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van Wee, G.P.

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Bert van Wee, Delft University of Technology, The Netherlands

The Increasing Importance of Cycling in Practice and Research

Since around the mid of the first decade of 21st century, cycling is booming in many cities and regions in the world, for example, cities such as New York, London, Paris, Santiago (Chile), and Muenster (Germany). Other cities, such as, Copenhagen and Amsterdam have a much longer cycling tradition. The increasing interest of policy makers and planners in cycling has resulted in a rapid increase in the number of academic papers in this area and several of these papers have high download and citation rates. As an illustration, of the ten most cited papers in the journal *Transport Reviews*, eight are about cycling.

Most papers are about the effects of cycling options like infrastructure provision or bike sharing systems on cycling levels. Despite this increased interest, the literature on the economics of cycling is limited. A possible explanation might be that several cycling policies are relatively cheap. Another reason could be that at first face there is no academic added value in discussing the economics of cycling, because all major cost and benefit categories are comparable to those of other transport projects (see next section). Another reason could be that decisions on cycling policies are generally made at the level of the local municipality and cities and towns do not often finance academic research, unlike national governments. A next reason could be that the variability in cycling over time can be relatively large, compared to traveling by car or train, due to season and weather effects. A final possible reason is that many cycling policies aim to improve comfort and safety, and these effects are more difficult to assess than travel time gains.

This chapter aims to discuss the economics of cycling and has one major conclusion: in estimating the economics of cycling one can easily, “do it wrong.” The emphasis is on infrastructure policies, but several of the conclusions also apply to other cycling policies, such as promotion campaigns or fiscal policies. In addition, the focus is on western countries because those dominate in the academic literature in this area. The problems and pitfalls discussed, apply even more for developing countries.

As a point of departure, it is assumed that the welfare effects are calculated via a social cost-benefit analysis (SCBA). An SCBA is an overview of all (dominant) pros and cons of a project, in quantitative terms, and next in monetary values. Final results are expressed as indicators like “benefits minus costs” or the “benefit-cost ratio.” SCBA is not further explained in this chapter.

Which are the Costs and Benefits of Cycling Policies?

Table 1 summarizes the dominant costs and benefits of cycling policies and the state of the art with respect to knowledge about the economics of each category of costs and benefits, as well as the main risks in their estimations.

The overall picture that emerges is that, at first face an estimation of the costs and benefits of cycling projects is about comparable to those of other transport infrastructure projects like road and public transport projects. The categories of costs and benefits are about the same, and the estimation of welfare effects can be based on the same methods as in the case of roads and public transport projects. But the state of knowledge on cycling projects really lags behind relative to those other projects. The quality of models is generally poor, there is very limited insight in the quantitative and even more so the monetary effects of effect categories, and as far as methods are available and applied there are substantial risks in estimating effects adequately, both quantitatively and in monetary terms. We later discuss some dominant risk categories.

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Table 1 Current knowledge and main risks for dominant categories of costs and benefits

	Current knowledge	*Main risks*
Costs		
Value of land needed for cycling infrastructure, construction costs.	• Generally poor, at least in the academic literature. • Some knowledge for larger projects, especially if previously built examples are available, which applies to cities and countries with a cycling tradition. • If cities implemented comparable projects before: quite well known because of experience.	• Risk of underestimating costs - worldwide transport infrastructure projects often face substantial cost overruns.
Maintenance cots	• Maintenance costs are relatively limited.	• Uncertain, but small, so not very important.
Benefits		
Travel behavior related impacts—quality of models	• Models for cycling are quite poor.	• Relying on "bad models"—many effect estimates rely on (model based) forecasting.
Travel time of cyclists	• Only a few studies on values of time of cyclists.	
Comfort impacts	• Poor.	• Risk of completely overlooking these benefits.
Travel times of other road vehicles	• Values of time quite well known.	
Other accessibility effects (social exclusion effects, option values)	• Poorly understood, generally ignored.	• Risk of completely overlooking these benefits.
Wider economic impacts	• Poorly understood.	
Environmental impacts – emissions related	• Cycling emissions per km zero, emissions due to increased exercise (and food intake), and for producing bikes and infrastructure.	• Emissions for the construction of infrastructure generally ignored.
Other environmental impacts	• Poorly understood, certainly not quantitatively and in monetary terms.	• Exclusion or Pro Memory in evaluations and therefore not seriously considered.
Health impacts	• Often substantial. Rapidly increasing body of knowledge, and even tools for health impact assessment. • But still large uncertainties.	• Some risk of double counting as far as health is included in travel behavior decisions. • Interaction between cycling and other forms of physical activity. • Self-selection effects.
Safety impacts	• Poor data on incidents in many countries. • Often only aggregate risk factors.	• Incorrect use of aggregate risk factors. • Ignorance of the safety-in-numbers effect.

Pitfalls in the Evaluation of Cycling Policies

Costs

There is limited information, at least in the academic literature, on costs of cycling projects, and the quality of cost estimate. Roads and rail projects often face substantial cost overruns, so estimations for cycling projects could also be biased. But the importance of the costs of the common cycling infrastructure projects is relatively limited in absolute terms because cycling projects are generally relatively cheap. This also applies relative to the benefits (benefits of bike projects are often way higher than the costs) and relative to the volume of kilometers traveled. Therefore, despite the uncertainty, the importance of costs and cost estimates is not as large as in case of (major) roads and rail projects.

Maintenance costs of cycle infrastructure projects probably are relatively small, first because the construction of cycling infrastructure is relatively cheap, and secondly because wear and tear due to the use of infrastructure by bikes is very limited. Even on motorways the impact of cars on wear and tear is limited —it is the lorries with high axle loads (especially due to overloading) that cause almost all wear and tear of motorways.

Models

The estimation of the benefits, and next their welfare effects, to a large extent relies on forecasting changes in travel behavior. This applies to travel time related impacts, other accessibility related impacts, such as, health, safety, and environmental impacts. A major problem is that cycling is generally poorly included in transport models, even in countries with cycling tradition. The poor inclusion in models might first of all result from the fact that in most countries and cities world-wide cycling is way less common than driving or even than traveling by public transport. In addition for decades transport planning has adopted the predict-and-provide paradigm, at least for roads: forecast travel behavior, explore where infrastructure capacity is not sufficient, and provide new capacity. This paradigm resulted in a focus on (capacity) problems, more than on a focus on challenges, accessibility in general, and active modes.

Accessibility

Changes in travel times and the generation of new travel are important benefit categories of transport infrastructure projects in general. This also applies to several cycling infrastructure projects. The economics of estimates are relatively easy: travelers who face reductions of travel times generally evaluate those positively. Multiplying the number of trips that travelers make by travel time reductions per trip results in an estimation of the travel time saved, and next the multiplication of travel time saved by the marginal value of time results in the monetary value of those travel timesavings. The benefits of generated travel are generally estimated via the so-called rule of half: new travelers on average face travel time gains that are half of the full travel time gains of the infrastructure projects.

This methodology also applies to cyclists. But practice is not as simple as theory. Not only the absence of adequate models is a problem, there is also limited insight into the marginal value of time of cyclists. The studies that are available suggest that these values are generally quite high, higher than those for car and public transport users.

But cycling projects can also influence values of time of other road users, both positively (e.g., if more capacity for other vehicles becomes available because some drivers switch to the bike) and negatively (e.g., because road space is reallocated to bikes). Here the problem of poor models, and consequently poor estimates of (changes in) travel times and mode choice impacts of other road users are also relevant. The marginal values of time of other road users are generally quite well known. A risk may be that cycling projects mainly influence other road users on short urban trips, and the marginal value of time for short passenger trips generally is lower than for longer trips, so the risk is an overestimation of the value of these travel time changes for other road users.

But not all accessibility related effects of bike projects are related to the travel times of cyclists (and others). At least two other accessibility effects should be added, the first one being social exclusion, referring to the fact that some people have poor access to important destinations (work, shops, schools, medical services, etc.), often because they have no car available, because of a low income, and/or because of poor public transport services. Most studies on reducing levels of social exclusion via transport policies focus on public transport services, but the bike can be a relatively cheap, flexible, and healthy alternative. Estimating the welfare effects of lower levels of social exclusion is difficult. There are academics arguing that the willingness to pay of the people being socially excluded is not the right way to estimate those benefits. An alternative could be to estimate the value of lower levels of social exclusion by looking at policy measures (not) implemented to reduce these levels, and their costs and social exclusion effects. This results in the willingness to pay of politicians to reduce levels of social exclusion.

A next potentially relevant effect category could be option values: people might value the availability of options even if they do not use them. And they might be willing to pay for this availability — this at least was found in a few studies on public transport services: car users are willing to pay for having the option available even if they do not use these services.

Wider Economic Effects

Wider economic benefits are often-debated category of impacts of transport projects in general, and the uncertainty in the estimations is still large. For cycling projects, there is hardly any literature on these effects.

Environmental Effects

Emissions effects (e.g., CO_2, NO_x, PM) are generally estimated by multiplying travel behavior changes for each mode-by-mode specific emission factors. The poor quality of models also influences the estimation of emission effects, because travel behavior changes are difficult to forecast. Emission factors for other modes than the bike are generally available but should be selected carefully. For example, average emission factors for all car kilometers do not necessarily apply to those (urban) trips that are influenced by bike policies. Emissions due to cycling are zero, but cycling takes more energy than driving or traveling by public transport. If cycling would result in additional exercise and food intake emissions due to producing food are relevant, but there is only very limited knowledge in this area. Emissions of (changes in) travel behavior on noise and noise effects and their monetary valuation are quite well understood, so the main problem is the quality of transport models.

But cycling has more environmental effects: cities that prioritize active modes over cars are often considered to be more attractive. Terms like livability, the quality of the urban environment, and spatial quality are sometimes used to label these effects. The literature on these effects, including the monetary valuation of these effects, is very limited, although some studies have tried to estimate some of those effects via housing prices.

Health Effects

Health effects of cycling projects are often very substantial, and in some cases even the dominant benefit category. To some extent people might include health in their travel behavior decisions, so there is a risk of double counting if health benefits would be fully added to those related to travel behavior benefits and their valuations. But because according to some studies, the health benefits are often way larger than the travel behavior benefits, the size of double counted health benefits must be relatively small.

A large problem is probably that we poorly understand the interaction between cycling and other forms of physical activity. Do people who cycle more, substitute other forms of physical activity for cycling? Or do they exercise more, because they have a better condition, and, for example, take the stairs and not the elevator? In other words, cycling can replace, be added to, or even increase other forms of physical activity. But there is very limited knowledge on the interaction between cycling and other forms of physical activity.

Another problem for the estimation of health effects could be self-selection effects, it could be that specific categories of people more than average are inclined to cycle, for example, people who more than average think health is important, have a healthy lifestyle in general, or who are fit because of genetic reasons. Health effects based on cross-section data of categories of people (cyclists and others) can therefore easily overestimate the health effects of (more) cycling.

Safety Effects

At first face estimating safety effects of travel behavior changes seems to be easy: estimate kilometers per mode, and multiply these with risk factors. But several problems emerge, the first one being the poor quality of models, and thus the estimation of travel behavior changes, as discussed earlier. Second, aggregate national risk factors are often not available for cycling because of the bad quality of registrations of bike incidents, and even bike levels. And if these are available, aggregate values do a poor job for specific travel behavior changes. For example the risks for car drivers on motorways are relatively low, but bikes do not or hardly compete with car trips for which motorways are used. Excluding motorways increases risk factors for cars. The third problem, from the perspective of adequate safety effect estimations, is that cycling becomes safer if cycling levels increase. This is referred to as the, *safety-in-numbers effect*. Explanations for this effect as mentioned in the literature include first that cyclists become more experienced, and that other road users become more used to cyclists. Second, road authorities provide better and safer infrastructure for cyclists the more people cycle. Note that safety effects might be partly included in people's value of time just as health effects, if, for example, people perceive cycling as relatively unsafe, they might be willing to pay more for shorter travel times, for example, due to a new cycle line.

Discussion

The overall picture that emerges is that at first face estimating the welfare effects of cycling seems straightforward and comparable to the estimation of the welfare effects of other transport infrastructure projects. Effect categories and methods are about the same. But practice is more problematic, due to the absence of adequate models, the lack of high quality data, very limited insights in several quantitative effects and their monetary valuation (like the impact of cycling on the urban environment), and difficulties in the estimation of some other effects, in particular health and safety effects.

In theory cities could learn from other cities that implemented cycling policies. But one has to be careful—context matters and this limits the transferability of results, at least across cities and countries with a different cycling tradition. To give a few examples, whereas in more egalitarian countries cycling is not linked to specific categories of people, it might be in other countries. And a hilly area could negatively influence utilitarian cycling, but positively some forms of recreational cycling. Also substitution of drivers or public transport users to cycling depends on the quality of alternatives and current use levels, and these factors have an impact of cross-elasticities.

How important is the general lack of knowledge for practice? First of all, not all topics discussed are equally important. The lack of adequate models, and the poor estimation of safety and health effects probably are most important. Second, in general the problem seems to be somewhat limited compared to road and rail projects. Cycling projects are often very cheap, and have high benefit-cost ratios. So, despite the uncertainty they are often no-regret. In several cases assessments might not be needed at all, cities can "just do it." And cycling projects could be implemented via guidelines for road design or the design of urban environments, like in the Netherlands. Then an assessment for each project is not needed—the guidelines are used for planning, not stand-alone assessments of candidate projects. Of course these guidelines preferably should be underpinned using the current stage of academic knowledge.

A specific problem emerges with respect to safety; sometimes (expected) safety effects are barrier for the local municipalities to implement cycling policies. If for that reasons they would not implement these policies, which would have contra-productive effects, even for health. Some studies have compared the negative impacts of higher cycling levels on health because of incident risks, exercise, and the intake of pollutants. Those studies generally found that the positive impact of more exercise on health is way larger than the negative impact of incidents (and the intake of pollutants).

Biography

Bert van Wee is professor in Transport Policy at Delft University of Technology, the Netherlands, faculty Technology, Policy, and Management. In addition, he is scientific director of TRAIL research school. His main interests are in long-term developments in transport, in particular in the areas of accessibility, land-use transport interaction, (evaluation of) large infrastructure projects, the environment, safety, policy analyses, and ethics.

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