The possibility of introducing congestion charging in Budapest – assessment of the theoretical alternatives

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Summary

In the last three decades the level of motorization has increased a lot in Budapest, so the well-known urban congestion effect became relevant in the capital of Hungary (ca. 30 years after western European cities). Since 2007, which was a peak in terms of traffic volumes the idea of the congestion charging scheme has become more and more popular among transport professionals and general public. The purpose of a possible measure could be quite complex: a combination of revenue generation, influence travel behaviour and environmental goals. As there were different legal, territorial and fiscal alternatives to achieve the goals, a widespread, detailed feasibility analysis needed in order to assess the expected effects and to choose the most efficient version. Therefore the research question was that is it suggested to introduce a congestion charging scheme in Budapest and if yes, than how the system should work? The research methodology was a conventional feasibility assessment with a multi-criteria analysis (MCA) of the theoretical alternatives, transport modeling, cost-benefit and cost-efficiency analyses. The aim of this paper is to present the results of these assessments. Through the analysis of expected transport, environmental, economic and social effects a few proposed alternatives have been selected. This case-study presents how complex a decision-making process can be which involve so many conflicting interests. It provides an insight to the main challenges and it shows through the results that what lessons can be learnt and adopted to other cities with similar issues.

Keywords: congestion, pricing, travel demand management

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1. Introduction

Budapest as many other cities all around the world is dealing with road congestion. It became a relevant issue in the Hungarian capital about 30 years later than in other big cities of Western Europe. The problem was mainly induced by the rapid motorization of the last decades. The motorization ratio has increased with ca. 25% since the 1990's, to the level of 360 vehicles/1000 inhabitants. However, structural factors can also be identified as the Hungarian road and rail network is heavily centralized to Budapest.

Having seen the preliminary results of the congestion charging scheme in London and the successful pilot in Stockholm, the idea of introduction congestion charging in Budapest raised its head in 2006. Since 2007, which was a peak in terms of traffic volumes, this idea has become more and more popular among transport professionals and general public. Moreover, the resolution of the European Commission on the EU subsidy of metro line M4 specified congestion charging as a supplementary measure in order to achieve environmental targets. A pre-feasibility study was carried out in 2009, which was followed by a detailed study in 2013.

The aim of this paper is to analyze whether it is suggested to introduce a congestion charging scheme in Budapest and if yes, than how the system should work? Or what other solutions are possible to overcome the above mentioned challenges? The research methodology is based on the feasibility studies, which contained a conventional multi-criteria analysis (MCA) of the theoretical alternatives, transport modeling, cost-benefit and cost-efficiency analyses. Through the analysis of the expected transport, environmental, economic and social effects a few proposed alternatives have been selected.

This case-study presents how complex a decision-making process can be which involve so many conflicting interests. It provides an insight to the main challenges and it shows through the results that what lessons can be learnt and adopted to other cities with similar issues.

2. Reasons why the idea of congestion charging arose in Budapest

After the democratic change (1989) the growing trend in motorization intensified. In nearly 10 years there was a significant 20% increase in the number of vehicles in the capital. The modal share of public transportation has decreased by 15-20% at the same time. In 2012 it was around 60% considering motorized modes only in a trip-based approach.

However, in its structure the road transport network has not changed a lot. It remained the same heavily centralized one, besides the fact that the national road and rail network is also very centralized to Budapest. It can be illustrated with the location of the crossings on River Danube, which is considered as a natural obstruction between the eastern and the western part of the country. There are 60 crossing transport lanes on the river (46 for road and 14 for rail transport) from which 49 are located in Budapest (82%). Furthermore, crossings in Budapest are also centralized: 7 out of 9 bridges are located within an 8 km long inner-section of the river (see Figure 1). There was only one major "relief" that the eastern section of M0 motorway have been implemented in 2008. While road traffic cannot drive round the city centre, the road transport network in these inner urban areas reached its maximum size, thus it cannot be extended furthermore. For instance in District V. – which is absolutely located in the central area

of the city – there are nearly 6000 parking places on street, while the number of parking permits for local inhabitants is around 7000. (Juhász, 2012)

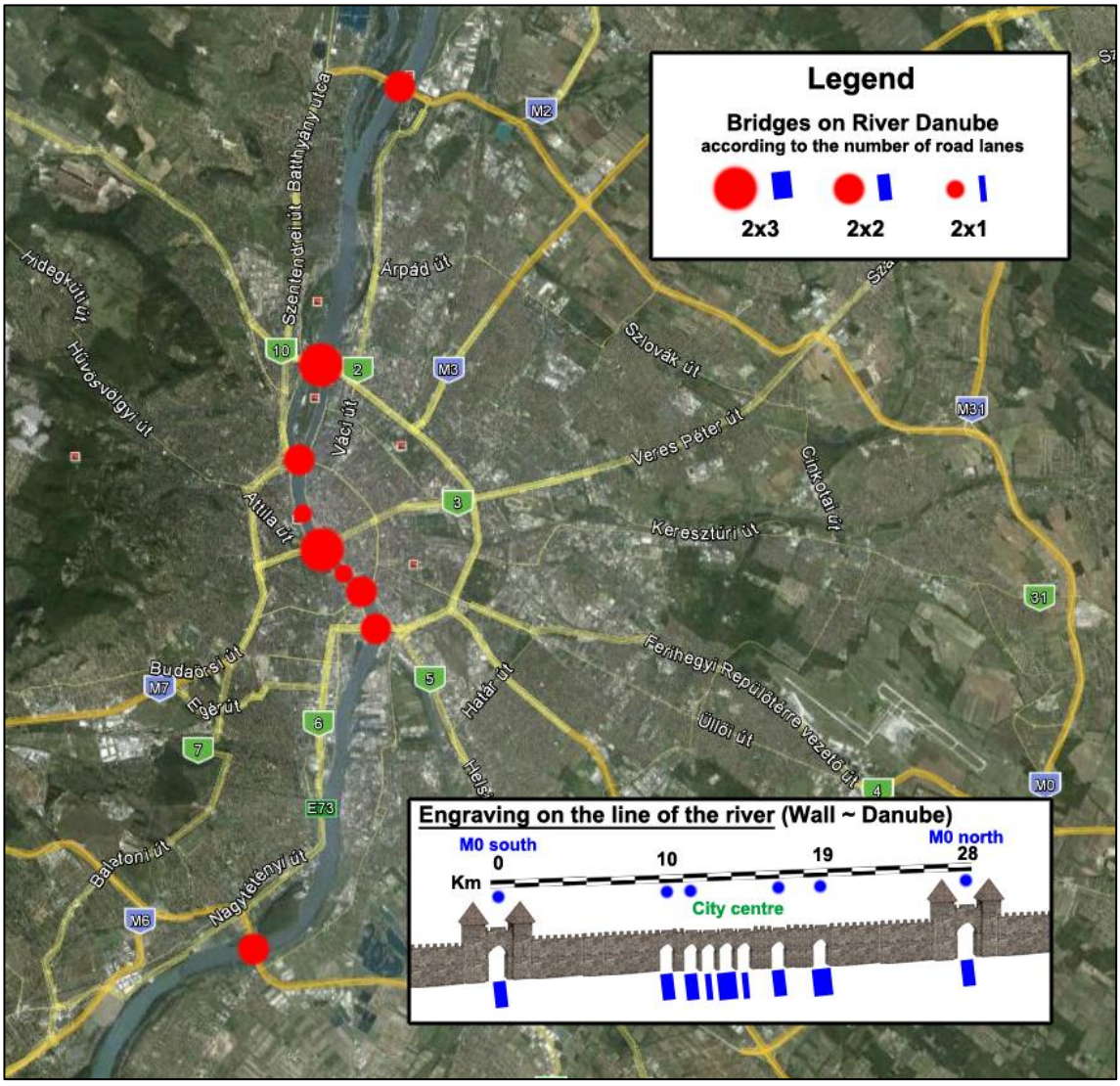

Figure 1: Location of the bridges on the River Danube in Budapest (Juhász, 2012)

In addition, in the past 20 years the population of Budapest decreased with almost 15% (around 250 thousand people) as a result of the so called urban sprawl effect. That extremely increased the road traffic to and from the city, because around two-third of these commuters choose to travel by car. It means that 30% of total car trips in the city are from the suburbs.

Consequently the average travel speed of cars decreased from 35 km/h to 20 km/h in the last 15 years. While in the case of buses it decreased from 20 km/h to 15 km/h. It means that:

- from 2000 the external cost from road congestion has become one of the largest transport-related cost in Budapest (Erhart, 2007);
- the average road speed reached that level, where it is in a state of long-term equilibrium without fiscal regulations (Smeed, 1949) and where other cities like London and Stockholm introduced congestion charging.

If we travel by car, it requires around four to five times more space and fuel than use of public transportation, so we can declare that cars are able to satisfy travel demands up until a moderate level. Therefore we need to increase the modal share of public transportation in dealing with growing travel demands. This is not possible only with the enhancement of public transport services, but certain restrictions have to be put in place on car use in dense urban areas. Based on international examples urban road pricing or congestion charging could be a very effective regulatory measure. The key factor of success is that a part of the external cost (which every road user causes for the others) is internalized. Therefore road users start to feel the real costs of road use and they can decide on their trips considering at least a part of the social costs and not only their private costs. In this way a "social trap" (the economic issue of the tragedy of commons; individual over-consumption) can be avoided. That is the theoretical basis of urban road pricing (Smeed, 1964). Figure 2 shows an example which is based on a practical estimation similar to the one in Orosz-Pásti 2002.

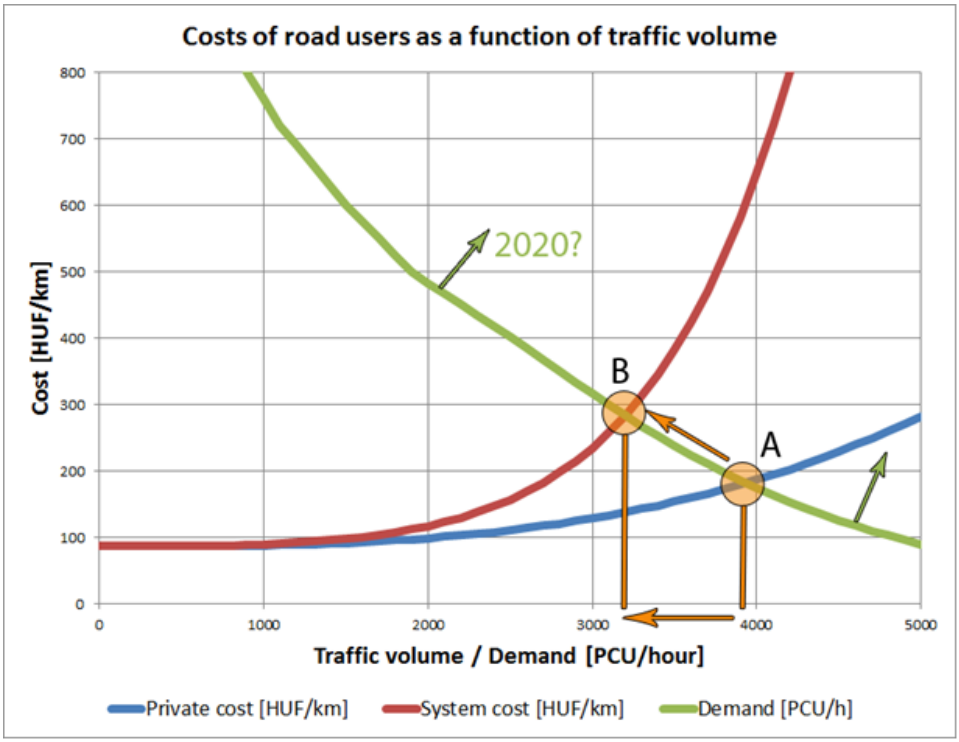

Figure 2: An example of congestion externality (Juhász, 2012)

The idea of congestion charging came ahead in 2007 and there were studies in the topic, and even the popularity of it has increased over the years, there was no real political ambition to implement it. Therefore there was not a specific purpose for which the city would like to give it a green light. So there were three easily-separable theoretical goals:

a) reduce road congestions (reduce the average travel time, increase average travel speed, increase the reliability of the road transport system)
b) mitigate environmental impacts of road transport (decrease air pollution and noise)
c) generate revenue to finance the transport system (financially stabilize the system)

Around 2007 reduction of congestions seemed to be the most important. Since then a 10% decrease in traffic occurred, which is primarily caused by the economic crisis and the constantly increased fuel prices. In accordance with this and as financing of public transport services became more and more problematic revenue generation became the top target, while among the citizens environmental reasons were also popular.[1]

3. Analysis of the theoretical alternatives

In 2007 the average speed of road traffic in Budapest reached the level where other European cities successfully introduced congestion charging; meaning that initiation of a similar system can have a positive effect on the transport system of the capital. Taking over a proven technology and practice would also mean less investment cost compared to the pioneer cities. (Erhart, 2007)

The feasibility of congestion charging in Budapest was analyzed in the following studies:

- BME Innotech (Zsolt Pápay – Pál Lukovich – Csaba Orosz): The possibilities in the application of a road pricing system in Budapest [1992]
- Transman Consulting (János Monigl – Zsolt Berki): Modelling the impacts of road pricing in Budapest [2001]
- Metropolitan Research Institute (Városkutatás Ltd.): Efficient transport-management in Budapest [2008]
- Metropolitan Research Institute (Városkutatás Ltd.): Pre-feasibility study of the congestion charging in Budapest [2009]
- BKK Centre for Budapest Transport - TRENECON-COWI Ltd.: Introduction of congestion charging in Budapest, Decision-support study [2013]

All of these studies thoroughly assessed the theoretical alternatives of congestion charging based on international best-practices, transport modeling results and cost-benefit analyses. Every one of these suggested that the restriction of car use is inevitable and road pricing or congestion charging could be a very useful and efficient instrument to achieve it. However, socio-economic and transport-related prerequisites were also stressed, including the development of the road network (new bridges, missing links etc.), public transport system and intermodality.

In spite of recent studies had suggestions elaborated in detail, it has not been decided yet whether Budapest is about to introduce congestion charging. At the moment the city has not got the right to collect road tolls as a motion for an amendment of the relevant law was rejected in the summer of 2012. Nonetheless, as there is only one year to municipal elections, it cannot be expected that political leaders will make the decision before 2015. However an open refusal of congestion charging would also be unpleasant, because it is specified in the resolution of the European Commission on the EU subsidy of metro line M4 as a supplementary measure. Anyway the deadline ("end of the 2007-2013 programming period") is quite hazy, which allows the topic to remain in the backstage for some time.

The above mentioned circumstances make the "lack of goal setting" also clear. It made the politically- and publicly-wanted detailed feasibility analysis extremely difficult that the city does not had any approved goal regarding the introduction of congestion charging. Thereupon, a mixture of every possible goals remained. After this

[1] There was also a thoughtless political campaign during the municipal election in 2010 about introducing the charge in order to give free public transportation to the citizens. Anyway, it was nipped in the bud.

so-called "complex goal setting" a comprehensive analyses of theoretical alternatives was the only way to go, which kept every detail open (target revenue, amount of the charge, differentiation of the charge, possible reductions, etc.) with certain given restrictions. Around so many "if"-s the correct weight between different aspects could not be determined. However, the goal of revenue generation seemed to grow all along the way as the government started to suggest in 2011 that a reduction and ceasing of operational subsidy (even reduced fare price complement) were in plan. That holds the public transport system of Budapest in a state of uncertainty considering its financing.

By all means, the theoretical alternatives of congestion charging in Budapest were assessed considering different kind of aspects throughout the last years. Table 1 shows an up-to-date summary regarding the main characteristics (price level: 2012). There are mainly zonal and cordon pricing solutions. Complex solutions are more or less the combination of these ones: alternatives with 2 or more zones or cordons, or hybrid variations.

We assumed that the charging will be effective between 7 am and 7 pm without any reduction for residents. We have calculated the affected amount of traffic from recent traffic counting results excluding public transport vehicles and motorcycles. The investment costs and the annual operational cost is estimated based on the above mentioned studies, including the cost of addition investment needs (necessary public transport developments, P+R developments etc.). The estimated annual revenue is a possible range assuming different fees and differentiation (daily charge, time-based, environmental-based, etc.).

We have created a multi-criteria analysis (MCA) of these alternatives taking previous transport modeling results, cost-benefit and cost-efficiency analyses into account. Economic, transport, environmental, social effects, and technical aspects have got the same weight. Table 2 shows the result of this MCA. Based on our assessments the following alternatives can be suggested for implementation:

- Cordon charging on the inner bridges [C0 alternative]
- Cordon (or zonal) charging in the line of the Outer Ring Road (Hungária-gyűrű) and the River Danube [C2 or Z2 alternative]
- Cordon (or zonal) charging in the line of the Inner Ring Road (Nagykörút) and the River Danube [C1 or Z1 alternative]
- Cordon (or zonal) charging in the line of the Outer Ring Road (Hungária-gyűrű) and the Buda Ring (Budai körút) [C3 or Z3 alternative]

Efficiency of different alternatives might vary on the specific goal. However, a gradual introduction of congestion charging is also possible (e.g. C0 as a first step and Z3 as a second).

Previous studies mainly suggested Z3 and C3 alternatives. The simplicity of a daily charge in C3 alternative could be tempting and can be modelled on "Area C" in Milan. However a time-based differentiation similar to Stockholm's system could be also efficient.

Table 1: Main characteristics of the theoretical alternatives of congestion charging in Budapest based on previous studies (Városkutatás, 2009; BKK-Trenecon COWI, 2013)

	Alternatives		Covered area [km^2 (%)]	Volume of affected traffic [car trips/day, 2012, 7-19h]	Investment cost [net mEUR]	Additional investment need [net mEUR]	Annual operational cost [mEUR/year]	Annual revenue* [mEUR/year]
Zonal pricing	Z1 Inner Ring Road - River Danube (Nagykörút - Duna)		6.5 (1%)	165 000	13,25	17,5	11	30-65
	Z2 Outer Ring Road - River Danube (Hungária körút - Duna)		32 (6%)	345 000	14,5	32	12	55-100
	Z3 Outer Ring Road - Buda Ring (Hungária gyürü - Budai körút)		42 (8%)	450 000	16,5	40	12,5	80-125
	Z4 The city itself		525 (100%)	1 385 000	20	150	24	80-180
Cordon pricing	C0 Inner Bridges on the River Danube		-	360 000	8	10	8	25-60
	C1 Inner Ring Road - River Danube (Nagykörút - Duna)		6.5 (1%)	140 000	12	17,5	10,5	25-50
	C2 Outer Ring Road - River Danube (Hungária körút - Duna)		32 (6%)	265 000	12,5	32	11,5	45-80
	C3 Outer Ring Road - Buda Ring (Hungária gyürü - Budai körút)		42 (8%)	350 000	14,5	40	12	60-100
	C4 City limits		525 (100%)	480 000	16,5	150	22,5	60-150
Complex solutions	Z3Z1		42 (8%)	455 000	21	40	15	90-130
	Z4Z3		525 (100%)	1 385 000	28	200	25	100-180
	Z4Z3Z1		525 (100%)	1 385 000	33,5	200	30	120-180
	C3C1		42 (8%)	375 000	18	40	14,5	75-120
	C4C3		525 (100%)	685 000	22,5	200	23	80-160
	C4C3C1		525 (100%)	725 000	26,5	200	27,5	110-160
	C4Z3		525 (100%)	780 000	25	200	24	100-160

*estimated range of the annual revenue assuming different charges and differentiation

Table 2: Multi criterion analysis of the theoretical alternatives of congestion charging in Budapest

	Alternatives		Evaluation [1-10]						Total / Investment cost	Estimated economic BCR
			Economic effect	Transport effect	Environmental effect	Social effect	Technical aspects (feasibility)	Total		
Zonal pricing	Z1 Inner Ring Road - River Danube (Nagykörút - Duna)		7	5	4	6	8	30	2,26	5,1
	Z2 Outer Ring Road - River Danube (Hungária gyűrű - Duna)		8	7	6	6	7	34	2,34	5,8
	Z3 Outer Ring Road - Buda Ring (Hungária gyűrű - Budai körút)		8	8	7	6	6	35	2,12	4,8
	Z4 The city itself		4	7	9	5	4	29	1,45	4,2
Cordon pricing	C0 Inner Bridges on the River Danube		9	7	6	4	10	36	4,50	6,0
	C1 Inner Ring Road - River Danube (Nagykörút - Duna)		8	5	4	6	9	32	2,67	4,8
	C2 Outer Ring Road - River Danube (Hungária gyűrű - Duna)		9	7	5	6	8	35	2,80	5,5
	C3 Outer Ring Road - Buda Ring (Hungária gyűrű - Budai körút)		9	7	6	6	7	35	2,41	4,6
	C4 City limits		5	5	7	2	5	24	1,45	4,0
Complex solutions	Z3Z1		6	8	7	8	5	34	1,62	4,6
	Z4Z3		4	9	9	8	3	33	1,18	4,4
	Z4Z3Z1		3	10	10	8	2	33	0,99	4,0
	C3C1		6	8	7	6	6	33	1,83	4,3
	C4C3		4	9	8	8	4	33	1,47	4,2
	C4C3C1		4	9	9	8	3	33	1,25	3,9
	C4Z3		4	9	8	8	3	32	1,28	4,3

4. Conclusion and lessons learnt

Having seen the combined effect of economic crisis, public transport investments and traffic calming measures in Budapest, we can state that road congestion cannot be eliminated by physical measures alone (Eliasson, 2010). Even the problem will not be solved by the credit crunch. Besides, if Budapest would like to make its transport system more sustainable, it cannot simply move on with traffic calming measures combined with the priority of public transport and cycling infrastructure developments but has to solve some structural issues. The constantly delayed reform of the parking

system, the procrastinated revision of urban freight transport strategy, integration of urban and suburban public transportation, and the reform of the financing are all among these ones. The gradual application of "user or polluter pays" principle would be beneficial from this point of view.

Congestion charging is one possible measure in introduction "user pays" principle. It could support structural reforms as well, because it seems to be a very efficient way of regulating car use, reducing road congestion and encouraging the use of public transport. Based on our assessments a significant contribution to finance the transport system is also possible, while a positive environmental effect can also be expected. Moreover, it would make car users conscious of the social cost of their trips and it would also create a possibility for the city to continuously influence travel behaviour depending on its current policy.

Anyway, we cannot expect that congestion charging will solve everything alone. The city would also need both road and public transport investments beside that the charging can seriously help.

However, the following conclusions can be drawn from this chaos, which has been running around the idea of introducing congestion charging in Budapest:

1. As the experiences from London and Stockholm also showed, it is indispensable to have an explicit and relevant goal (or combination of goals), which is approved by policy-makers. Without it system planning and communication can easily become a nightmare.
   Formulating goals and restrictions is a job for policy-makers (in cooperation with transport professionals), while designing the charging system is a job for experts. However system design is not working with impossible restrictions or with conflicting interests (e.g. the goal is to generate 100 million EUR, but the maximum charge could be 1 EUR and there should be a 100% reduction for residents within the zone). (Eliasson, 2010)
2. After setting the goal(s) decision-makers have to consistently take the responsibility for it. Keeping this political will is a key to secure funding and public acceptance.
3. It needs time to plan and implement a congestion charging system. It is more advisable to plan the political process in accordance with the introduction of the charge instead of hurrying or skipping important parts of preparation. During this process we have to aware that acceptability of congestion charging will decrease when details raise their head but it will increase when people get accustomed to the charging and feel its benefits (Eliasson, 2010).
4. Communication can be a key element, which could determine the destiny of the scheme. Without open and initiative communication scandals are spreaded, which might affect the process. Conscious and well-timed stakeholder involvement is also essential. Defensive communication strategies are not recommended.

After all, introduction of congestion charging is more favourable during an economic crisis when mobility needs are lower and it is easier to get used to it, while additional funds needed the most to finance the transport system.

Nevertheless, congestion charging is not the only way to reduce road congestion and to generate revenue. If charging scheme is not working for any reasons, an integrated and well-designed parking charging policy could be also useful (see the example of Vienna).

References

BKK Centre for Budapest Transport - TRENECON-COWI Ltd. (2013): Fővárosi személyforgalmi behajtási díj bevezetése, döntéstámogató tanulmány (Introduction of congestion charging in Budapest, Decision-support study)

Eliasson, J. (2010): So you're considering introducing congestion charging? Here's what you need to know - An FAQ based on Stockholm's experiences. ITF/OECD round table, discussion paper no. 2010-4

Erhart, Sz. (2007): A budapesti közlekedési dugók okai és következményei (Reasons and consequences of road congestions in Budapest). Közgazdasági Szemle LIV. pp. 435–458.

Juhász, M. (2012): Budapest főváros XI. kerület (Újbuda) városközpont közlekedésfejlesztési kérdései – A Hamzsabégi út fejlesztésének vizsgálata (Transport development issues of the city centre of Budapest XI. District (Újbuda) – Examination of the development of Hamzsabégi Road). MSc thesis. Széchenyi István Egyetem.

Monigl, J. & Berki, Zs. (2001): Modelling the impacts of road pricing in Budapest. Transman Consulting.

Orosz, Cs. & Pásti, B. (2002): Kielégíthetetlen közlekedési kereslet – fejlesztési és finanszírozási lehetőségek Budapesten – útdíjakkal vagy nélkülük? (Insatiable transport demand – development and financing possibilities in Budapest – with or without road charges?) Városi közlekedés 2002/4.

Pápay, Zs., Lukovich, P. & Orosz, Cs. (1992): Útdíjfizetési rendszer alkalmazásának lehetõségei Budapesten (The possibilities in the application of a road pricing system in Budapest). BME Innotech Ltd.

Smeed, R. J. (1949): Some statistical aspects of road safety research. Journal of the Royal Statistical Society, Series A (General), Vol. 112.

Smeed, R. J. (1964): Road pricing: the economic and technical possibilities. HMSO.

Városkutatás Ltd. (2008): Efficient transport management in Budapest (Hatékony közlekedés-menedzsment Budapesten)

Városkutatás Ltd. (2009): A fővárosi személyforgalmi behajtási díj előzetes megvalósíthatósági vizsgálata (Pre-feasibility study of the congestion charging in Budapest)

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