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Benefits and costs of urban parks

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1 Introduction

Urban parks (UPs) are a component of urban green surfaces (UGSs) and can be defined as green areas that have been designed and are managed to meet some needs of the population[1]. These needs relate to the necessity to relax spending time in contact with nature, socialize, play and take part in physical activities and sports. UPs are principally designed to produce benefits (recreational and social) that can be enjoyed only through their direct use by citizens. In some cases, due to their high architectural, aesthetic, historical and environmental quality, UPs can also have a relevant educational and cultural value. Their use is generally free, but in some contexts, as in the case of the historical parks, the payment of an entrance fee is required.
However, like all other UGSs, UPs may have other important effects on the characteristics of the urban environment. For example, they can improve the atmosphere (physical and chemical characteristics), hydrology (water depuration, runoff regulation), reduce traffic noise and increase biodiversity. These can all result in considerable economic benefits for the population. For example, recreational activities can promote

[1] The UGSs also encompass other types of green areas and in particular urban forests. I decided to exclude them from the analysis since these areas have not been designed expressly to satisfy some needs of the population despite the fact that they are often used for recreational purposes.

an increase in cognitive and physical performances that can directly (increased work productivity) and indirectly (lower time lost due to illness) improve incomes. The improved air quality and the possibility for physical activity can improve health and reduce healthcare expenditure. The reduction of the air temperature in summer leads to lower air-conditioning costs.
Since UGSs provide economic benefits, if the market were efficient, we would find a balanced presence of green, residential and productive areas in cities. In other words, if home buyers or renters were willing to pay a premium price to live in proximity to UGSs exactly equal to the benefits they get, developers would build homes with private gardens or other green spaces in a proportion that satisfies the needs of the buyers and renters. If that happened, there would be no need for public interventions to increase the presence of green spaces.
However, there are various factors that hinder the market operating efficiently. First the benefits coming from the UGSs generally assume the nature of pure public goods and this can induce people to adopt strategic behaviour (e.g. free riding.). The creation of a private park produces environmental and aesthetic benefits that can be enjoyed at least partially by all those residing nearby, so every developer will be strongly encouraged to bear only part of the costs for the establishment and maintenance of urban green. As a result the percentage of urban area occupied by UGSs will be lower than the socially optimal one. It should also be emphasized that people are not always able to properly evaluate the benefits produced by UGSs because they cannot know the exact trade-off between the amount of UGSs and individual well-being. For example, it is difficult for a person to have precise knowledge of the energy savings due to living in the proximity of parks. It is even more complex for a person to understand the health benefits associated with the restorative effect of seeing a pleasant landscape or the improvement of air quality generated by the trees in a park.
In addition, UPs are places for citizens to meet and socialize, so must therefore be open to the public. The enhancement of this vital function can only be done through public intervention that takes into account the needs of the community and not just individual aspirations.
Ultimately only public intervention can ensure that there is an adequate supply of greenery and parks in urban areas (Choumert and Salanié, 2008). However, this poses the problem of being able to properly establish what area should be occupied by city parks and how it should be distributed within the city in order to maximize the net social benefits. In other words, to avoid the so-called "public failures" would mean that the costs incurred for public parks provision were lower than the benefits. As we will see the calculation of the costs and especially of the benefits is anything but simple.

2 The costs

Following Mcdonough Maland (2012), the costs of UPs can be summarized as follows: “costs of acquiring the property; costs associated with developing the property, including design and construction costs; costs associated with operation and maintenance, including employee payroll and landscaping costs; the opportunity costs associated with the loss of property tax income that communities would have received if the property had been developed for other purposes”. Obviously all these costs can vary widely depending on the specific characteristics of the area where the park has been established and its design; e.g. in some cases the area belongs to the municipality and in others not. The features of the trails can strongly modify the maintenance costs; the density of trees and shrubs or the presence of flower beds can increase the costs significantly, etc. Moreover the UPs can be managed in very different ways (Tempesta, 1997). In some cases maintenance can be contracted out to a private company while in others it can be fully implemented by the municipality. Especially in a period of economic crisis municipalities tend to reduce the maintenance expenditures and delay some interventions (e.g. pruning), so an analysis of current expenditure could led to an underestimation of the true costs (Fratini et al., 2009). As a result, a wide variability exists in maintenance costs. A study conducted in 40 municipalities in the Veneto Region (Tempesta, 1997) highlighted that maintenance costs varied from 0.39 to 2.73 euro per m^2 (constant price 2012) with an average cost of 1.10 euro per m^2. On average the cost per inhabitant was 10.08 euro per year. In the 50 biggest USA cities the spending on parks and recreation per resident ranges from 10 to 287 dollars per capita per year (average = 73 dollars) (CCPE, 2014). In 15 UK parks the cost per inhabitants range from 10.61 to 44.12 euro and the cost per m^2 from 0.28 to 1.34 (constant price 2002) (Dunnett et al., 2002).

3 The benefits

As previously described, UPs and UGSs in general may produce several benefits for the population. Despite a general consensus on some benefits, in some cases there seems to be a partial discrepancy among the scholars opinions. Konijnendijk et al. (2013) reviewing the scientific literature in the field of UPs services listed the following effects: direct and indirect health effects, social cohesion, tourism, house prices, biodiversity, air quality and carbon sequestration, water management, cooling. Analyzing the benefits of UPs in some USA cities, Harnik and Welle (2009) added to the list "direct uses" (sports, bicycling, skateboarding, walking, picnicking, bench-sitting and visiting a flower garden).
Nowak and Dwyer (2007), with reference to the urban forests and trees, distinguished two main categories of benefits:
1 Physical/biological (1.1 urban atmosphere - temperature and microclimatic effects, removal of air pollutants, emission of volatile organic compounds by trees and emissions due to tree maintenance, energy conservation in buildings and consequent effects on emissions from power plants; 1.2 urban hydrology; 1.3 urban noise; 1.4 urban wildlife and biodiversity; 1.5 phytoremediation.
2 Social and economic benefits (2.1 benefits to individuals - city aesthetic improvement, emotional and spiritual experiences, psychological benefits, health; 2.2 benefits to communities - sense of community, stronger ties among neighbours, greater sense of safety, more supervision of children in outdoor places, healthier patterns of children's play, more use of neighbourhood common spaces, fewer incivilities, fewer property crimes, and fewer violent crimes; 2.3 real estate values.
Tyrväinen et al. (2007) also include historical and cultural benefits.
In my opinion two major concerns arise from these lists of benefits. First, as pointed out by Konijnendijk et al. (2013), not all the effects are supported by scientific evidence. These authors, reviewing the recent literature, state that the effects of UPs on tourism, social cohesion and water regulation have not been clearly and univocally demonstrated. Evidence of the effects on health and carbon dioxide sequestration is also weak to moderate.
Second, a certain degree of confusion seems to exist since the scholars do not generally distinguish the urban environment modifications generated by green areas from the benefits that these can produce and the methods that can be used in order to quantify the benefits in monetary terms; e.g. the increase in house prices is not a benefit per se, but can be considered as a sign that people like to live in proximity to the UPs. So the willingness to pay a higher price for a home is a monetary measure of all the benefits that can come from living near a green area. The improvement of health (a benefit) depends on several and interacting environmental modifications: reduction of air pollution, noise reduction, the possibility for physical activities, etc.
As a result it can be stated that the estimation of the benefits generated by UPs is a very complex task given that each effect can contribute to different types of benefits and at the same time a single benefit can be the result of several environmental changes. In this respect double counting is probably the most important source of bias that can occur when estimating UPs benefits.

4 Benefits estimation

To estimate the value of the services generated by natural and semi-natural ecosystems in monetary terms, economists have proposed several methods that can be grouped into two broad categories: the approaches based on consumer surplus evaluation through demand analysis; the approaches based on the market value of benefits and costs. The first category includes stated preferences methods (contingent valuation – CV; discrete choice experiments- CE) and revealed preferences methods (hedonic pricing – HP; travel cost - TC). The second category includes analysis of: the damage costs avoided, the defensive expenditures and market value of the food and raw materials provided by the natural environment. The evaluation can refer to an environmental effect (e.g. the composition of the atmosphere), to a benefit (e.g. health improvement) or to an ecosystem (e.g. a specific UP). As noted above, UPs can be evaluated in two different ways: analysing each benefit one at a time and then adding up the value of all the benefits; evaluating an urban park system as a whole or a single park. Unfortunately, in the past economists have rarely used one of these alternatives. By means of contingent valuation, economists have usually tried to estimate the recreational value, which is a typical use value. But the recreational value encompasses different kinds of benefits (health, psychological restoration, socializing needs, educational, etc.) some of which exceed the park boundary; e.g. since parks modify the atmosphere composition and climate the health benefits tend to also affect people who live near

the park regardless of whether they frequent it. Hedonic price estimations are also quite spurious. There are several motivations that can induce the people to pay more for a home located near a UP. The view of the green area, less time needed to reach the park, health benefits, reduction in air-conditioning costs, etc. By means of the hedonic price methods it is not possible to capture the recreational benefits for people living far from the park. While the influence of a UP on house prices tends to disappear within a radius of 600 m (Crompton, 2005), the visitors usually come from a wider area. 40% of visitors to 7 UPs in the Veneto Region travelled more than 5 km to reach the recreational area (Tempesta, 2009).

Revealed preferences

The HP method is based on the analysis of the relationships between the price of real estate (housing in particular) and quality of the surrounding environment.

A number of studies have used this method to estimate the value of UPs (Crompton, 2005 and 2007; McConnell and Walls, 2005), but the results are often not entirely comparable. In this respect McConnell and Walls (2005) state that "the values tend to vary widely with the size of the area, the proximity of the open space to residences, the type of open space, and the method of analysis" so the results tend to be very case-study specific.

Bourassa et al. (2004) and Sander and Polasky (2009) highlighted the importance that the visibility of the natural element from the home can assume. Their findings support the hypothesis that house price variation due to the proximity to natural elements depends on several factors, among which the aesthetic quality of the vista is of particular importance. It is also interesting to note that the natural elements that mostly concur to increase the price are water and grassland while the impact of a forest is much lower.

With reference to distance, the model estimated by Brander et al. (2011) through a meta–analysis suggests that the impact of UPs on house prices tends to reduce very quickly. Crompton (2005, p.216) maintains that, in general, despite the high variability of HP researches, "a positive impact of 20% on property value abutting or fronting a passive park area is a reasonable starting point guideline". However the impact is substantial up to 150-180 m. "In the case of community size parks it tended to extend out to 450 – 600 m but after 150-180 m the premium was very small" (Crompton, 2005, p. 216).

With reference to the size of the park, Poudyal et al. (2009) found that a 20% increase of the parks area in the city of Roanoke, Virginia could increase the residents consumer surplus by about $160 per family, that is $6.5 million for the whole community. Analyzing the data collected by McConnell and Walls (2005) it emerges that in a radius of 460 m from the park the average price increase is lower than 1.8%.

Cho et al. (2006), analysing the relationship between parks and house prices in Knox County (East Tennessee – USA), found that "the marginal implicit price of proximity to local parks (300 m closer) was estimated to be $172 […], but ranged from -$662 to $840 locally at an individual park level." (p. 504).

These data highlight that the effect of UPs can be very variable depending on the characteristics of the park itself and of the neighbourhood but in some cases its magnitude seems to be not negligible.

Stated preferences

Stated preferences approaches (and in particular CV) are probably the method applied most often in the past to evaluate the benefits produced by several categories of amenities. Despite the presence of a not negligible source of bias (Arrow et al., 1999), in the case of familiar goods (like UPs) the values obtained may be considered substantially reliable.

Several studies applied CV to evaluate UPs benefits (Chen and Jim, 2008; del Saz Salazar, 2007; del Saz Salazar and García Menéndez, 2008; Jim and Chen, 2006; Lo and Jim, 2010; Marone et al., 2010; Oueslati, et al. 2008; Tameko et al., 2011; Tempesta, 2010; Tyrväinen and Väänänen, 1998) while, to my knowledge, only two used a CE (Bullock, 2004; Vecchiato and Tempesta, 2013). The CV studies have been conducted to estimate the recreational value of existing parks (Del Saz Salazar and Rausell-Köster, 2008; Jim and Chen, 2006; Marone et al., 2010; Tempesta, 2009; Tyrväinen and Väänänen, 1998), the value of the improvement of an existing park (Oueslati et al., 2008; Tameko et al., 2011), the total value of a new or an existing park (Chen and Jim, 2008; Lo and Jim, 2010).

By means of CE, Bullock (2004) and Vecchiato and Tempesta (2013) analysed the total economic value of new recreational areas considering the presence of some elements (water, tree cover, etc.). CE are of particular interest since they permit not only to estimate the social economic value but also to find the best arrangement in terms of land use and presence of facilities.

Given the diversity of the studies it is almost impossible to draw any general conclusion about the value estimated by means of the stated preferences approach. However, with reference to the Italian experience,

table 1 summarizes the estimation of the recreational value of 6 parks in Florence (Marone et al., 2010) and 7 parks in the Veneto Region (Tempesta, 2010). As can be seen, the yearly benefits flow per hectare assumes very different values in both Florence and the Veneto Region. Furthermore, given that maintenance costs in Italy are about 0.8÷1.0 euro per m^2, in 4 parks out of 13 the recreational benefits are lower than the maintenance costs.

Other methods

Especially in the USA, there has been an attempt in recent years to evaluate the benefits generated by the UPs one by one. With this aim some authors tried to apply the STRATUM methodology originally proposed by the US Forest Service to estimate the total economic value of urban trees (McPherson and Simpson, 2002; Millward and Sabir, 2011). A large number of studies following a similar approach have been carried out by the Trust for Public Land - Center for City Park Excellence[2]. In general these approaches try to transform trees and/or other elements of park cover into a monetary value by defining a trade-off between the environment transformation and the costs saved by the community in terms of energy savings, atmospheric carbon dioxide reductions, air quality benefits, stormwater runoff reductions, aesthetics and other benefits (McPherson and Simpson, 2002). Unfortunately the coefficients utilized to transform the physical modifications of the urban environment into a monetary value sometimes seem not to be scientifically grounded. Moreover, since the aesthetic value is estimated by means of a simplified hedonic pricing approach an evident problem of double counting exists.

5 Conclusions

In the last years scholars have devoted a lot of attention to estimating the total economic value of UPs. As the literature analysis has shown, some not negligible drawbacks have emerged, so it can be stated that none of the existing approaches are free of limitations and bias. In the future it will be necessary to try to clarify what kind of benefits can be estimated using alternative approaches. Especially in the case of hedonic pricing there seems to be some degree of confusion over the real meaning of the estimation. Moreover it has to be considered that the attempt to put a monetary value on some social benefits produced by parks can be misleading. To submit an historical park to a cost benefit analysis is meaningless simply because the cultural heritage also belongs to future generations and the present one does not have the right to destroy or degrade it.

On the other hand, during recent years there has been a progressive improvement in the methodologies that has contributed to increasing the reliability of the evaluations. Despite the necessity to continue refining the methodologies, the past studies seem to indicate that the benefits generated by UPs, in many cases, largely overcome the costs. This knowledge is useful since it can favour the creation of new green areas and correct the market failures in the allocation of land between alternative uses.

Table 1 The recreational benefits of 13 Italian urban parks.

Park	Municipality	Surface (ha)	WTP (euro per visit)	Total WTP euro per ha per year
Villa Voegel	Florence	4.98	3.19	5,924.2
Villa Strozzi	Florence	8.70	4.31	12,165.9
Piazza Tasso	Florence	0.62	2.08	22,427.5
Borgo Allegri	Florence	0.19	4.25	8,145.8
Campo di Marte	Florence	2.60	3.23	9,415.3
Galluzzo	Florence	1.22	5.33	24,754.9
Castello S. Martino	Cervarese Santa Croce (PD)	1.88	1.49	1,535.0
Villa Bolasco	Castefranco Veneto (TV)	7.63	2.79	2,560.0
Manin	Montebelluna (TV)	3.20	1.40	14,427.0
Buzzaccarini	Monselice (PD)	3.24	0.90	2,781.0
Iris	Padova	6.50	1.12	18,748.0

[2] It is possible to download the research reports consulting this site: https://www.tpl.org/center-city-park-excellence.

Bosco di Pianura	Piove di Sacco (PD)	5.00	2.68	16,529.9
Villa Margherita	Treviso	6.50	2.03	14,354.3

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