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THE IMPACT OF PUBLIC TRANSPORTATION INVESTMENTS MADE BY THE MUNICIPALITY OF BUCHAREST UPON QUALITY OF LIFE

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Abstract: *Starting from evidence suggesting declining population figures in Bucharest, the research asks for the reasons why the Municipality should continue its investments in public transportation, given the negative demographics and natural growth. Research results indicate a strong and linear positive relationship between investments and number of journeys with public transport services. Building on this finding, the paper discusses that public administration investments in transportation eventually lead to improvements of the quality of life, by reducing the negative externalities of private vehicle use.*

Keywords: *public transport, public expenditures, infrastructure investment, quality of life, transport accessibility.*

Introduction

Researchers have been investigating the demand for public transportation services ever since motorization has come to play a significant role in urban areas. Questions about the relationship between transportation demand and critical determinants of economic progress such as congestion, extension of urban spaces or mobility of individuals have played a role ever since (Albalate, Bel, 2010; Banister, 2008; Eliasson et al., 2009; Kottenhoff, Freij, 2009; Proost, Van Dender, 2008).

More recently, the worldwide challenges of sustainability and environmental protection have restored attention towards public transport as a mean to reduce the faulty and deteriorating effects of individual vehicle use (Maizlish et al., 2013). Improving transport services is regarded as an indispensable action of public administration in

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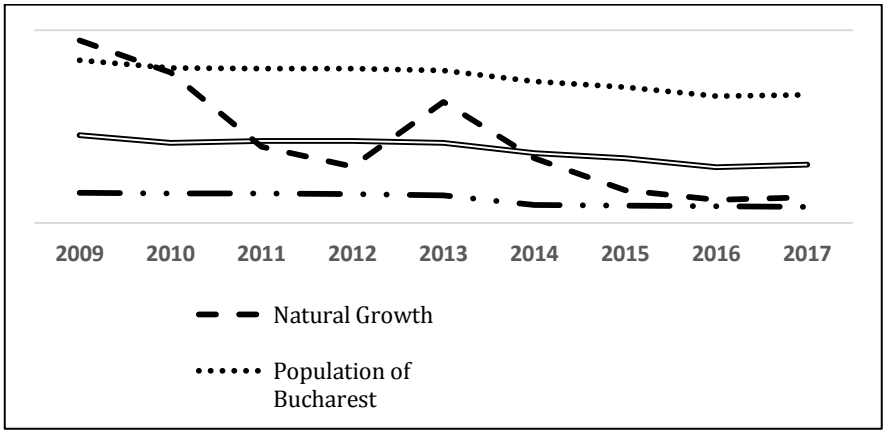
order to improve quality of life (Frank, 2000). Districtual decision-makers have to diagnose supply and demand for public transport and accordingly tailor budgetary allocations so as to produce a transport structure practicable and affordable enough to encourage people to reduce the amount of private transport and opt for the less polluting and cheaper communal alternative.

Bucharest, the capital city of Romania, has found itself in a post-communist transition towards capitalism over the past thirty years and it is still undergoing major redevelopment projects (Nae, Turnock, 2011). As the country's leading development region in terms of foreign direct investments or educational and employment opportunities, Bucharest has witnessed a fast growth in the number of businesses opening offices in the city.

These transformations have set new challenges for the public transport system, which many people rely on for commuting to their jobs. At the same time, private vehicle transport is still at high levels. Earning better thanks to the existing opportunities, many inhabitants have purchased land or dwellings at the outskirts of Bucharest and have moved residence there (Suditu, 2009), using the own car to commute to the city. The convenience of the private vehicle use, the rather slow adoption of public alternative transport or intermodal transport solutions, the emergence of ride-sharing businesses and the fact that, according to a 2005 World Bank study, 93% of yearly trips in Bucharest were made without a pass (Carruthers et al., 2005, p. 19) are but some of the causes that have led to a diminishment by 46% between 2009 and 2017 and by 7.5% alone since 2014 to 2017 in the number of trips with public transport. Figure 1 graphically displays these reductions, whereas it also highlights that, apart from the declining public transport trips, Bucharest also faces demographic pressures (constantly declining population and negative natural growth) that might raise significant concerns for municipal transit.

Figure 1: *Demographic evolutions and public transport evolution in between 2009 and 2017*



Source: own display based on statistical data inputs collected from the Bucharest Agency of Transit (STB), the Romanian National Institute of Statistics (INSSE) and the Ministry of Regional Development and Public Administration (MDRAP)

Given the declining figures, the purpose of this research is to ascertain if and why the Municipality of Bucharest should continue public budget investments in transport. The Research Question asks „*What are the main justifications for the Municipality of Bucharest to continue public investments in transport considering that a diminishment of the number of yearly journeys with public transport can be witnessed?*". By trying to find an answer to the question, the paper aims to provide insights that might assist public policymakers make better decisions in what concerns investments in the future of public transport in Bucharest.

Literature and Method

Public transport is important for societal and economic welfare. Good public services can diminish dependence on private vehicle transport and have a significant environmental impact upon the quality of life (Ellaway et al., 2003). In economics, a good transport infrastructure can be a catalyst for the productivity of both the state-owned sector and of private businesses (Cohen, Paul, 2004). Therefore, a minimum of investments made by central or local authorities is imperative for endogenous growth and for the wellbeing of an economy (Button, Nijkamp, 1997; Button, 1998).

Next to public consumption, public investment makes up for the amount of public expenditure. Devarajan et al. (1996: 314) make a distinction between „*unproductive*" and „*productive*" public expenditures. „*Unproductive*" expenditures do not yield resources and do not create any competitive advantages for the public administration. Such expenditures can include debt payments (Ferreiro et al., 2009), interest payments (Groneck, 2011) or maintenance expenditures (Townsend, Thirtle, 2001). The unproductive expenditures are understood as the costs that a public administration is subject to through its manner of conduct. The „*productive*" expenditures are constituted by investments meant at amplifying economic productivity. They can produce return on investment and increase governmental earnings. Public investments can be made either by centralized or decentralized government level and are used in order to supply the population with goods or services of essential significance for the welfare of the community, among them transport.

Investment in public transport can target several areas of development. Creating new routes and increasing the number of vehicles can lead to better spatial and temporal accesibility and affordability (Bocarejo, Oviedo, 2012). Improved acces from different areas of a city can encourage people to use public transport services in exchange of the own vehicles, resulting in lower transport costs and, thus, an increase of household available income. At the same time, transport accessibility and mobility are key for „*participation*" in urban opportunities that are pivotal determinants of matured societies (Delmelle, Casas, 2012; Martens, Golub, 2012), such as commuting to work (López-Iglesias et al., 2018), commercial and leisure activities.

Overall, accessible public transport can improve quality of life (Metz, 2000). The threat of increased private vehicle use on environmental and individual issues can be combated through public transport plans that can decrease congestion, pollution and costs (Redman et al., 2013).

This research took the form of a desk research based on secondary data. Two different data sources have been used for the same series of time (2009-2017, n=9 years). Internal secondary data regarding the number of yearly rides with public transit has been collected from Bucharest's Agency of Transit (STB) annual reports publicly available on the organization's website[1]. External secondary data concerning public expenditures on transportation made by the Municipality of Bucharest has been drawn from the Ministry of Regional Development and Public Administration (MDRAP). All Figures and Tables in this research are based on the author's own computations of data retreived from these two sources of data, if not otherwise indicated.

The Null Hypothesis (H_0) claimed that no relationship existed between the independent variable x (municipality investments in public transportation) and the dependent variable y (number of yearly rides with public transport). The Alternative Hypothesis claims the opposite as true. For testing the research hypotheses, a statistical data analysis based on a bivariate linear regression according to the following equation has been carried out:

$$Y_j = f(\beta_0 + \beta_1 x + \varepsilon)$$

where Y_j is the dependent variable, which is a function of the intercept value β_0 added to the coefficient of public investments in transportation to be predicted ($\beta_1 x$) plus the error term (ε).

Research results

The regression analysis is statistically relevant at a confidence level of 95% (Significance $F = 0.01 < \alpha = 0.05$; Table 1). The correlation coefficient ($0.77 > 0.70$) points out to a strong and linear positive relationship. The coefficient of determination ($R^2 = 0.59$) indicates that nearly 60% of public transport rides can be explained by the investments made in transportation.

Table 1. Anova and Regression Statistics

Regression Statistics	
Multiple R	0.7729104
R Square	0.5973905
Adjusted R Square	0.5398749
Standard Error	113518.79
Observations	9

	df	*SS*	*MS*	*F*	*Sig. F*
Regression	1	1.33847E+11	1.33847E+11	10.3865761	0.01459621
Residual	7	90205609211	12886515602		
Total	8	2.24052E+11			

Source: own computations in Microsoft Excel based on statistical data inputs collected from the Bucharest Agency of Transit (STB) and the Ministry of Regional Development and Public Administration (MDRAP)

[1] Societatea de Transport Bucuresti (Bucharest Transport Company) (STB), Activity Report, available at: http://stbsa.ro/raport_activitate.php

Based on the set of natural numbers ℕ collected for data analysis in this research, the mean values of „*Rides with public transport (in thousands)*", respectively of „*Municipality Investments*

in Transportation" have been calculated as follows:

$$\mu = \frac{1}{n} * \sum_{i=9}^{n} Xi$$

where μ is the arithmetic mean of the set of natural numbers ℕ, n accounts for the respective 9 terms in ℕ and Xi is the value of each term of ℕ for average. The means obtained show that, on average, there have been 618.776.000 rides with STB per annum between 2009 and 2017, while, during the same interval, the Municipality of Bucharest has invested, on average, 1.287.287.135 Lei per year in transportation (see also the Anova Descriptive Statistics in Table 2).

Table 2. Anova Statistics

Groups	*Count*	*Sum*	*Average*	*Variance*
Rides (thousands)	9	5568988	618776.4444	28006547962
Investments in Transportation	9	11585584219	1287287135	23816307877901600

Source: own computations in Microsoft Excel based on statistical data inputs collected from the Bucharest Agency of Transit (STB) and the Ministry of Regional Development and Public Administration (MDRAP)

Based on the mean values, the Variance has been calculated for the two indicators, according to the formula:

$$\sigma^2 = \sqrt{\frac{(x-\mu)^2}{n}}$$

where σ^2 is the variance value, x is each of the nine individual terms in ℕ, μ is the arithmetic mean, while n is the amount of terms in ℕ.

For the number of rides with STB, the Variance has been calculated as:

$$\sigma^2 = \sqrt{\frac{(x-\mu)^2}{n}} = \sqrt{\frac{(788.223-618.776)^2 + (761.078-618.776)^2 + \cdots + (426.636-618.776)^2}{9}} = 28.006.547.962$$

Similarly, for investments in transportation made the Municipality, the Variance has been calculated as:

$$\sigma^2 = \sqrt{\frac{(x-\mu)^2}{n}} = \sqrt{\frac{(1494754845-1287287135)^2 + (1494754845-1287287135)^2 + \cdots + (1494754845-1287287135)^2}{9}} = 23816307877901600$$

Finally, the standard deviation (σ) of the two variables has been calculated as the square root of the variance ($\sqrt{\sigma 2}$). The standard deviation value for the rides with STB was:

$$\sqrt{28.006.547.962} = 167.351,$$

while for the Municipality investments in transportation

$$\sqrt{23816307877901600} = 48.801.954.$$

The negative value of the regression intercept (β_0=-460163) lets understand that if public authorities did not invest in transportation (i.e. if the independent variable was null), then public transit services would not be used, or would only be used beneath potential (in numbers, public transit rides would drop by 460163 per annum if investments in transport stopped). The predicted coefficient of the independent variable (β_1=0.000838, p = 0.01 < α=0.05) is significant and positive, even though of a low value.

Discussions

Although the regression values are insignificant as numbers per se (β_0=-460163; β_1=0.000838), their utility for the research resides in their ability to demonstrate that, if the Municipality of Bucharest suddenly stopped investing in transportation, then the number of yearly rides with public transit services would most probably diminish. Municipality investments in transportation can explain up to 60% of the numbers of yearly rides with public transit services.

This shows that other factors have as well got an impact on how often the citizens of Bucharest use the STB services, but, at the same time, that public investments in transportation shouldn't be ignored either, as they have their own share to play in the utilization of transit services.

Therefore, investments in transportation should be continued at least for maintenance purposes, e.g. for preserving the current status and not downgrading any further. Even if the demographics of Bucharest are not encouraging and even if the number of public transport rides has dramatically dropped over the course of no more than a decade (2009-2017), municipality investments should be continued because they have got a direct and positive influence – albeit not necessarily very strong – on the number of rides and, thereafter, as demonstrated by Metz (2000) and Redman et al. (2013) on the quality of life.

Using the Standard Deviation calculated in the Results section, a benchmark of what would mean commonplace, subpar or excellent values of public transportation, respectively investments in transportation in Bucharest can be studied, whereby normal values would be distributed between (μ+σ) and (μ-σ). Hence, normal values for rides with STB would be distributed between (618.776.000+167.351.000 = 786.127.000) and (618.776.000-167.351.000 = 451.425.000), while for public money invested in transportation between (1.287.287.135+48.801.954 = 1.336.089.089) and (1.287.287.135-48.801.954 = 1.238.485.181).

A common year for the public transit agency of Bucharest would mean carrying out between 451,42 million and 786,12 million transits, while for the municipality, a standard year would bring investments between roughly 1.24bn Lei and 1.34bn Lei. Table 3 shows that, for the number of rides, only one year has been above standards (2009), five years have been among normal values (2010, 2011, 2012, 2013, 2014), while three years – the latest of them – have been between normal (2015, 2016, 2017). This distribution analysis reveals a steady, but continuous decline of yearly rides carried out by STB.

Table 3. Distribution values for the number of rides carried out with the public transit agency of Bucharest (STB)

Year	2009	**(μ+σ)**	2011	2010	2012	2013	2014	**(μ-σ)**	2015	2016	2017
Rides with public transport (thousands)	788223	**786127**	769261	761078	750946	725605	461006	**451425**	447671	438562	426636

Source: own computations in Microsoft Excel based on statistical data inputs collected from the Bucharest Agency of Transit (STB)

The distribution values show that the number of rides, as well as the amount of investments have declined in 2015, 2016 and 2017, these being the only (and the same) years with values below average for both variables (Tables 3 and 4). This equivalence met at the subpar end cannot be observed at the other side of the equation. Between 2009 and 2014, the annual investments in transportation have been within normal distribution in one instance (2011) and five times below average (2009, 2010, 2012, 2013, 2014). However, the high amounts of investments have not been matched by the numbers of public transport rides.

Table 4. Distribution values for the municipality investments in transportation (in Lei)

Year	Municipality Investments in Transportation
2009	1494754845
2012	1374399699
2013	1359172434
2010	1358336789
2014	1355128519
(μ+σ)	1336089089
2011	1325727194
(μ-σ)	1238485181
2015	1227478629
2017	1083398472
2016	1007187638

Source: own computations in Microsoft Excel based on statistical data inputs collected from the Ministry of Regional Development and Public Administration (MDRAP)

The only cases of parity can be observed for 2009 (the year with the highest values for both x and y) and 2011 (within standard limits). Apart from these two years, 2010, 2012, 2013 and 2014 have seen the Municipality of Bucharest make above the average investments in transportation, but only for obtaining average results in the amount of ridership. Under such circumstances, the subparity of 2015, 2016 and 2017 might be an indication of economic adjustment policy: the adverse (and nonlinear) impacts of earlier years have been adapted towards alignment. A rationalization of expenditures can be observed after 2015, with direct influence on the number of rides. The average of expenditures between 2015 and 2017 has decreased by 14% compared to the entire average between 2009 and 2017. This has led to a 29% drop of rides over the same period observed (Table 5).

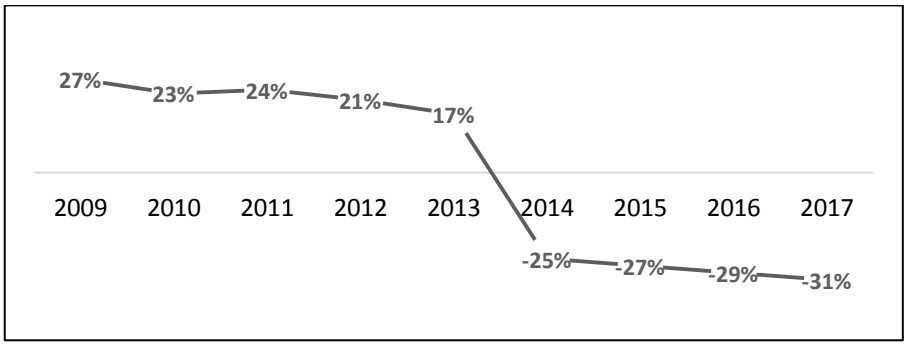
Table 5. Percentual changes in the number of rides and the amount of municipality expenditures

	% Change Rides y-o-y	% Change Rides vs. mean value	% Change Expenditures y-o-y	% Change Expenditures vs. mean value
2009	/	27%	/	16%
2010	-3.44%	23%	-11.30%	5.50%
2011	1.07%	24%	2.45%	3%
2012	-2.38%	21%	1.18%	6.70%
2013	-3.37%	17%	-1.10%	5.60%
2014	-36.46%	-25%	-0.29%	5.30%
2015	-2.89%	-27%	-9.41%	-4.70%
2016	-2.03%	-29%	-17.94%	-22%
2017	-2.71%	-31%	7.56%	-16%

Source: own computations based on statistical data inputs collected from the Bucharest Agency of Transit (STB) and the Ministry of Regional Development and Public Administration (MDRAP)

Figure 2 graphically displays the aforementioned percentual changes.

Figure 2: *Percentual changes in the amount of municipality expenditures compared to the average expenditures between 2009 and 2017*



Source: own computations and display based on statistical data inputs collected from the Ministry of Regional Development and Public Administration (MDRAP)

Conclusions

This research has demonstrated that a directly proportional and positive relationship exists between investments made by public administration in transport services and the number of rides with public transport. The more people use public transit services, the higher the quality of life can be expexted, as negative externalities of private vehicle use (such as traffic jams, or air and noise pollutions) can be avoided. Therefore, public authorities should continue investments in public transport. Although the decision of the Municipality of Bucharest to decrease its investments over the course of the years (32.6% less money invested in 2016 compared to 2009) can be justified by the reduced demographics and natural growth or by an ever-increasing preference of citizens towards ride-sharing services such as Uber, expenditure on public transport should not be ignored. Economic convergence policies aligned with demographic and societal realities meant at decreasing unnecessary expenditure should not also autmoatically mean drastical drops of budgetary allocations towards public services. Public authorities have the responsibility to continue investments in public transportation, even if, as has been seen in this article, the number of journeys diminishes. Giving up investments in public transportation would also mean giving up the pursuit of an improved quality of life for the citizens, which would be unacceptable.

The main limitations of this research are based on the insufficient sample size for an adequate statistical measurement. The research only took into account a data range of nine years, based on publicly available information. The data sets are relying on very small samples, which could raise questions upon the regression model. Future reseach should use larger samples and more variables for a better regression design. At the same

time, the interpretation of the results might be better double-checked with available research existing on the topic.

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