name	Number of streets	Number of treated streets	Number of observations
Tverskoy	115	39	920
Khamovniki	83	14	664
Yakimanka	42	18	336
Krasnoselsky	51	9	408
Presnensky	92	17	736
Zamoskvorechye	53	16	424
Arbat	47	13	376
Tagansky	81	14	648
Basmanny	94	13	752
Meshchansky	48	13	384

The preparation of the dataset included several steps. First, map coordinates which fully include the central districts of Moscow have been determined. Then, the IDs and the coordinates

of the shops and amenities located inside the defined zone have been obtained for each node category of interest on January 1 of each year from the openstreetmap.org change history database. After that, the ID lists compiled for each category and year were compared for two neighboring years: if the shop or amenity was mapped on openstreetmap.org on January 1 of the year T+1, but was not on the map a year before, it was assumed that the business was opened during the year T. On the contrary, if an object was on the map on January 1 of the year T, but was missing a year later, it was assumed that it closed during the year T. This data processing resulted in a dataset that includes all points located in the area of interest, their geolocation, and the years of opening and closing (if the object was closed). Next, the Nominatim service was used to match the coordinates of objects to the corresponding street names. Afterwards, the number of shops and amenities opened and closed on a street in each year was determined. The final dataset was received by adding the street treatment status in each year, the length of the street and normalizing the dependent variable.

Table 4. Main descriptive statistics for the net number of opened shops and amenities, length of the street and the normalized dependent variable.

Variable	Mean	Std	N
Number of net opened shops and amenities	1,4	3,88	5216
Length of the street (km)	0,6	0,49	5216
Number of net opened shops and amenities per km	2,4	7,2	5216

Table 4 shows main descriptive statistics for the key dependent variable – the net number of opened shops and amenities per kilometer of the street in each year and the components of this measure. A table with the full names of variables and their sources is presented in annexes. Figure 2 depicts the length distribution of considered streets and shows that the majority of the streets in the dataset have length between 0,3 and 1,8 km.

Figure 2. Distribution of Street Lengths in the sample.

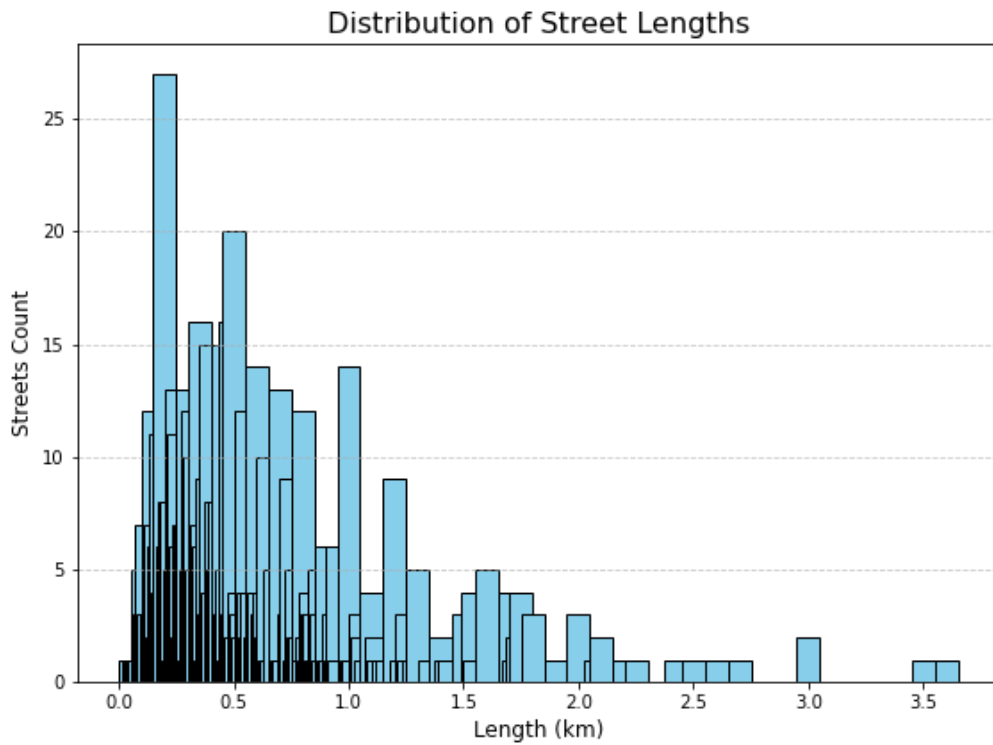
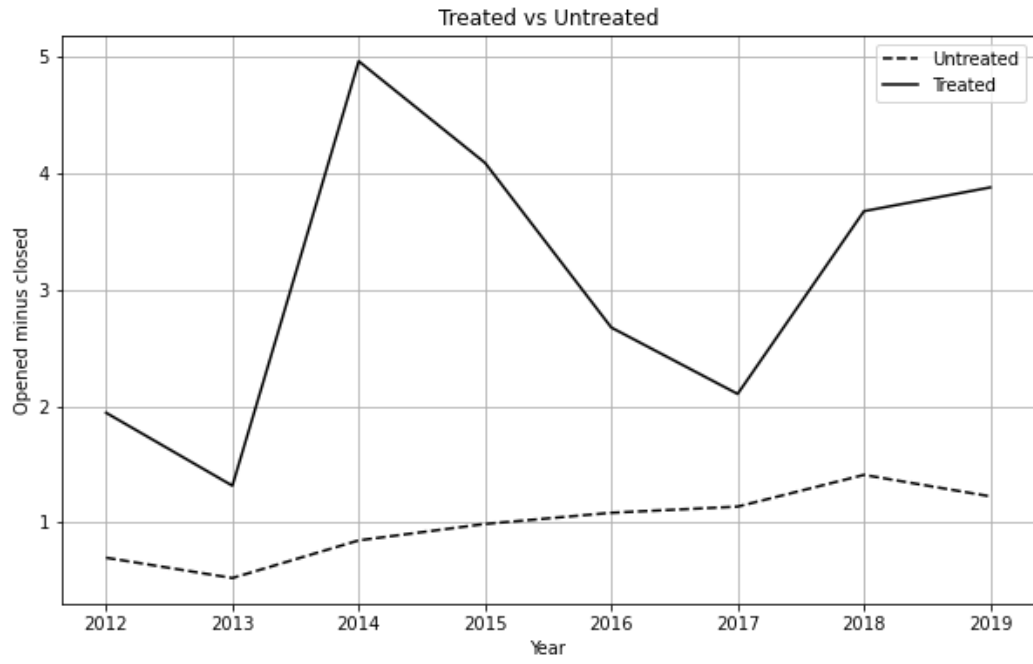


Figure 3 compares the trends of the target indicator for control and treated groups of streets in 2012-2019. The main observation is that the trends of the two groups are parallel in the pre-treatment period. However, by the end of the treatment period the number of opened minus closed shops and amenities on the treated streets noticeably increased relative to the control group.

Figure 3. The trends of the dependent variable for control and treated groups of streets in 2012-2019.



4. Methodology

This master's thesis uses panel data analysis to determine the impact of implementing the street and public spaces improvement program on the net number of opened shops and amenities per kilometer of the street. Duration of this influence and the negative effects of street construction works are also considered in this study. A two-way fixed effects (TWFE) design with year fixed effects and time-invariant fixed effects is the base model of the analysis enabling to control for the time effects and the individual characteristics of the streets. The sample includes observations on 660 streets from 2012 to 2019. The applied model is shown in equation 1:

$$Y_{it} = \alpha_0 + \alpha_1 \times D_{it} + \gamma_t + v_i + \epsilon_{it}, \quad i = 1, \dots, 660, \quad t = 2012, \dots, 2019 \quad (1)$$

where Y_{it} – the number of opened minus the number of closed shops and amenities on the street i in year t normalized to the length of the street in kilometers, D_{it} - a post-treatment dummy variable (the core explanatory variable) that equals to one in the years after the street i was improved and zero otherwise, α_1 - the improvement program impact on the number of opened minus the number of closed shops and amenities per km of the street, γ_t - year fixed effects, v_i - street fixed effects, ϵ_{it} - random error term.

5. Results

A simple pair regression without control variables was conducted to check whether post-treatment dummy indeed impacts the target measure. Table 5 shows that the post-treatment dummy is significant at the 1% significance level. The dummy coefficient turned out to be quite large and equal to 4.39, which indicates that street improvement contributes noticeably to the net number of opened shops and amenities per km of the street.

Table 5. The results of a paired regression of post-treatment dummy on the net number of opened shops and amenities per km.

	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Opened minus closed (per km)							
Post-treatment	4.39	.396	11.09	0	3.614	5.167	***
Constant	2.124	.102	20.83	0	1.924	2.324	***
Mean dependent var		2.416	SD dependent var			7.201	
R-squared		0.023	Number of obs			5216	
F-test		122.896	Prob > F			0.000	
Akaike crit. (AIC)		35278.410	Bayesian crit. (BIC)			35291.529	

*** $p < .01$, ** $p < .05$, * $p < .1$

The result above allows us to continue the analysis by adding year fixed effects to the previous pair regression. Table 6 presents the results of the regression analysis for the model with post-treatment dummy and year fixed effects. The post-treatment dummy is again significant at 1% significance level. The dummy variable coefficient has decreased slightly and equal to 4,2. The decline is expected when adding new variables to the model. The obtained results allow to move on to the target two-way fixed effects model.

Table 6. The results of the regression analysis for the model with year fixed effects.

	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Opened minus closed (per km)							
Post-treatment	4.277	.41	10.43	0	3.473	5.081	***
2012b	0	.	.	.	.	.	.

2013	-.764	.393	-1.94	.052	-1.535	.007	*
2014	1.273	.393	3.24	.001	.502	2.043	***
2015	.986	.393	2.51	.012	.215	1.757	**
2016	.687	.394	1.75	.081	-.085	1.459	*
2017	.388	.396	0.98	.327	-.388	1.164	
2018	.682	.4	1.71	.088	-.102	1.465	*
2019	.397	.398	1.00	.319	-.384	1.178	
Constant	1.676	.278	6.03	0	1.131	2.221	***
Mean dependent var		2.416	SD dependent var		7.201		
R-squared		0.030	Number of obs		5216		
F-test		19.894	Prob > F		0.000		
Akaike crit. (AIC)		35256.890	Bayesian crit. (BIC)		35315.925		

*** $p < .01$, ** $p < .05$, * $p < .1$

Table 7 shows the results of the regression analysis for the two-way fixed effects model with the net number of shops and amenities being opened per km of the street as dependent variable. The post-treatment dummy turned out to be significant at 5% significance level. The year and street fixed effects only slightly reduced the significance of the key explanatory variable, which proves that street improvement has quite a tangible positive impact on business. The post-treatment dummy coefficient has decreased quite seriously, which meets expectations given that year and street fixed effects are added to the regression. The received coefficient corresponds to the supposed effect. It seems real that on average 1,14 more shops and amenities are opened on improved streets than on the streets from the control group per 1 km.

Table 7. Two-way fixed effects regression results.

	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Opened minus closed (per km)							
Post-treatment	1.145	.483	2.37	.018	.198	2.092	**
2012b	0	.	.	.	.	.
2013	-.764	.367	-2.08	.038	-1.484	-.044	**
2014	1.321	.367	3.60	0	.601	2.041	***
2015	1.039	.367	2.83	.005	.319	1.759	***

2016	.855	.368	2.32	.02	.134	1.577	**
2017	.744	.371	2.00	.045	.016	1.472	**
2018	1.225	.377	3.25	.001	.486	1.963	***
2019	.892	.375	2.38	.017	.157	1.627	**
Constant	1.676	.26	6.45	0	1.167	2.185	***
Mean dependent var		2.416	SD dependent var		7.201		
R-squared		0.014	Number of obs		5216		
F-test		7.920	Prob > F		0.000		
Akaike crit. (AIC)		33850.138	Bayesian crit. (BIC)		33909.173		

*** $p < .01$, ** $p < .05$, * $p < .1$

Although the applied sample is rather balanced, it has some outlier values. The next step was to build a two-way fixed effects regression on a sample without outliers. 10% of the largest and 10% of the smallest values were excluded from the sample to make it more balanced. Table 8 shows the results of the regression with year and streets fixed effects based on the sample without outliers. The post-treatment dummy turned out to be significant at 1% significance. The dummy coefficient has increased comparing to the model that uses the whole sample as expected.

Table 8. Two-way fixed effects regression results on the sample without outliers.

	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Opened minus closed (per km)							
Post-treatment	1.684	.181	9.30	0	1.329	2.039	***
2012b	0	.	.	.	.	.
2013	-.096	.123	-0.78	.435	-.338	.145	
2014	.586	.126	4.65	0	.339	.833	***
2015	.665	.127	5.23	0	.416	.914	***
2016	.818	.128	6.37	0	.566	1.07	***
2017	.805	.129	6.25	0	.552	1.057	***
2018	.858	.13	6.61	0	.603	1.112	***
2019	.674	.126	5.34	0	.426	.921	***
Constant	.974	.087	11.22	0	.804	1.145	***

Mean dependent var	1.590	SD dependent var	2.528
R-squared	0.062	Number of obs	4695
F-test	33.373	Prob > F	0.000
Akaike crit. (AIC)	19942.153	Bayesian crit. (BIC)	20000.242

*** $p < .01$, ** $p < .05$, * $p < .1$

A placebo test has also been performed checking the adequacy of the model. The placebo test is based on the dataset that includes objects belonging to the categories of shops (garden centers, auto parts stores) and amenities (schools, hospitals) that are not in the main sample. In the placebo test the treatment dummy appeared to be insignificant, which meets expectations.

The next step after checking the significance of the street improvement treatment variable was to study whether the street improvement impact increases over time. The improved streets gain popularity among pedestrians for several years after completing the works, that is why it was assumed that the net number of amenities and shops opened is also a cumulative indicator. The same model with the treatment limited to two years was used to check this hypothesis. Comparing the significance of the treatment limited to two years to the results of the initial model allows to conclude whether the impact of street improvement projects is rather long-term or short-term.

Table 9. Results of the two-way fixed effects regression analysis for the model with the limited period of treatment.

	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Opened minus closed (per km)							
Post-treatment (lim)	.217	.478	0.45	.649	-.719	1.154	
2012b	0	.	.	.	.	.
2013	-.787	.371	-2.12	.034	-1.515	-.06	**
2014	1.344	.368	3.65	0	.623	2.064	***
2015	1.062	.368	2.89	.004	.341	1.783	***
2016	.926	.368	2.52	.012	.204	1.647	**
2017	.882	.368	2.40	.017	.161	1.604	**
2018	1.41	.369	3.83	0	.688	2.133	***
2019	1.06	.369	2.88	.004	.338	1.783	***
Constant	1.667	.261	6.40	0	1.156	2.178	***

Mean dependent var	2.416	SD dependent var	7.201
R-squared	0.013	Number of obs	5216
F-test	7.235	Prob > F	0.000
Akaike crit. (AIC)	33856.329	Bayesian crit. (BIC)	33915.365

*** $p < .01$, ** $p < .05$, * $p < .1$

Table 9 shows the results of a TWFE regression analysis for a model with the limited treatment period. Unlike the previous regression results, the treatment dummy turned out to be insignificant. Still, in the model without time-invariant fixed effects, but with year fixed effects the limited post-treatment dummy is significant at 1% significance level (Table 10). Thus, street improvement projects proved to have an increasing impact on the net number of opened shops and amenities over time, confirming the assumption. A possible explanation for this result is the network effect that occurs between businesses and pedestrians. An improved street environment brings more visitors to the nearby shops, cafes and other amenities. The revenue and attendance in this location grow, which attracts new entrepreneurs to open a business. Eventually, the street turns into the center of attraction for both people and amenities and shops.

Table 10. The results of the regression analysis for the model with year fixed effects when post-treatment is limited to two years.

	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Opened minus closed (per km)							
Post-treatment (lim)	2.477	.456	5.43	0	1.583	3.371	***
2012b	0	.	.	.	.	.
2013	-1.03	.399	-2.58	.01	-1.812	-.247	***
2014	1.399	.396	3.53	0	.622	2.176	***
2015	1.104	.396	2.79	.005	.327	1.88	***
2016	1.016	.397	2.56	.01	.238	1.793	**
2017	.972	.397	2.45	.014	.195	1.75	**
2018	1.279	.397	3.22	.001	.5	2.057	***
2019	.929	.397	2.34	.019	.15	1.707	**
Constant	1.577	.281	5.62	0	1.027	2.127	***

Mean dependent var	2.416	SD dependent var	7.201
R-squared	0.015	Number of obs	5216
F-test	9.891	Prob > F	0.000
Akaike crit. (AIC)	35335.258	Bayesian crit. (BIC)	35394.293

*** $p < .01$, ** $p < .05$, * $p < .1$

The next question to study is whether street improvement construction works have short-term negative effects on businesses. The assumption about the presence of such negative effects is based on the available literature, according to which street construction works could be a great challenge for nearby businesses. Temporary restrictions for pedestrians and transport users and other limitations complicate the work of amenities and shops, reduce the number of visitors and revenues. However, the scale of these problems depends heavily on the duration of the works. My Street improvement projects in Moscow usually last five months starting in April or May and continuing until the City Day in the middle of September. The businesses near street improvement construction works have to operate the whole summer season under severe limitations, which could negatively affect revenues and even put the small business at the risk of bankruptcy. Still, the prospects of higher incomes in the future might be a sufficient incentive for entrepreneurs to overcome the period of street improvement works. The initial model with modified treatment that equals to one for the years when the street improvement works took place has been used to check the assumption that these works have short-term negative impact on the normalized net number of amenities and shops opened.

Table 11. The results of the TWFE regression for the model with the dummy treatment on the construction period.

	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Opened minus closed (per km)							
Post-treatment (constr)	.012	.223	0.05	.957	-.425	.449	
2012b	0	.	.	.	.	.
2013	-.096	.125	-0.77	.441	-.341	.149	
2014	.62	.128	4.85	0	.369	.871	***
2015	.688	.129	5.35	0	.436	.94	***
2016	.898	.13	6.89	0	.643	1.153	***
2017	.969	.129	7.50	0	.716	1.222	***

2018	1.119	.128	8.74	0	.868	1.37	***
2019	.903	.126	7.17	0	.656	1.149	***
Constant	.969	.089	10.90	0	.795	1.143	***
Mean dependent var		1.590	SD dependent var		2.528		
R-squared		0.042	Number of obs		4695		
F-test		22.088	Prob > F		0.000		
Akaike crit. (AIC)		20041.725	Bayesian crit. (BIC)		20099.813		

*** $p < .01$, ** $p < .05$, * $p < .1$

Table 11 shows that the construction works post-treatment dummy appears to be insignificant and has a coefficient close to zero. Other models demonstrate a similar result. The absence of a significant negative coefficient for modified treatment dummy reveals that the shops and amenities are indeed ready to cope with the restrictions created by the street improvement works. The results suggest that new businesses arise not in place of existing ones, but in addition to them increasing the area of premises dedicated to trade and services. Thus, the street improvement program effectively stimulates the growth in the number of shops and amenities located on the treated streets.

Conclusion

The current work examines a very relevant issue, the impact of the Moscow streets improvement program on businesses, namely on the net number of shops and cafes being opened per kilometer of the street. The analysis has proven that street and public space improvement projects increase the studied indicator, and the placebo test did not reveal any inaccuracies in the analysis. Thus, it has been shown that the realized program had a positive impact on the economic development of the city even in the absence of data on more basic measures, such as revenues of the businesses and their tax deductions to the budget of Moscow.

In addition, a slightly modified regression analysis that uses a limited treatment period has been performed to assess the duration of changes caused by street improvement programs. While in initial model the treatment lasts for all years after street improvement, in the modified regression the treatment is limited just to two years after the improvement works. The results of the model reveal that the limited treatment dummy is insignificant for the dependent variable, which means that the positive impact of street improvement increases over time. This suggests that there are network effects between the visitors of the street and the nearby business. The improvement of the public place increases the number of its visitors, which encourages more entrepreneurs to open amenities and shops in this location. As a result, the street becomes the center of attraction for both businesses and people.

Besides, it was studied whether the street improvement construction works had short-term negative effects on the net openings of small business. The regression analysis failed to find any significant impact of construction dummy on the dependent variable. The result implies that shops and amenities in the center of Moscow are ready to cope with the restrictions caused by street improvement works. High speed of street improvement works and expected increase in sales of the nearby business after street improvement are possible reasons for this phenomenon.

Thus, the master's thesis comprehensively approaches the impact of the street improvement program on the appearance of shops and amenities. This work is among the first examines the impact of comprehensive street improvement programs in Moscow on business environment, which makes a substantial contribution to evaluating the effectiveness of this urban initiative. Moreover, the study is based on unique data using the normalized number of open minus the number of closed shops and amenities as the dependent variable. This measure turned out to be a

good alternative for business revenue and tax deductions to the city budget when this data is not available.

The achieved results confirm the prospects for studying the economic effectiveness of urban improvement projects. In the follow-up studies other dependent variables such as revenues and tax deductions could be used if there is access to the necessary data. Another variable of interest is the property values which remained untouched in this study due to lack of data. What is more, it seems promising to conduct a similar study based on data on other Russian cities. For instance, the large cities in Russia, such as Kazan and Kaliningrad, where the regional officials pay attention to the quality of the urban environment, could be the objects of further research. In addition, data on the small Russian towns included in federal or regional urban environment improvement programs could become the basis for such work. One of the most ambitious such programs is the All-Russian competition for the best projects for creating a comfortable urban environment, funded and implemented by the Russian government since 2018 in order to support the creation of comfortable public spaces in small towns and historical settlements, the development of an integrated approach to historical territories to preserve the historical and cultural heritage. An in-depth study of street and public space improvement programs gives a better understanding how these initiatives impact small business and urban economy development, and allows for better forecasting of the economic effects of such projects.

List of References

1. Anderson, G., Searfoss, L., Cox, A., Schilling, E., Seskin, S., & Zimmerman, C. (2015). Safer Streets, Stronger Economies: Complete Streets Project Outcomes from Across the United States. *Institute of Transportation Engineers Journal*, 85(6), 29–36.
2. Arancibia, D., Farber, S., Savan, B., Verlinden, Y., Lea, N. S., Allen, J., & Vernich, L. (2019). Measuring the Local Economic Impacts of Replacing On-Street Parking With Bike Lanes. *Journal of the American Planning Association*, 85(4), 463–481.
3. Audikana, A., Ravalet, E., Baranger, V., & Kaufmann, V. (2017). Implementing bikesharing systems in small cities: Evidence from the Swiss experience. *Transp Policy (Oxf)*, 55, 18–28.
4. Bieda, A. (2017). Urban renewal and the value of real properties. *Studia Reg. Lokal.*, 3, 5–28.
5. Brambilla R., Longo G., & Rudofsky B. (1977). *For pedestrians only: Planning, design, and management of traffic-free zones*. Whitney Library of Design New York.
6. Buddemeyer, J., Young, R., & Giessen, S. V. (2008). *Highway Construction Related Business Impacts: Phase 3 Effort for the Town of Dubois*. Cheyenne, WY: Wyoming Department of Transportation.
7. Buffington, J. L., & Wildenthal, M. T. (1998). *Estimated Economic Impact of Selected Highway Widening Projects in Texas*. Texas Transportation Institute. Austin, TX: Texas Department of Transportation.
8. CH2M Hill. (2009). *Mitigation of Transportation Construction Impacts*. Minnesota Department of Transportation. St. Paul, MN: Minnesota Department of Transportation.
9. Chiquetto, S. (1997). The environmental impacts from the implementation of a pedestrianization scheme. *Transportation Research D*, 2(2), 133-146.
10. Colliers Erdman Lewis, (1995). *Colliers Erdman Lewis How to Get Pedestrian Rental Growth*. Colliers Erdman Lewis Research and Consultancy, London.
11. Concas, S. (2018). *Assessing the Impact of Roadway Rehabilitation on Small Businesses*. Paper presented at the Transportation Research Board 97th Annual Meeting. Washington, DC: Transportation Research Board 97th Annual.

12. ECOTEC Research and Consulting Ltd. (1996). *The Economic Impact of Canal Development Schemes*. ECOTEC Ltd., Birmingham.
13. European Federation for Transport and Environment (EFTE). (2002). *Transport and the Economy: Myths and Facts*.
14. Evans-Cowley, J. (2006). Sidewalk Planning and Policies in Small Cities. *J. Urban Plan. Dev.*, 132, 71–75.
15. Ferenczak, N., & Marshall, W. (2021). Bicycling Facility Inequalities and the Causality Dilemma with Socioeconomic/Sociodemographic Change. *Transportation Research Part D: Transport and Environment*, 97(102920).
16. Gilroy, P. (2020). Driving while black. In: D. Miller, ed. *Car cultures*. Abingdon: Routledge, 81–104.
17. Hall, P., & Hass-Klau, C. (1985). *Can rail save the city?* Aldershot: Gower.
18. Handy, S. L., Heinen, E., & Krizek, K. (2012). Cycling in small cities. In *Cycling for Sustainable Transport: International Trends and Policies*; Pucher, J., Buehler, R., Eds.; MIT Press: Cambridge, MA, USA.
19. Hass-Klau, C. (1993). Impact of pedestrianization and traffic calming on retailing: a review of the evidence from Germany and the UK. *Transport Policy*, 1(1), 21-31.
20. Hass-Klau, C. & Crampton, G. (2002). *Future of Urban Transport, Learning from Success and Weakness: Light Rail*. ETP, Brighton.
21. HEI. (2010). *Traffic Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure and Health Effects*. HEI Special Report 17. Boston Health Effects Institute.
22. Hu, H., Xu, J., Shen, Q., Shi, F., & Chen, Y. (2018). Travel mode choices in small cities of China: A case study of Changting. *Transp. Res. D Transp. Environ.*, 59, 361–374.
23. Jackson, C. (2019). The effect of urban renewal on fragmented social and political engagement in urban environments. *J. Urban Aff.*, 41, 503–517.
24. Jančová, N. (2019). New approaches for research public spaces and urban green infrastructure in the context of livable urban environment. In *Proceedings of the International Technology, Education and Development Conference*, Valencia, Spain, 11–13, pp. 3829–3832.
25. Jaszczak, A., Kristianova, K., Pochodyła, E., Kazak, J. K., & Młynarczyk, K. (2021). Revitalization of Public Spaces in Cittaslow Towns: Recent Urban Redevelopment in Central Europe. *Sustainability*, 13, 2564.

26. Jaszczak, A., Morawiak, A., & Zukowska, J. (2020). Cycling as a sustainable transport alternative in polish cittaslow towns. *Sustainability*, 12, 5049.
27. Jayne, M., Gibson, C., Waitt, G., & Bell, D. (2010). The Cultural Economy of Small Cities. *Geogr. Compass*, 4, 1408–1417.
28. Karwińska, A., Böhm, A., & Kudłacz, M. (2018). The phenomenon of urban sprawl in modern Poland: Causes, effects and remedies. *Zarządzanie Publiczne*, 45, 26–43.
29. Khreis, H., Warsow, K., Verlinghieri, E., Guzman, A., Pellecuer, L., Ferreira, A., Jones, I. H., Heinen, E., Rojas-Rueda, D., Mueller, N., et al. (2016). Urban Transport and Health: Understanding Real Impacts, Underlying Driving Forces and Co-Producing Future Directions. *J. Transp. Health*, 3, S7–S8.
30. Kothencz, G., Kolcsár, R., Cabrera-Barona, P., & Szilassi, P. (2017). Urban green space perception and its contribution to well-being. *Int. J. Environ. Res. Public Health*, 14, 766.
31. Kramarova, Z., & Kankovsky, A. (2020). Mobility in Public Spaces of Small Towns in the Czech Republic. *IOP Conf. Ser. Mater. Sci. Eng.*, 960(4).
32. Kristianova, K., & Jaszczak, A. (2020). Historical Centers of Small Cities in Slovakia — Problems and Potentials of Creating Livable Public Spaces. *IOP Conf. Ser. Mater. Sci. Eng.*, 960, 022012.
33. Lerner, S., & Poole, W. (1999). *The Economic Benefit of Parks and Open Space: How Land Conservation Helps Communities Grow and Protect the Bottom Line*. The Trust for Public Land, San Francisco, CA.
34. Liu, J., & Shi, W. (2020). *Understanding Economic and Business Impacts of Street Improvements for Bicycle and Mobility - A Multicity Multiapproach Exploration*. Portland, OR: Portland State University - Transportation Research and Education Center (TREC).
35. Lorentzen, A. (2013). Sustaining small cities through leisure, culture and the experience economy. In *Cultural Political Economy of Small Cities*; Lorentzen, A., van Heur, B., Eds.; Routledge: Oxon, UK, pp. 65–79.
36. McCormick, C. (2012). *York Boulevard: The Economics of a Road Diet*. Los Angeles, CA: Bikes Belong, LACBC.
37. Mehdipanah, R., Marra, G., Melis, G., & Gelormino, E. (2018). Urban renewal, gentrification and health equity: A realist perspective. *Eur. J. Public Health* 2018, 28, 243–248.

38. Monheim, R. (1980) *Fussgangerbereiche und Fussgangerverkehr in Stadtzentren in der Bundesrepublik Deutschland*, Bonn: Dummler.
39. Muñuzuri, J., Cortés, P., Onieva, L., & Guadix, J. (2012). Estimation of daily vehicle flows for urban freight deliveries. *Journal of Urban Planning and Development*, 138(1), 43-52.
40. Newby, L. (1992). Paved with Gold-A Study of the Economic Impact of Pedestrianisation and its Relevance to Leicester, Research Report No. 7. *Leicester Environment City Trust*.
41. Nieuwenhuijsen, M. J., & Khreis, H. (2016). Car free cities: Pathway to healthy urban living. *Environment International*, 94, 251–262.
42. Nieuwenhuijsen M. J., Khreis H., Verlinghieri E., & Rojas-Rueda D. (2016). Transport and health: a marriage of convenience or an absolute necessity. *Environ. Int.*, 88, pp. 150-152.
43. NYDOT. (2013). *The Economic Benefits of Sustainable Streets*. New York City, NY: New York City Department of Transportation.
44. OECD. (1978). *Results of a Questionnaire Survey on Pedestrian Zones in Paris*. OECD, Paris.
45. Pearson C. (2000). Making Good Design Pay Off Fourth Annual Business Week/Architectural Records Awards. *Architectural Record*, 188 (10), pp. 84-99.
46. Perk, V., Catala, M., & Mantius, M. (2015). *Capturing the Benefits of Complete Streets*. Center for Urban Transportation Research. Tallahassee, FL: Florida Department of Transportation.
47. Phinney, R., Fonseca, C., Bean, N., & Zhao, J. (2020). *How do Complete Streets Matter for Communities? The Case of Richfield, Minnesota*. St. Paul, MN: Minnesota Department of Transportation.
48. Poirier, J. (2018). Bicycle Lanes and Business Success: A San Francisco Examination. *Transportation Research Record*, 2672(7), 47–57.
49. Radin, S., & Ray, R. (2011). *Technical Report on the Potential Impacts on Business Revenues during Construction of the Central Corridor Light Rail Project*. Federal Transit Administration. Washington, DC: U.S. Department of Transportation, Federal Transit Administration.
50. Ray, R. (2017). Open for Business? Effects of Los Angeles Metro Rail construction on adjacent businesses. *The Journal of Transport and Land Use*, 10(1), 725–742.

51. Said, M., Geha, G., & Abou-Zeid, M. (2020). Natural Experiment to Assess the Impacts of Street-Level Urban Design Interventions on Walkability and Business Activity. *Transportation Research Record*, 2674(7), 258-271.
52. Sinnett, D., Williams, K., Chatterjee, K., & Cavill, N. (2011). *Making the Case for Investment in the Walking Environment: A Review of the Evidence*. Bristol: University of the West of England.
53. Smart Growth America. (2015). *Safer Streets, Stronger Economies: Complete Streets Project Outcomes from Across the Country*. Washington, DC: Smart Growth America.
54. Szaja, M. (2018). Social Aspects of Revitalization of Urban Public Spaces. *EJSM*, 28, 463–469.
55. TEST (Transport and Environment Studies), 1989. *Trouble in Store? Retail Locational Policy in Britain and Germany*. TEST, London.
56. Vandegrift, D., & Zanoni, N. (2018). An Economic Analysis of Complete Streets Policies. *Landscape and Urban Planning*, 171, 88-97.
57. Whitehead, T., Simmonds, D., & Preston, J. (2006). The effect of urban quality improvements on economic activity. *Journal of Environmental Management*, 80, 1-12.
58. Wood, R., & Handley, J. (1999). Urban water front regeneration in the Mersey basin, north west England. *Environmental Planning and Management* 42, 565–580.
59. Xing, Y., Handy, S., & Mokhtarian, P. (2010). Factors associated with proportions and miles of bicycling for transportation and recreation in six small us cities. *Transp. Res. D*, 15, 73–81.
60. Yiu, C. Y. (2011). The impact of a pedestrianisation scheme on retail rent: an empirical test in Hong Kong. *Journal of Place Management and Development*, 4(3), 231-242.
61. Young, R. K., Wolffing, C., & Tomasini, M. (2005). Highway Construction Impacts on Wyoming Businesses. *Journal of the Transportation Research Board*, 1924(1), 94–102.
62. Yu, C.-Y., Xu, M., Towne, D. D., & Iman, S. (2017). Assessing the Economic Benefits and Resilience of Complete Streets in Orlando, FL: A Natural Experimental Design Approach. *Journal of Transportation and Health*, 8(3), 10.
63. Zagroba, M. (2016). Issues of the Revitalization of Historic Centres in Small Towns in Warmia. *Procedia Eng.*, 161, 221–225.

64. Ведомости. (2019, December 13). Благоустройство Москвы в этом году оказалось дорожке Крымского моста.
<https://www.vedomosti.ru/economics/articles/2019/12/12/818607-blagoustroistvo-moskvi>
65. Минстрой России. Стратегическое направление развития «ЖКХ и городская среда».
<https://minstroyrf.gov.ru/trades/zhilishno-kommunalnoe-hozyajstvo/strategicheskoe-napravlenie-razvitiya-zhkkh-i-gorodskaya-sreda/#:~:text=ФЕДЕРАЛЬНЫЙ%20ПРОЕКТ%20>
66. Открытый бюджет города Москвы. <https://budget.mos.ru>
67. Официальный сайт Мэра Москвы. (2014, May 19). Закон № 18 от 30.04.2014 «О благоустройстве в городе Москве».
<https://www.mos.ru/authority/documents/doc/3730220/>
68. РБК. (2017, July 7). Власти Москвы пообещали никогда не заканчивать программу «Моя улица».
https://www.rbc.ru/society/07/07/2017/595f945b9a7947172457fb1a?from=article_body
69. Сайт Сергея Собянина. (2017, November 19). Ответы на вопросы по благоустройству.
<https://www.sobyanin.ru/otvety-na-voprosy-po-blagoustrojstvu>
70. Cathkart-Keays. (2015, December 9). Will we ever get a truly car-free city?
<http://www.theguardian.com/cities/2015/dec/09/car-free-cityoslo-helsinki-copenhagen>.
71. International Network of Cities Where Living is Good. (2017, January 4). Revitalization of Cittaslow Town Launched. <https://www.cittaslow.org/news/polish-national-networkrevitalization-cittaslow-town-launched>
72. USDOT. (2015, August 24). Complete Streets.
<https://www.transportation.gov/mission/health/complete-streets>

Annexes

Annex 1. Descriptive table of all variables with their data sources

Variable	Description	Source
Number of opened shops and amenities	The number of shops and amenities belonging to the categories of interest, opened and closed in a particular year on a particular street	OpenStreetMap, https://www.openstreetmap.org/
Street Length	The length of the part of the street located within the Central Administrative Okrug of Moscow	Yandex Maps, https://yandex.ru/maps/213/moscow/