Is the widespread use of urban land for cycling promotion policies cost effective? A Cost-Benefit Analysis of the case of Seville

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A B S T R A C T

Cycling promotion has without doubt been the most intensive policy seen in Seville in the 21st century as far as the use of public land is concerned. In the current context, economic tools need to be applied rigorously to assess the efficiency and economic rationality of cycling infrastructure investments. This article provides a Cost-Benefit Analysis to estimate the economic and social returns on investments from the construction of a bicycle lane network in the city of Seville (Spain). This kind of studies tries to contribute to mitigating the degree of conflict associated with a land policy that breaks with the traditional status quo. The case study is especially relevant due to the successful public policy implemented in recent years to transform the Seville’s urban mobility model into a sustainable system. Based on fieldwork with two survey campaigns conducted among the different cyclist profiles (private bicycle users and public bicycle sharing system users), we analyze two major effects: modal change and changes in journey time. Our robust findings, subjected to a sensitivity analysis, point to the remarkable economic benefits of the bicycle promotion policy in Seville, with significant savings in travel times, vehicle use and infrastructure maintenance, health, traffic accidents, and air pollution for both cyclists and society as a whole.

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1. Introduction and prior research

Nowadays, the search for an efficient economy, i.e., that the social benefit produced compensates for the loss of well-being (Martínez-Paz et al., 2014; Munger, 2000; Schulze et al., 2016), is an essential requirement for any public intervention to be undertaken (Bateman, 2009; Jongeneel et al., 2012). Cost-Benefit Analysis (hereafter CBA) has come to be one of the most popular economic analysis tools for the rigorous assessment of public investments, especially in the area of transport infrastructure (Jones et al., 2014; Kelly et al., 2015; Lavee, 2015; Mouter et al., 2013), as not only does it enable the suitability of a scheme to be examined, but the various alternatives can also be ordered according to their ability to improve social well-being (Mishan and Quah, 2007).

Recently published articles in the field that have used CBA to assess transport infrastructure can be classified in three categories: first, studies that conduct a theoretical analysis of CBA and any possible difficulties for its application (Beukers et al., 2012; Boardman et al., 2010; Damart and Roy, 2009; Peer et al., 2012; Salling and Leleur, 2015; Van Wee, 2012); second, studies that compare CBA with other assessment methods (e.g., Eliasson and Lundberg, 2012; Gühneumann et al., 2012; Tsamboulas, 2007; Tudela et al., 2006); and finally, studies that apply CBA to assess the socio-economic benefits (economic effect, safety, environmental and health effects) of a specific transport scheme for both individual users and broad society, as Legaspi and Hensher (2015) explain.

Much more recent are CBA applications to evaluate strategies developed to promote sustainable means of urban transport, such as the bicycle. Following this line, this article applies CBA to estimate the economic and social returns on investments made in the city of Seville (Spain) to construct a bicycle lane network. This case
study is especially relevant due to the success that was achieved\(^1\) in progressively transforming Seville’s urban mobility model into a sustainable system (see Castillo-Manzano and Sánchez-Braza, 2013a; Castillo-Manzano et al., 2014; Castillo-Manzano et al., 2015a; Marqués et al., 2015) by means of a number of public actions. Cycling promotion has without doubt been the most intensive policy seen in Seville in the 21st century as far as the use of public land is concerned. Examples of this intensive land use include the construction of a 140 km bicycle lane network and the implementation of a public bicycle share system called SEVici (managed by the JCDécaux Company), with 260 docking stations, 2650 smart-bikes and 5163 individual bicycle racks. All this has required a major investment effort by local governments.

These efforts have resulted in Seville being evaluated as the Spanish city with the safest and most convenient bicycle lanes in a study carried out by the leading Spanish consumers’ organization (OCU, 2013). In addition, international organizations such as the European Environment Agency (2013) have valued this policy with Seville being placed fourth in the Copenhagenize Index of the world’s most bike-friendly cities (Copenhagenize, 2013). However, it has not all been praise. Intensive land use has led to serious disputes among citizens (see Castillo-Manzano et al., 2015b; Castillo-Manzano and Sánchez-Braza, 2013b), due to a widespread belief that the amount of land given over to bicycle lanes, docking stations for hire bikes and parking space for privately-owned bicycles hampered mobility and spoilt the city, especially the historical center, declared a World Heritage site by UNESCO in 1987. The anti-bike campaign degenerated into protests and demonstrations. In the worst cases, frequent and violent vandalism resulted in, for example, 213 of the on-average 2650 bicycles available during the September 2009 – September 2010 period, being stolen and 1442 vandalized, and, to give another example, 240 anchorage points also being put out of use.

Regarding the prior literature on this topic, we find a range of studies that use CBA to conduct a direct or indirect assessment of public policies to promote bicycle use. In this context we find articles that use CBA to assess the construction of bicycle lane networks (Krizek, 2006; Wang et al., 2005); the cost effectiveness of investment required to promote them (Gotschi, 2011; Korve and Niemeier, 2002; Liand Faghi, 2014; Lind et al., 2005; Meletiou et al., 2005; Rahul and Verma, 2013); the bicycle’s public health effects (Rutter et al., 2008; Saehrensminde, 2004); the introduction of certain types of bicycles in specific contexts (such as Morey et al., 2002; for mountain bikes); the social costs of the bicycle compared to other modes of transport (Gössling and Choi, 2015) expressed, e.g., in terms of the value of the time saved by bicycle users (Borjeson and Eliasson, 2010); the analysis of the bicycle’s influence on traffic and road traffic accidents (Elvik, 2000; Veisten et al., 2007); and the evaluation of public programs to promote helmet use by cyclists (Farley et al., 1997; Russell et al., 2011). Authors such as Krizek (2007) and Litman (2014) even draw up methodological guidelines to evaluate bicycle infrastructure.

This article contributes to the prior literature in a number of ways. First, it is an umbrella study of the effects of the construction of a city-wide 140 km long bicycle lane network in Seville, in southern Spain. Second, this article uses information collected in two survey campaigns specifically designed to estimate two major effects of the policies to promote bicycle use in cities: modal change and changes in journey time. The responses to these surveys have enabled these impacts to be estimated on the basis of real stated behaviors as opposed to extrapolations from other studies. Third, the study distinguished between two cyclist profiles: private bicycle users and SEVici bicycle users. Finally, it should be highlighted that costs and benefits have been calculated in great detail in order to enable this study to be replicated easily in any of the many cities that have developed, or are developing, similar policies.

In short, from a practical approach we think that this kind of study, based on an evaluation of the economic and social returns of public investments in cycling promotion, may also be helpful to alleviate the resistance generated in certain communities as a consequence of intensive land use for the implementation of urban bicycle facilities, as commented above.

The paper is structured as follows: after this introduction, Section 2 sets out the empirical framework, with a detailed analysis of the sources used; Section 3 presents the results in terms of the scheme’s impacts on bicycle users and on society as a whole; Section 4 provides a discussion of these findings and a sensitivity analysis to confirm the stability of the results. Finally, the conclusions are given, followed by a References section.

### 2. Empirical framework

#### 2.1. Data collection

For this CBA, personal face-to-face interviews were conducted of SEVici public cycle hire users (1400 interviews) and private bicycle users (504 interviews) in Seville in March and April 2014 (see Castillo-Manzano et al., 2016).

The journey points of origin and destination given by the interviewees were coded by the census tracts of Seville in which they were located. In 2014 there were 108 census tracts or neighborhood (see Fig. 1) divisions in Seville. A central point was established for each of the census tracts in order to code the length of journey, and the distance was calculated in kilometers as the shortest route by motorized vehicle (car or motorcycle), the distance in kilometers of the shortest route on foot, and the shortest route by public transport. In the case of public transport, the route was expressed as two components: time taken traveling on the public transport itself, and the distance that had to be covered on foot to arrive at the journey’s point of origin and/or destination.

#### 2.2. Estimation of changes in demand for modes of transport due to the bicycle promotion policy

For this CBA, the assessment period runs from the year before work began to construct the bicycle lanes in Seville (i.e., 2006) to 25 years afterwards.

Once the assessment period had been decided, one of the key aspects of a CBA of a bicycle promotion scheme is to determine the impact that said policy might cause or has caused on both: (i) bicycle use, and (ii) demand for other modes of transport.

In the case of Seville, the most reliable measurement unit used to estimate the change in bicycle use (i) due to bicycle promotion policies is the number of bicycle journeys made. The estimation technique was first used by Marqués et al. (2015) to determine the evolution of bicycle trips in Seville for the 2006–2011 period and later applied in SIBUS (2014)\(^2\) and SIBUS (2016) to calculate the number of bicycle trips for 2013 and 2015, respectively.

Specifically, the estimation procedure consisted of: first, the annual figures from a range of sources were used to estimate the number of journeys per year: Seville City Hall for the 2006–2009 period (Ayuntamiento de Sevilla, 2006, 2010; Sigma Dos, 2007);

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1 As an example of this success, it is sufficient to cite the European Cyclists Federation, for example, which points to an increase from 6000 to 66,000 cyclists per day in Seville between 2006 and 2010, with a rise from 0% to 6.6% of mechanized journeys in only 4 years (see Castillo-Manzano et al., 2015a, 2015b).

2 SIBUS is the University of Seville’s Integrated Bicycle Scheme.
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