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**Rivalry and Excludability as Characteristics of Tools
Aimed at Making Cycling in Cities More Attractive**

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Rivalry and Excludability as Characteristics of Tools Aimed at Making Cycling in Cities More Attractive

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Keywords: *rivalry, excludability, cycling, transport demands, urban transport systems*

Abstract

Research background: Cycling is considered one of the most required ways of commuting, because it generates multiple benefits and low levels of external costs of transport. Many cities try to increase the share of cycling in the modal split by the way of various interventions. Effects of these efforts are different, depending on levels of rivalry and excludability of goods provided, what is influencing the attractiveness of cycling.

Purpose of the article: The main aim of the paper is (i) to describe key elements of and some solutions for cycling systems in urban areas with focus on two characteristics of goods: rivalry and exclusion, and (ii) to examine, how different levels of rivalry and exclusion influence the attractiveness of cycling and contribute to required effects of cycling policy.

Methodology/methods: The paper is based on the theory of private and public goods, as well as on some elements of the New Institutional Economics. The author uses secondary data and research results presented in scientific papers available in the Web of Science Database and Google Scholar, and other information available in online documents.

Findings & Value added: A change in levels of rivalry and excludability can lead to an increased attractiveness of cycling. Further research on levels of rivalry and excludability in terms of the complexity of transport systems can contribute to a better understanding of transport behaviour, creating adequate solutions and predicting future effects.

Introduction

The paper focuses on interventions and solutions for improving attractiveness of cycling in cities, as this transport mode combines some benefits of public transport and of walking. Cycling policy measures were investigated and evaluated in many studies (Pucher *et al.*, 2010). In this paper, a new approach is used, based on levels of rivalry and excludability as characteristics of goods that make up urban cycling systems. The main aim of the paper is (i) to describe key elements and some solutions for cycling systems in urban areas with focus on levels of rivalry and excludability, and (ii) to examine, how different levels of rivalry and excludability influence the attractiveness of cycling and contribute to required effects of cycling policy.

Research Methodology

The paper is based on the theory of private and public goods, and on some elements of the New Institutional Economics. Rivalry and exclusion are described in terms of characteristics of different elements of biking systems in urban areas in order to underline solutions aimed at making bikes more attractive. A brief analysis is presented of the impact of rivalry and excludability on satisfying transport demands of cyclists. The author uses secondary data and research results presented in scientific papers available in the Web of Science Database and in Google Scholar, and other data and information available in online documents.

Motives and triggers for cycling in cities

The share of cycling in the modal split of urban mobility significantly differs in countries across the world (Pucher & Buehler, 2008; Buehler *et al.*, 2011; Heesch *et al.*, 2012), and perceptions of “attractiveness” of urban cycling can vary greatly across individuals. Numerous advantages are underlined while promoting cycling, from keeping fit or saving money to being independent (Handy *et al.*, 2014). An important issue is, if these benefits are significant for non-cyclists to the same extent as to regular/occasional cyclist. Moreover, for each travel type different transport demands and characteristics can be more or less important. For example, when citizens travel to work or school, reliability and punctuality may be of great importance. And similarly, visiting friends may be an opportunity for physical activity or experiencing nice environment. Some factors (e.g. accessibility, connectivity, safety) may be equally important, regardless of the travel type or destination. Different transport demands can influence transport choices of people in different ways, what is determined by age, gender, mental models and other factors. Lack of adequate cycling infra-

structure has the highest priority among all barriers discouraging people from cycling and expanding such infrastructure is perceived as more than required. This is strictly related to cyclists' concerns about safety (European Union, 2016, p. 9). Although many cities make huge efforts to provide infrastructure measures leading to an increase in the number of cyclists, real effects of such interventions are not always in line with intended ones (Pucher & Buehler, 2016).

The meaning of rivalry and excludability in urban cycling systems

Different types goods can be distinguished, based on rivalry and excludability (Samuelson, 1954; Buchanan, 1965; Ostrom, 1990). What is very important, is that rivalry and excludability are not “present or absent” but rather vary from low to high (Ostrom, 1990, 2010). Table 1 presents main types of goods based on levels of rivalry and excludability.

Table 1. Different types of goods

Perfect rivalry	Open access (Tragedy of the Commons)	Private good featuring high control costs	Private good
Partial rivalry	Impure public good with some rivalry, but no exclusion	Congestion good	Club good
No rivalry	Pure public good	Impure public good with some exclusion	Excludable public good
	Non excludability	Partial excludability	Excludability

Source: Platje, 2012, p. 46.

Elements of urban cycling systems have features of different goods listed in Table 1. These characteristics influence numbers of aspects related to cycling in cities: incentives and responsibilities for provision (elimination) of specific goods, profile of people that are likely to cycling, levels of satisfying particular transport demands, perceived adequacy of cycling for different travel purposes etc. The character of these impacts is strictly related to rivalry and excludability. For example, some people can be unlikely to cycle to work, as they need to share the road with other transport users and a high level of rivalry exists. But even separated bike paths can be unattractive for unexperienced cyclists, because regular cyclists go too fast and incalculably. “Self-exclusion” in such a case can be understood as resigning from cycling by a person due to factors making it difficult or even impossible – in the opinion of this person – to ride a bike. It can result from many factors.

An interesting concept is that some goods are characterised by anti-rivalry and anti-excludability (De Vries, 2005; Levinson, 2014). According to the Vries (2005), the use of anti-rivalrous goods “increases the amount available for consumption by others”, while anti-excludability means that the use of a good encourages other people to consumption, what can be the case of cyclists attracting others to ride a bike.

Impacts of levels of rivalry and excludability on incentives and motives for urban cycling

The whole cycling systems have features of a club good (Platje, 2012), though it consists of many various elements characterised by different levels of rivalry and excludability. Table 2 presents levels of rivalry and excludability of some basic elements of cycling systems.

Table 2. Characteristics of selected elements of cycling infrastructure

Elements of infrastructure	Rivalry / Excludability	Comments
One road for all transport users	Very high (perfect) rivalry among all types of transport users / no one is excluded from use, but self-exclusion can exist	An open access regime can lead to a “tragedy of commons” (Hardin, 1968), as using the road is inconvenient for many or all users. Cyclists can resign due to lack of safety, air pollution, behaviour of drivers etc.
On-road bicycle lanes, separated from lanes for motor vehicles by painted markings	Low or high levels of rivalry among cyclists, depending on their number, the width of the lane, one-way or two-way bike traffic etc.; level of rivalry with car drivers depends on behaviour of drivers / non-cyclists are excluded from using bike lanes	A club good for cyclists, prone to congestion. There is still a high probability of an accident and exposure to air pollution. “Dishonest” car drivers can use the road (a free-rider problem).
Bike lanes shared with buses/taxi drivers / bike paths shared with pedestrians	Levels of rivalry with other users can be different, but it is generally lower than on roads shared with cars / different types of transport users can be excluded, depending on the specific solution	Congestion good / a club good. Depending on the type of separation, car drivers can cause a free-rider problem. Self-exclusion can exist when some transport demands of cyclists are not met. In peak hours rivalry can be very high.
Off-road bike paths, physically separated from car infrastructure	Rivalry only with other cyclists, low or high, depending on their number and the character of a path / exclusion of other transport users	A club good for cyclists with low or very low probability of a free-rider problem caused by car drivers.
Bike boxes (advanced stop lines)	For cyclists, low level of rivalry with car drivers while starting at green traffic light / exclusion of car drivers in the priority at traffic lights	A club good for cyclists.

Traffic lights and signage	There is nearly no rivalry and exclusion in use	Both separate (only for cyclists) as well as shared traffic lights and signage have features of a public good. Facilities designed for cyclists make the access and utility strictly adjusted to cyclists' needs.
Bike-sharing (bike-rental) systems	Levels of rivalry increase together with an increase in number of users / exclusion of people who don't pay the fee (or do not meet other requirements, like registration, having a special card etc.)	Depending on the number of users and the ease of access, bike-sharing systems can be considered different types of goods, e.g. club goods or congestion goods.
Intersections	Depending on the character of infrastructure and types of users, levels of rivalry and exclusion vary from low to high	Different facilities can prevent intersections from becoming an open access regime (the tragedy of commons).

Source: Author's own elaboration.

The first most important conclusion resulting from Table 1 is that cycling infrastructure exposing cyclists to high rivalry, especially with users of motor vehicles, negatively influences attractiveness of cycling. The main reason is that some significant transport demands of cyclists are or can be satisfied at lower levels (see Table 3). Moreover, an efficient cycling system requires high accessibility and connectivity, i.e. a real network of high quality, safe bike roads and paths. Separated, good quality bike paths generate the best effects (Pucher & Buehler, 2016). Finally, a large number of stops due to e.g. traffic lights, intersections without priority etc. makes cycling less attractive (Heydon & Lucas-Smith, 2014).

In order to remove obstacles to cycling, some solutions are implemented that have features of public goods or of club goods for cyclists (Pucher *et al.*, 2010). These interventions can have dissimilar impacts on regular, occasional cyclists as well as on non-cyclists. Thus, free educational programmes (a “near-public” or public good) or special tandem programmes for people with disabilities (a club good) are introduced, inter alia to eliminate self-exclusion or unrequired exclusion of disabled people (Pucher *et al.*, 2010).

Table 3. Examples of impacts of levels of rivalry and excludability on selected transport demands related to cycling

Transport demands	Levels of rivalry	Levels of excludability
Accessibility and connectivity	High levels of rivalry, especially with car drivers can negatively affect connectivity/accessibility of	Self- or real exclusion due to infrastructure deterrents leading to poor connectivity can discourage from

	some cycling infrastructure.	cycling.
Price / costs	Increase in demand for cycling can lead to higher prices of private goods provided via markets, higher costs of bike services etc.	Exclusion of other transport users can lead to an increase in prices due to greater demand for cycling. Bike-sharing systems allow for cycling at low costs and eliminate some types of exclusion.
Travel time / travel speed	The majority of bike lanes/paths are congestion-prone goods, thus increased number of users can lead to longer travel time. Looking for a free parking place or bike station can make the travel time longer.	Purposefully exclusion of other transport users usually leads to lower levels of rivalry and congestion, positively influencing travel time. Shared spaces with pedestrians usually make people cycling slower.
„Door-to-door” travel	A bike, similar to a car or walking, offers the possibility of a direct travel, but high levels of rivalry in terms of parking space available can weaken this effect.	Exclusion of cars from using some roads or parking space can cause that only walking and cycling would allow for “door-to-door” travels in cities. Lack of bicycle parking or unsecure parking can cause exclusion (cyclists are afraid of thefts, stolen bikes).
Safety	High levels of rivalry, especially with car users, usually make cycling less safe. Traffic lights dedicated for cyclists can make cycling safer. Anti-rivalry can exist, e.g. when presence of other cyclists make someone feel safer.	Bicycle infrastructure that excludes other transport users can make cycling safer, positively influencing attractiveness of cycling. Lack of exclusion in case of street lights, traffic lights etc. makes the overall level of safety higher.
Reliability and punctuality	The higher the level of rivalry, the higher the risk of an accident and the higher the probability of congestion.	As in examples presented above – exclusion of car users etc. can lead to an improved reliability and punctuality of a journey.
Health / environmental aspects	No rivalry with cars usually positively influences health aspects of cycling. Anti-rivalry can occur, when cycling by some citizens allows other cyclists to breath fresh, not polluted air.	If there is an effect of anti-exclusion, people cycling to work, shops or for leisure can attract other people due to health and environmental reasons.

Source: Author's own elaboration

In Table 3 there are some examples presented of impacts of levels of rivalry and exclusion on transport demands related to cycling. Cycling, though it has many advantages, is often not perceived as a close substitute for commuting by car. Moreover, high levels of rivalry with car drivers in access to infrastructure make bikes less attractive. Therefore, developing cycling infrastructure and introducing educational programmes can be not enough for a real shift from cars to bikes. As the example of London City shows, measures aimed at exclusion of cars, e.g. by additional pricing, caused a large increase in bike travels in the city centre, with relatively

stable modal split in London's downtown and suburbs (Wright, 2016). Moreover, effects of anti-rivalry and anti-excludability shouldn't be undervalued, as they can contribute not only to fashion for cycling, but to first steps on the way to changing people's mental models related to preferred transport modes.

Conclusions

A brief analysis presented above points to the following key conclusions:

- High levels of rivalry, especially with car drivers, are likely to negatively influence the attractiveness of cycling in cities. Safety, travel time and speed are one of the most important transport demands affected by high levels of rivalry.
- Intended exclusion of car drivers, pedestrians and other transport users by the way of providing separated, non-shared cycling infrastructure can lead to an improved attractiveness of cycling.
- Separated cycling infrastructure allowing for experiencing fresh air and nature can cause an effect of anti-exclusion, and attract people that usually ride a bike e.g. for leisure and recreation.
- Accessibility and connectivity needs to be ensured by the cycling infrastructure as a whole. Higher levels of rivalry and/or some other deterrents can lead to self-exclusion or real exclusion of some potential cyclists.
- Improved cycling infrastructure can have no influence on elimination of self-exclusion. Some other interventions aimed at provision of public or club goods (e.g. educational programmes) can be necessary to change people's mental models.
- Transport demands vary among different types of cyclists and non-cyclists, and can be satisfied at various levels, depending on levels of rivalry and excludability. Thus, rivalry and excludability as characteristics of elements of cycling infrastructure need to be considered while creating tools aimed at making cycling more attractive.
- A great focus should be on avoiding exclusion of people with disabilities or special needs. This can be done by providing club goods or public goods within a cycling-inclusive transport policy.

Rivalry and excludability influence transport choices and behaviour of all transport users. For this reason, cycling policy needs to be integrated with other transport policies in order to make whole transport systems efficient and to generate expected changes and shifts between transport modes. Further research on levels of rivalry and excludability in terms of the com-

plexity of transport systems can contribute to a better understanding of transport behaviour, creating adequate solutions and predict future effects.

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