Making Cities green. Understanding willingness to pay (WTP) for components of green spaces within urban communities: A Discrete Choice Experiment.

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Abstract
This paper explores how individuals value green spaces within urban communities, with the Covid-19 pandemic shifting preferences and global institutions highlighting the importance of urban green spaces in terms of biodiversity and their role in public health, it is both an increasingly stimulating and relevant topic. Urban green space is defined as an area of urban land covered by vegetation of any kind, irrespective of size or function, and may include bodies of water such as ponds ("blue spaces") or other urban infrastructure. Relying on foundations from Lancaster's Theory of Value and Random Utility Theory, a Discrete Choice Experiment (DCE) as a stated preference method made it possible to uncover individuals' Willingness to Pay (WTP) for components of urban green spaces. Analysing primary research in Stata, utilising the mixed logit regression model, revealed the respective WTP estimates for attributes of the urban green space, with results showing that individuals were willing to pay most for higher levels of biodiversity, to conclude the importance emphasised by existing literature.

Keywords:
Urban green space, Lancaster, Random Utility Theory (RUT), Discrete Choice Experiment (DCE), Willingness to Pay (WTP), Mixed logit regression model.

Introduction

The majority of modern economies are developing in their awareness of, and desire to understand, the influence and value of urban green spaces on people and the natural environment. Urban green space is an important component of urban infrastructure that serves as a health-promoting environment for residents of the city. Certain important characteristics are thus required in the construction of an urban green space and ensuring that local governments are aware of people's Willingness to Pay (WTP) for each should ensure that those areas are both easily accessible and equitably distributed within the urban setting. Many economies have made a conscious effort to become more environmentally friendly, most notably in metropolitan areas in recent years. In June 2019, London was designated as the World's First National Park City, demonstrating the importance of green spaces in urban 'ecosystems.' London, for example, has a long history of urban green areas, and it later became the world's first National Park City to further promote and exhibit a holistic support for a greener and healthier society, according to Leahy (2019). Singapore, portrayed by Wood et al. (2021), is another city to follow a similar initiative, illustrating how Singapore has adopted innovative types of green space to solidify its position as a global leader in urban sustainability. Green spaces provide an inherently valuable area that is relatively free of air and noise pollution in cities with high population density, as we see in London and Singapore, two of the world's most densely populated urban cities, emphasising their importance in these places where there exist negative externalities due to increased traffic of both people and vehicles. Urban green spaces that provide dedicated areas for activity, social interaction among community members, and much more are associated with healthier civilizations, implying that a green space is defined by a variety of features that become obviously relevant throughout. Gozalo et al. (2019) investigate the effect of the size of a green space on user satisfaction, claiming that their research fills a gap in the literature by examining the relationship between residents'

perceptions of park characteristics and uses (as a function of park size). The benefits associated with green spaces within urban communities are extensive, from enhancing individual wellbeing to providing areas of relatively clean air. Hence why as economists, we are interested in learning how people value the properties of these urban green spaces, which is the primary aim of this study. Individual factors determine the possibility of individuals being willing to pay for these vital urban green spaces, as a new normal emerges as a result of many people's lives changing due to the Covid-19 pandemic. By understanding the value placed on components of the urban green space, it can be displayed how these values are likely to fluctuate in the case of individuals having certain characteristics; characteristics that are likely altered by occurrences such as Covid-19 induced lockdowns. This paper therefore plans to, by way of Discrete Choice experiment, use economic theory to investigate exactly how individual choice around green spaces is influenced by the characteristics of that green space (assuming that it is within an urban framework).

The study will leverage current literature to motivate and provide a foundation for the research, apply economic theory to explain and create the appropriate method, then review the primary data recorded using the powerful statistical software Stata to reach solid conclusions. In the following section, you will be introduced to the background and motivation for addressing the issue, and how the external environment may well have been influential in shaping individuals' preferences. A thorough literature study will then be conducted to evaluate some of the existing academic literature relevant to the research into urban green spaces, demonstrating how this research will contribute to resolving challenges that local governments encounter when establishing new urban green spaces. Following that, the methodology and research design section will describe in depth how the research was conducted to demonstrate the coherent and valid approach taken, detail the experimental and statistical design of the research, state the

hypothetical choice setting employed, and reflect on any potential limitations presented. Further to this, both socio-demographic and empirical results will be presented in order to acquire a comprehensive view of the WTP for components of urban green spaces, closely followed by a discussion to evaluate said results and final conclusions.

Background

Recent years have witnessed the observable shift in the needs and preferences of individuals throughout the Covid-19 pandemic, where remote working became, and is persistently becoming, a new normal due to country-wide lockdowns resulting in many spending more time in and around their place of residence, particularly in urban cities such as London. In an article written for the Financial Times by Clark (2022) the term "The Great Resignation," coined by Anthony Klotz, portrays the significance of the pandemic on individual preferences. Prior to the pandemic, Klotz noticed that individuals arranged their life around work, but since it has been seen as the other way around, and with this shift in mindset many are utilising urban green spaces to receive the additional utility from doing so. While few have had the luxury of moving from urban to rural areas where green space is more readily available, many have not, revealing the importance of green space within the urban constituencies where the majority call home, being of rising importance. Global institutions note the importance of having access to green spaces, especially within urban regions. Modern life in urban cities is closely linked with heightened levels of stress and inadequate physical activity, hence why evidence exposing the benefits of parks, playgrounds, and other similar areas promoting mental and physical health provides reason for the necessity of introducing urban green space. An amplified demand for housing in recent years has left many living in high-rise buildings, making it even more challenging to have access to urban green space. Gifford (2007) in his review of literature, identifies how living in high-rise buildings is less satisfactory than other housing forms for

most, of course for several reasons, yet the inability to have access to a private garden or other urban green spaces is likely one key explanation. One potential solution could be the introduction of Community Gardens (CGs), as Chow *et. al.* (2020) notes the increasing recognition of benefits that these urban green spaces can provide to the neighbouring community. By way of example, CGs can deliver personal development, community cohesion, improved health, and environmental stability, but then once more it becomes a question of what characteristics (attributes) should go into said space, being the fundamental motivation behind research into the value of urban green space components.

Review of Literature and Theory

3.1. Systematic Literature Review

Urban green spaces have been the theme of research for several years, with papers and other publications in more recent years proclaiming their significance for diverse aspects of the natural environment. The United Nations' (UN) Department of Economic and Social Affairs set out 17 Sustainable Development Goals (SDGs) to accentuate how shifting toward a sustainable economy is of growing importance. The SDGs were adopted by the 193 UN countries in 2015 in attempt to tackle economic, environmental, and social impacts as a method of achieving clean growth by 2030. The United Nations (2018) Goal 11 is to make cities and human settlements inclusive, safe, resilient, and sustainable revealing just how important the introduction of urban green space is. More specifically, Goal 11.7 states that by 2030, [member states should] provide universal access to safe, inclusive, and accessible, green, and public spaces, in particular for women and children, older persons, and persons with disabilities. As affirmed by Sadler *et. al.* (2010) there also exists a plethora of papers that trumpet the value of urban green spaces as providers of benefits to both people and biodiversity, continuing to identify five means by which such spaces improve urban environment, most importantly by

shaping the character of the city and its neighbourhood – a key theme for this research. According to the UN, as of 2014, there was approximately 73% of the population of Europe living in urban areas, proposing that a large majority are impacted by green spaces within their place of residence, with Chen (2020) examining the role which urban infrastructure has on public health, discovering that it is of vital importance. Previous studies show how individuals appreciate the purpose of green spaces and being within nature itself (as implied by Chen in his work) producing beneficial effects which involve elements of relaxation and stress reduction – referred to by Wilson (1984) as the Biophilia effect. As asserted by Wilson in the 'Biophilia Hypothesis,' confirmed by empirically grounded evidence, humans are intrinsically drawn toward the natural environments, suggesting an inherited predisposition toward life in general – most noticeably, those with access to natural environments tend to recover faster from illness. The World Health Organisation (WHO) (2017) ascertain that living in urban areas undoubtedly limits access to nature and green spaces more generally, while increasing the likelihood of coming into contact with air and noise pollutants which further promotes the need for said spaces. Therefore, urban green spaces are more important than ever as individuals are drawn toward, and recognise the benefits of, having access to the spaces, as uncovered by the literature. Thus far, we have seen how current literature stresses the inherent, qualitative value of urban green spaces in terms of benefits to the natural environment and biodiversity, as well as humans and their health. Tzoulas and James (2004) cleverly link the ideas together, revealing how benefits to biodiversity from the subsequent introduction of urban green spaces, indirectly benefits human health and general well-being. Kondo *et. al.* (2018) later confirms through a systematic review of published literature, that there exists a consistent negative association between exposure to urban green space and issues such as mortality and violence, while additionally there exists a positive association with mood and physical activity. While Xu *et. al.* (2020) successfully uncovers the Willingness to Pay (WTP) for urban green space

conservation, there seems to be a current gap in literature that directly uncovers the WTP for the attributes of the urban green space themselves, motivating the investigation through this paper. By conducting a survey following a Contingent Valuation Method (CVM), the paper uncovers the public's WTP and works to evaluate the non-use value of the green spaces in urban cities, yet still there is no mention of valuing the green space itself in terms of its components. Albeit a great advantage that the CVM adopted acts as a flexible method of valuing more non-market goods than other indirect valuation methods, the limitations to stated preference (SP) methods are still present, whereby individuals do not have the incentives to make decisions with the same level of accuracy than they would in a market situation where preferences are revealed, and directly impact the individual making the choice. It is once again proven that individuals value having access to urban green spaces, as the survey itself conveyed that 56% of respondents would be willing to pay to conserve green spaces, and those that wouldn't believe it was the responsibility of the government to preserve and improve green spaces. This therefore links back to the necessity of urban green spaces, and the inherent value individuals place on these spaces, even before the shift in preferences and habits around urban green space due to the Covid-19 pandemic. This is seen to be summarised by Berman *et. al.* (2015) who compares the restorative effects of cognitive functioning of interactions with natural versus urban environments, finding that both the experiments carried out demonstrate the restorative value of nature, acting as a vehicle which improves cognitive functioning.

3.2. Lancaster's Theory of Value

Certain characteristics of urban green space, and green infrastructure more broadly, are said to aid the alleviating of stress by offering an environment that individuals can use for several functions that endorse physical and mental health. These characteristics are later defined by carefully constructed attributes and attribute levels to uncover individuals' WTP for the

components of an urban green space. The method adopted for the research is grounded by Random Utility Theory (RUT) and consistent with Lancaster's Theory of Value, hence why understanding both is crucial. Lancaster propositioned a substitute approach to the standard idea that goods are demanded in their entirety. Instead, Lancaster's Theory of Value argued a theoretical approach based on the notion that goods themselves possess characteristics that are demanded as opposed to the goods themselves. Especially in the case of non-market goods, this approach made significant advancements – for example in the case here, it is not the urban green space itself that is demanded, but the attributes of the urban green space, which is coherent with the idea that depending on the makeup of the green space, different benefits are delivered. Lancaster (1971) summarised this new approach by stating that the good, per se, does not give utility to the consumer, its characteristics give rise to utility with each one good possessing many characteristics, and many characteristics being shared by more than one good.

3.3. Random Utility Theory (RUT)

While the beginnings of probabilistic discrete choice modelling stems from Thurstone's (1927) work where some alternative is apparent with some error, McFadden with Random Utility Theory (RUT) provides the economic groundwork for evaluating the value placed on said alternatives. RUT, in line with neoclassical economic theory, relies on the supposition that each individual is a rational decision maker who acts in self-interest intending to maximise their own utility relative to the choice him or her can make. By acting rationally, RUT assumes that consumers decide on the alternative generating the greatest level of utility, a theory formalised by Manski (1977) and extended by McFadden (1980) identifying distinct foundations of randomness. Making such assumptions, RUT posits that individuals are able to choose between alternatives consisting of defined attribute levels (as demanded by consumers in Lancaster's Theory of Value above) and thus determine and make their best choice in terms of gains to

utility, repeated under duplicate situations as by Anderson *et. al.* (1991). Given that true utility itself, denoted by U_{in}, is an unobservable phenomenon for the alternative i for any individual n, utility becomes:

(3.3.1) $U_{in} = V_{in} + \varepsilon_{in}$

Where V_{in} reflects the explained component of utility which the research aims to uncover, and ε_{in} the random non-explainable component. RUT therefore theorises that while people generally choose the alternative that is most favourable to them, in a setting where they do not, this is due to random factors, defined as epsilon in the (true) utility function (*3.3.1*) above. This theory, together with Lancaster's Theory, will form the basis for the choice of method to begin valuing urban green spaces and their attributes as a form of green infrastructure, where observable utility, V_i, will be estimated so that true utility, U_i, can be defined and subsequent WTP estimates for attributes can also, combining RUT and Lancaster's Theory of Value.

Methodology and Research Design

4.1. Methodology

RUT and Lancaster's Theory of Value, explained in previous sections *3.2* and *3.3* respectively, are both fundamental to the choice of research method to provide necessary results to address and make solid conclusions on the issue. By striving to understand what goes into the perfect urban green space, it was identified that valuing the features of the non-market good could only be done by applying Lancaster's Theory of Value, exploiting the idea that goods possess certain characteristics that are demand by individuals. Together with the assumptions of RUT, it would be made it possible to henceforth value each attribute with a corresponding WTP by manipulating beta coefficients of the later estimated model. Through creating the Discrete

Choice Experiment (DCE) it was possible to achieve the goal of uncovering the value of urban green spaces, thus why the DCE is so powerful in understanding WTP for such goods that retain several attributes at differing levels. The DCE as a research method draws on Lancaster's Theory of Value which follows the same idea but extending beyond the neoclassical ideal of goods possessing characteristics in some fixed proportion. Due to the fact that an individual's preferences are expressed over the bundles of characteristics, and consumption (or use) of said goods is the pursuit of extracting a goods' characteristics, Lancaster's Theory is positioned well to suit the DCE. The research question is therefore set up in a way that via the use of the DCE, economic value could be tied to urban green spaces and amenities by their attributes. It is key to establish the most realistic hypothetical setting possible, as a stated preference (SP) method, to ameliorate any issues associated with respondents making decisions in a situation which does not impact their lives. The DCE itself relies on individuals making choices over the different hypothetical alternatives, thus depicting the importance of the hypothetical alternatives and hypothetical setting in general – the hypothetical setting will be defined in the '*4.2. Experimental design'* section, along with an example of a trade-off in alternatives faced by respondents. Of course, as with any research method, the DCE has its limitations, but ensuring careful experimental design and strategy allows for the most accurate and valid results for environmental valuation.

Microeconomic theory would typically consider an entire household as a decision-making unit, but for the sake of this paper it is not assumed that there is a representative agent within the household structure as there may be many differing choices within the one household. This is not such a prominent issue in the discrete choices being made in this experiment, however with minimal consideration for an appropriate in other DCE's, there is the potential for biased welfare estimates and potential erroneous policy predictions, that contain error. The DCE

satisfies the idea presented by Molin *et. al* (1996) that choices are assumed to reflect preferences (with individual preference simply being a function of choice) by providing respondents with alternatives entailing a bundle of attributes. Furthermore, this reflects the choices faced in everyday life by each person which is necessary when making the choice of research method, with preferences and choices being described as a lifetime phenomenon whereby individuals operate within the framework of making choices between many alternatives, consisting of different attributes and levels, whatever area they may be operating in. In line with Lancaster's theory of value, the DCE provides the ideal framework for setting up the answer to valuing these everyday attribute choices. The DCE is beneficial in the sense that it is one of many methods of unveiling state preferences (SP), having itself advantages over market data, where individuals' reveal preferences in the case of valuing something not valued in a market directly – being impossible to value or estimate the disparity in a specific attribute in revealed preference (RP) settings. Additionally, conducting a DCE is the simplest way to identify preferences and choices, making a low cognitive ability required to respond its greatest advantage, Louviere *et. al.* (2000) formalises this by stating that the degree of task complexity and difficulty arising from the experiment is minimal, making data collection relatively straight forward.

Sustaining that all attributes are fully known and objectively measurable is key behind the assumption that per unit of good, the amount of an attribute is stable irrespective of the amount consumed. Recall the RUT implies that unobservable utility is given by explained utility and some error term.

(4.1.1) $U_{i,n} = V_{i,n} + \varepsilon_{i,n}$

It then becomes possible (when redefining the explained component of utility, V_{in}) to form an estimating equation for true utility.

(4.1.2) $V_i = \beta x_i$

(4.1.3) $U_i = \beta x_i + \varepsilon_i$

Where x_i represents the attribute variables chosen by individual i when presented with the choice alternatives. Equation *(4.1.2)* effortlessly flows into *(4.1.3)* as the level of utility illustrated by the estimating equation made feasible by the DCE, again emphasising the assumption that individuals are rational utility maximisers, as stated by RUT. This is where the power of the DCE is once more evident, as estimating the equation permits WTP estimates to be curated with the inclusion of a cost attribute defined in latter sections. The experimental design will outline how attributes, including a cost attribute, were decided upon, and the statistical design will expand on the Marginal rates of Substitution (MRS) between two attributes to uncover WTP estimates. MRS signals the trade-off between two attributes that embody the good, found by comparing two attributes taking ratios of beta values once the model has been estimated. MRS is formalised by

(4.1.4) $MRS = -\frac{dx_{i1}}{dx_{i2}} = \frac{\beta_1}{\beta_2}$

When holding the total level of utility as a constant, which will be revisited when the estimating equation is introduced with the cost attribute – where β_{price} will transform the standard MRS approximation into an interpretable WTP estimate.

4.2. Experimental design – Research outline and hypothetical choice setting

Setting up the hypothetical situation is the key, whereby each respondent is asked to envisage they are making the choice between three candidates in a local election, something simple to understand for all, independent on their socio-demographic. Each candidate will only differ in one aspect – what they plan to incorporate in their green space – with there being no political stance defined to avoid any potential selection bias based on personal political opinions. Each space is to be comprised of attributes that will be set out below, where they are still able to choose their status quo (the candidate making no change) if they prefer the urban green space proposed by rival candidates. For efficiency in design, the space will be priced in terms of a tax increase (a local council tax), since it is a (local) public good provided by the candidate that wins the most votes. Attributes and levels are defined as follows:

Council tax change *– How much will council tax rise?*

- *+3%*
- *+6%*
- *+9%*

Accessibility *– Who can access the urban green space?*

- *Residents only*
- *Public good (Open to all)*

Distance *– How many minutes' walk is the space?*

- *5-minute walk*
- *10-minute walk*
- *20-minute walk*

Size *– How big is the urban green space relative to the number of people?*

- *Sufficient space for everyone to enjoy individual space in solitude*
- *Buzzy but not crowded*
- *Highly social / busy with little opportunity for individual space*

Maintenance *– How many times weekly will the urban green space be cleaned / maintained?*

- *Zero maintenance service*
- *Once weekly maintenance service*
- *Three times weekly maintenance service*

Biodiversity – *What vegetation, and natural resources will be promoted / introduced?*

- *Flower beds*
- *Flower beds + Woodland area*
- *Flower beds + Woodland area + Pond*

Infrastructure – *What infrastructure will be put in place in the urban green space?*

- *Paths*
- *Paths + Seating area*
- *Paths + Seating area + Space for physical activity*

Former surveys and pre-design research allowed for the most suitable and relevant attributes of urban green spaces to be defined for the DCE. A questionnaire survey directed by Lee *et. al.* (2015) set out to analyse and identify some key general characteristics of individuals' awareness of parks and alternative green spaces was incredibly relevant. Results suggested that one of the main reasons for visiting parks was for relaxation and walking, meaning the benefits are also respected by those individuals using the green spaces themselves. Additionally, parks offering relaxing environments close to natural rivers ("blue spaces") were desired, suggesting that what goes into the urban green spaces in terms of biodiversity and infrastructure to promote these feelings of relaxation, are of vital importance also. Those parks visited most frequently were described as pocket parks, suggesting that size matters, and were visited with such frequency because they were "closest to home," validating the attribute considering the distance to the urban green space. Their survey also reveals how maintenance of the green space was also inherently valued by the respondents, as those parks visited infrequently, were often done so due to poor overall management.

The DCE adopted was carefully pieced together in design and employed in such a way that allowed individuals' WTP for attributes of urban green spaces to be uncovered. The Choice Experiment (CE) was designed around a hypothetical setting which was set out to each respondent prior to making their choices. As urban green spaces are often provided and introduced into regions by local governments, the hypothetical situation asked respondents to envisage they were voting in a local election for candidates offering a new urban green space, provided at a cost of a council tax increase to model the most realistic decision possible. With the brief introduction of Psychologist Maslow (1943), his hierarchy of needs suggest that attributes that adhere towards specific needs of an individual provide different prospects, with certain attributes leaning towards the satisfaction of specific needs – aesthetic and safety being two central attributes here. Understanding what motivates agents' behaviour is intrinsically valuable in the context of introducing green amenities into a community, as it is necessary to answer the question at hand. Ensuring attribute levels are therefore thoughtfully constructed ensures that a significant trade-off can be made between choices, and an unbiased WTP estimator for each green space [attribute]. To ensure that respondents are guaranteed to understand the situation and the choice they are being asked to make, before sharing the google form survey via social media platforms to achieve a snowball sample of direct and indirect networks, the survey underwent extensive pre-testing, being piloted to selected individuals. Through piloting the study and gathering feedback to streamline the survey, no complications were faced when respondents were navigating through. The snowball sampling technique gathered responses from 100 unique individuals which provided the data necessary to discuss how individuals value the attributes of urban green spaces. ***'Figure 4.2.1'*** provides an example of the formalised hypothetical setting, which was [in the survey] followed closely by the fifteen choice cards. A choice card by way of example can also be found below, shown in ***'Figure 4.2.2.'***

Figure 4.2.1. The description of the hypothetical setting.

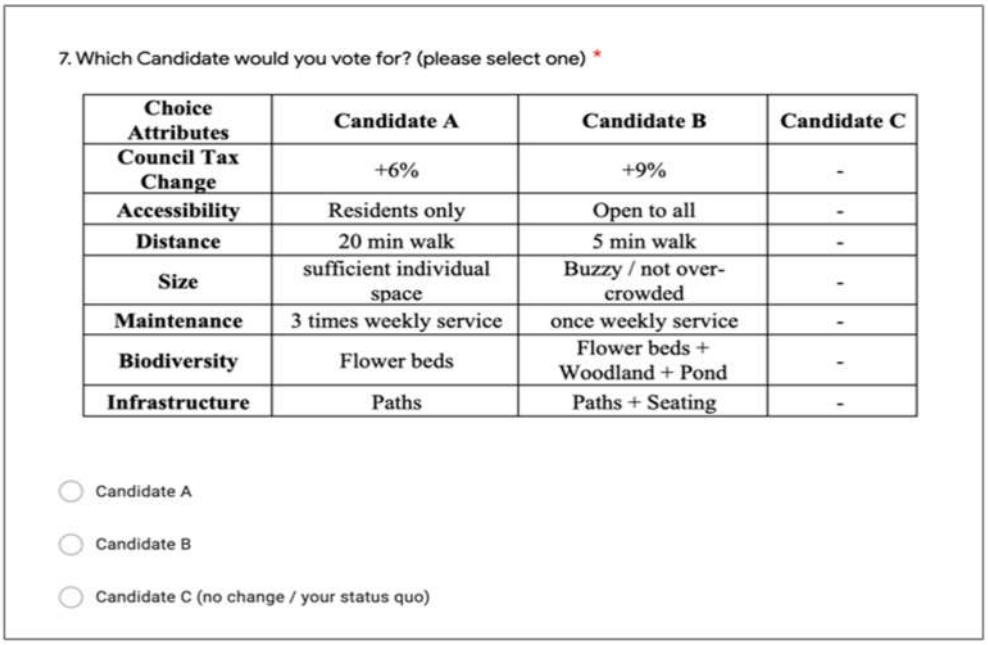
You will now be presented with 15 choice sets, and all you need to do is select your preferred urban green space based on the attributes defined.

Imagine there is an upcoming election, whereby you will be voting for one of three candidates, who only differ in what they will be offering in their new green space.

All else remains constant, with each candidate taking an identical, and neutral political stance to emphasise that the only factor influencing the decision should be the choice of urban green space.

Consider having to choose between candidates A, B, and C – A and B providing a new urban green space, and if you find that you like neither A nor B more than your current situation, please choose Candidate C, opting for your status quo.

Figure 4.2.2. Example of a choice card.



7. Which Candidate would you vote for? (please select one) *

Choice Attributes	Candidate A	Candidate B	Candidate C
Council Tax Change	+6%	+9%	-
Accessibility	Residents only	Open to all	-
Distance	20 min walk	5 min walk	-
Size	sufficient individual space	Buzzy / not over-crowded	-
Maintenance	3 times weekly service	once weekly service	-
Biodiversity	Flower beds	Flower beds + Woodland + Pond	-
Infrastructure	Paths	Paths + Seating	-

Candidate A

Candidate B

Candidate C (no change / your status quo)

The research paper written by Tiebout (1956) provides relevant insight into urban green spaces as a factor influencing movement to an area, suggesting that those who have the option to move, will consider a range of alternatives, and if the local community they currently live in is not providing the public goods they require, the extensive range of residential choices (together with the assumption of costless moving) assures that the individuals' choice of where to reside, reflects their preferences. He specifically links the idea of local public goods creating economic efficiency for this exact reason, as they will almost 'self-select' themselves into their chosen constituency, dependent on the amount of tax, enforced by local tax law (council tax), that they will be willing to pay for what is provided. A local public good is a public good restricted to those living in the local community, therefore making them non-excludable to those in the area only, and non-rival. I have adopted this view for when providing respondents with the option to have a residents only urban green space within their community, as this is essentially a local public good, financed by local taxation (the council tax increase). In the other case, we have a standard public good scenario whereby the free-rider problem once more becomes prevalent.

4.3. Statistical design

Having used pre-design research and former surveys to identify the set of attributes that would define each urban green space, including the number of unique attributes and the attribute levels, the unique choice sets could be produced for the DCE. Ensuring that all attributes and levels were incorporated to get a fully balanced design yielded 30 choice sets, split equally across two blocks of individuals. A blocking design allowed my data to integrate 30 different choice sets, each with two alternatives and a status quo, while only asking each respondent to respond to 15, avoiding a laborious experience which would likely cause response fatigue as the task becomes less and less manageable. The survey was blocked on whether the respondent was born on an odd or even day of the month, and results suggested a [relatively] even split – 52% and 48% for odd and even birthdays respectively. As mentioned, in each choice set there were three options, giving the option of choosing the respondent's status quo, whereby they preferred neither candidates A nor B offering a new green space. Alternative options were generated using the 'dcrete' function in Stata, created for efficient CE design, which when taken through a pilot study, successfully dropped any dominating choices.

Taking survey responses directly as they were answered (in wide form) meant the data needed to be manipulated in such a way that allowed it to be run through the statistical software, Stata, to create meaningful results. By making a choice, the respondent is deciding on the alternative which provides them with the highest level of utility and essentially rejecting the opposing two, so separating each choice set and creating binary dummy variables for the alternative chosen *(1=choice, 0=rejected)* meant that when matched with the attributes and levels, a logit model regression would show the relationship between urban green space attributes and utility gained. The model run then meant that the goal of the DCE could be successfully met, characterising

and referring to the random utility function whereby utility is described as a function of the attributes associated with the potential choices faced by respondents. Due to the fact that utility cannot be directly observed, to comprehend the model, the general form utility stated previously – *(4.1.1) and (4.1.3)* – must be formally defined to fit the model. The estimating equation, using the choice of given attributes to reveal true utility, is therefore given by.

(4.3.1)
$$U_{i,j} = \beta_{1,i,j}(price_{i,j} + \beta_{2,i,j} residentsonly + \beta_{3,i,j} distance + \beta_{4,i,j} maintenance + \beta_{5,i,j} buzzy + \beta_{6,i,j} overcrowded + \beta_{7,i,j} paths\_seating + \beta_{8,i,j} paths\_seating\_physicalactivity + \beta_{9,i,j} flowerbeds\_woodland + \beta_{10,i,j} flowerbeds\_woodland\_pond) + \varepsilon_{i,j}$$

As one of the attributes presented in the model is a cost attribute, the equation holds additional estimating power, as the MRS between the beta coefficients of an attribute and the price now signifies the Willingness to Pay (WTP) for the change in that qualitative attribute. This can also be called the Marginal Willingness to Pay (MWTP) as qualitative attributes change along with the price. From the equation defined in *(4.1.4)* for MRS, we can uncover the MWTP, given by the following identity.

(4.3.2)
$$MWTP_i = \frac{dx_i}{dU_{price}} = \frac{\beta_{xi}}{-\beta_{price}}$$

This therefore shows how the statistical work that has gone in to designing the model is on intrinsic value in the results of the DCE, accentuating the importance of having statistically significant coefficients from careful experimental and statistical design.

4.4. Limitations

There are, however, limitations to using DCEs despite their relevance and prominence in economic literature, especially when valuing non-market environmental goods by revealing WTP for attributes. While experimental and statistical design work to ameliorate any potential issues that could arise with the use of DCE, there are still research specific curbs. The likelihood of some issues surfacing can be (more simply than others) reduced. The hypothetical setting has the potential to limit the predictive power of the DCE, hence why it is important to be vigilant when setting up the hypothetical to avoid any problems or bias from arising. When describing the hypothetical setting, it was made clear that there was no political stance of the candidates, only differing in how they intend to develop their new urban green space to ameliorate any possible selection bias from creeping into responses. Issues may also ascend from the cost attribute if levels are defined in such a way that the increments do not provide sufficient trade-offs to be made. Of course, not every respondent will have the same idea of whether or not something is expensive, and therefore motivates the use of a council tax change as the cost attribute to measure the MWTP for attributes as the extent at which a council tax increase would be accepted for the new green space. By maintaining thought-out attributes, we have the capacity to provide respondents with a choice selection that is both realistic but eludes being too complex. Ensuring that said attributes are carefully pieced together further guarantees the most representative alternatives are being chosen, and the unanimous shifting of responses towards one choice is circumvented. To manoeuvre any additional limitations, respondents are also given the option, in each set of choices, of their status quo, or the candidate making zero change in terms of green space, if this is preferred to a new urban green space.

The DCE itself, while enormously relevant in the valuation of non-market environmental goods, still exhibits a certain limiting nature to the carrying out of the experiment. As noted in

a paper by Rakotonarivo *et. al* (2016) they still remain controversial because of their hypothetical nature. This once more highlights the necessity of defining the hypothetical situation, as this acts as a limiting factor to the DCE. They too, point out that the contested reliability and validity of results means that it is not infrequent for the DCE to overvalue goods relative to a non-hypothetical choice setting – in some cases by 50% to 100%. The hypothetical nature stems from being a SP method, which means that the DCE exercises limitations by not reflecting true market choices by individuals as would be the case in a RP setting. Respondents do not act with the same incentives that they would be seen to act with in a RP method where choices have real impacts on their lives. Even with a focus on consumer utility, if accurate utility weights were applied, choices could still be expected to differ when compared to a RP market situation, causing a so-called SP specific bias. Search costs provide a real-life example of an error term contribution that cannot be captured by the DCE, further suggesting that there may be absent attributes observed by the respondent, pushing these into the error term of the choice model. Being a SP method, this does however have its advantages. Representing a voting choice for candidate in a general election, if RP data were to be used (assuming the implemented urban green space was based on a majority vote), this may be susceptible to strategic voting, or no voting at all. If individuals believed that they could either shape the outcome of the voting, or had no real impact on the outcome, a RP method may not be able to tell the story of true preferences. While the method implemented is most useful for valuing goods that wouldn't otherwise be within the framework of a market, it is still important to be careful is designing the experiment to lessen the effects of limitations such method poses.

It is important to note that the 100 respondents cannot be blindly defined as representative of the population, due to the snowball sampling method applied. We can still however, make grounded conclusions about the model despite having its own feasible problems. The pre-

sample questions help us do so, identifying certain individual socio-demographic characteristics prior to recording the data necessary to uncover WTP estimates, such as age, or whether paying council tax currently has any impact on results, to mention and attempt to remove any demographic bias. The regression model designed by McFadden, used to analyse the findings from the survey, just like any other regression model, does not necessarily promise that coefficients (and hence WTP estimates) will be causal – they may instead just follow a correlation if they cannot be explained. The McFadden model is set up in such a way that results can be interpreted in terms of a stated random utility function, derived from the foundations of RUT. Inferring certain aspects of the utility function is therefore key, which means supplementary assumptions are added into the model which could potentially distort it further from reality, for example RUT relies heavy on the assumption that consumers are rational decision makers that maximise utility with every single decision they make.

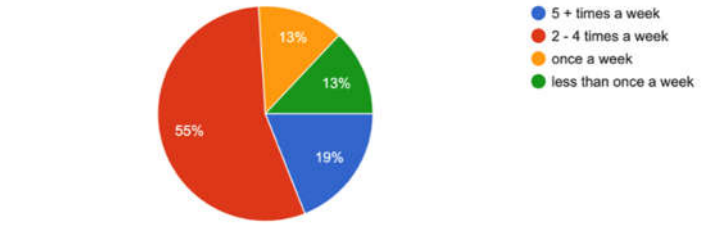
Although, as has been discussed, the use of DCE in a SP setting does have its problems, it proves to be of greatest value when comparing methods to value the specific attributes of urban green spaces which are not directly valued by the market. We also attempt to capture any thereafter benefits individuals assume to place on having access to green space within their urban community, as there are likely to be positive externalities associated with such. As has been seen, shocks over the course of an agents' lifetime effect their preferences and therefore their choices, with the DCE being the favourable method to unearth those stated preferences and subsequent value. Problems are inevitable when conducting primary research, such as the possibility of unobserved attributes that respondents do observe that collect in the error term as a result yet defining the hypothetical setting clearly and understanding the importance if key attributes minimises potential issues from surfacing, and meaningful results to be established.

Results

5.1. Demographics of survey respondents

It is often of benefit to include so called interaction variables in the utility function to control for person-specific variables. The inclusion of person-specific variables, or as they will be referred to in the estimating models, case-specific variables (*casevars*), allows for heterogeneity in preferences between subgroups to be tested for by considering how belonging to a certain socio-demographic may affect the likelihood of a specified outcome (*choice*). It is important to note the importance of survey demographics being that responses are likely not representative of the entire population, yet still despite this it is possible to obtain meaningful data that can be unpacked via the use of interaction terms to ensure any bias is noted when discussing results. These specific variables are the variables which do not vary over alternatives, but instead enter the model in such a way that creates differences in utility by their influence. It is made possible to see how subgroups respond differently by observing the way in which these personal characteristics interact with the attributes of the urban green space and choice.

Figure 5.1.1. Respondent urban green space use.



Parameters of the model directly are conditioned on two main socio-demographic characteristics established through pre-sample questions respondents were required to answer, however further demographics were taken to comprehend how reliable results were and how meticulously the hypothetical mirrored respondent's true situation. Certain pre-sample questions produced noteworthy results. After finding that all respondents have access to at least some form of urban green space, '***Figure 5.1.1***' below is especially interesting, displaying exactly what percentage of the 100 respondents make use of the urban green space they have access to, based on how many times per week they visit an urban green space (whether it be a public or private urban green space). Understanding the demographics allow us to make certain assumptions about our respondents as will form the main discussion, and directly link to discussing the empirical results produced by the model.

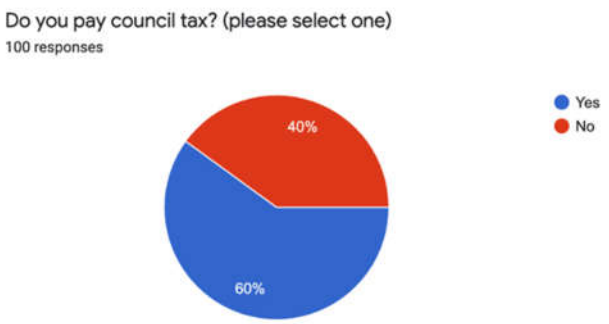
While we use some of the pre-sample questions work to understand how close to reality the hypothetical stated preference setting really is for respondents, it is also of concern how well respondents can comprehend the CE task. Prominently in the hypothetical choice setting at hand which uses a council tax increase as a cost attribute, the research will want to ensure there is limited bias in the model. Hence why '***Figure 5.1.2***' is so important to understand to which extent responses are likely to model tangible choices and reflect true preferences, as if they were to be revealed in a market setting. For example, and as will be discussed in later sections, those that do not pay council tax may not be able to grasp the real effects of an increase of the given amount in each choice presented as well, and thus underestimate the proposed percentage increase.

5.2. Empirical Results

Two principal models for discrete choices were adopted to analyse the choice data gathered, McFadden's choice model and a mixed logit choice model. McFadden's choice model assumes Independence of Irrelevant Alternatives (IIA) which is then dropped for the sake of the mixed logit model, providing an additional benefit of adopting said model. Albeit a starting point for unpacking results of the DCE, McFadden's choice model makes assumptions which possibly oversimplify the model. While the model itself provides great insight into the results of the CE, relaxing the IIA assumption makes the mixed logit model the favourable model for making thorough conclusions. The IIA assumption, in the case of the experiment whereby respondents make a choice of Candidate in a vote setting, is a condition that sustains the idea that the relative likelihood of choosing between alternatives A and B will remain constant if a third choice is offered.

Further explaining, where respondents are offered the choice between Candidates A, B, and C (C being the status quo) the IIA assumption would suggest that removing the respondents' status quo and only giving the choice of new urban green space offered by A or B, the choice would be the same as when the choice of status quo is included – otherwise the IIA assumption is said to be violated. However, the mixed logit model relaxes this assumption and does not infer those preferences toward the additional third choice is not irrelevant but actually affects individual choices.

Figure 5.1.2. Percentage of respondents paying council tax.



Case-specific variables, identified as socio-demographics from the previous subsection, were included in the model as those that do not vary across alternatives, because it is not believed that over the course of making choices these individual characteristics change, and can help identify any potential bias that may creep into results. Caution can therefore be taken when discussing coefficients of the model, and subsequent WTP estimates. In both the standard McFadden choice model, and the mixed logit model, it is interesting to see how certain case-specific variables defining the individual's characteristics effect the choice of opting for their status quo (alternative choice 3). The mixed logit model, dropping the IIA assumption, is especially relevant with the presence of case-specific variable, as these variables may help to explain the relationship between certain characteristics and the related choice of alternative. The Mixed logit model results can be found detailed below in '***Figure 5.2.1***' whereby WTP estimates are derived using the respective coefficients. This remains the key reason for

extending the model beyond the standard choice model without the insertion of case-specific variables in the mixed logit model results.

To then widen the scope of the DCE results further, the use of margins delivers some form of predictive power to the model, to make predictions going forward based on the sample data collected. Margins calculates predictions to the model fit from the mixed logit model previously defined. Predictions of concern provided by the 'margins' function in Stata are the probabilities of an alternative being chosen, with the overall predictive margin telling us how likely a choice is – alternative 3 is particularly meaningful being the choice of candidate making zero change (respondents' status quo) being favoured. Output from running margins on the

Figure 5.2.1. Mixed Logit Model results.

choice	Coefficient	Robust std. err.	z	P>|z|	[95% conf.	interval]
alt						
price	-.1810431	.0221718	-8.17	0.000	-.224499	-.1375872
residentsonly	-.2338218	.0916432	-2.55	0.011	-.4134392	-.0542044
distance	-.0293848	.0075435	-3.90	0.000	-.0441697	-.0145999
maintenance	.2807089	.0378579	7.41	0.000	.2065087	.3549091
buzzy	-.2357335	.0866228	-2.72	0.007	-.4055111	-.0659559
overcrowded	-.6107777	.128348	-4.76	0.000	-.8623352	-.3592203
paths_seating	.1191721	.0952008	1.25	0.211	-.0674181	.3057622
paths_seating_physicalactivity	.5735245	.0913435	6.28	0.000	.3944945	.7525545
flowerbeds_woodland	.2451771	.1004163	2.44	0.015	.0483647	.4419894
flowerbeds_woodland_pond	.7895165	.1147129	6.88	0.000	.5646834	1.01435
1						
3.weeklyuse	.0581968	.1434547	0.41	0.685	-.2229693	.3393628
wfh	-.1600704	.1271369	-1.26	0.208	-.4092541	.0891133
counciltax	-.1854488	.1367232	-1.36	0.175	-.4534215	.0825238
_cons	-.0134576	.1817357	-0.07	0.941	-.369653	.3427378
2	(base alternative)					
3						
3.weeklyuse	-.0806053	.2504724	-0.32	0.748	-.5715222	.4103116
wfh	-.4303454	.1804965	-2.38	0.017	-.784112	-.0765788
counciltax	.3928615	.2606759	1.51	0.132	-.1180538	.9037768
_cons	-.4160223	.3732756	-1.11	0.265	-1.147629	.3155844

mixed logit model provide the following results shown in '***Figure 5.2.2***' which are to be discussed in the following section.

Figure 5.2.2. Margins.

	Margin	Delta-method std. err.	z	P>|z|	[95% conf.	interval]
_outcome						
1	.322	.0151245	21.29	0.000	.2923565	.3516435
2	.3786667	.0156106	24.26	0.000	.3480705	.4092628
3	.2993333	.0239931	12.48	0.000	.2523077	.3463589

Discussion

Results from the pre-sample questions identifying socio-demographics of the sample, help us understand the respondents that little bit more so more holistic comments on the empirical results can be made thereafter. Every respondent can be seen to have access to at least some form of urban green space at the time of making choices, with the vast majority making use of the space(s) they have access to. None of the 100 respondents indicated that they had 'no urban green space within easy walking distance,' instead they either had one (or more) of the following within easy walking distance: private garden, shared green space, or local park. '***Figure 5.1.1***' clearly shows that over 85% of respondents visited an urban green space at least once a week, which is assumed to play a vital role in understanding urban green spaces and their inherent benefits. As the research shows, just 13% of respondents visit an urban green space less than once a week, and comfortably over half visit between two and four times weekly, suggesting that green spaces are of significant importance in the lives of all, helping ensure precise results. Green space is evidently imperative and plays a central function to the lives of those living within urban areas which insinuates that most respondents could comprehend the survey and respond in accordance as closely to when revealing their preferences. For similar reasons, '***Figure 5.1.2***' is equally notable to understand how easily understood the cost attribute is for respondents to comprehend. The importance of the cost attribute and potential problems with its inclusion has been spoke about beforehand, hence why

the research must certify that respondents have at least some understanding of it, especially in terms of a council tax here as not everyone has experience of paying this. It is however indicated from pre-sample results that the majority do in fact pay council tax and would therefore grasp the hypothetical cost in such a way that minimises the chance of overestimating the WTP values in the following model. Just 40% of responses came from those that do not currently pay council tax, which was used as a case-specific variable that remains constant over alternatives in the formalised mixed logit model found in '*5.2. Empirical Results*' section, to test the likelihood of making a specific selection based on having, or not having, these characteristics – in this case identifying how whether or not the individual pays council tax affects their choice selection (*counciltax=1if they do and counciltax=0 if they do not pay council tax*).

Though the demographics of the research are exceedingly important, the estimated models fit using the appropriate methodology as discussed help to tell the full story of interest. Firstly, it is important to note the results of margins of the model before deriving WTP estimates to make comment on the statistical likelihood of specific alternatives being chosen, especially alternative three which indicates respondent choosing Candidate C, their status quo. '***Figure 5.2.2***' displays the probabilities of each choice being selected by the respondents, allowing for assured statements to be made on findings. It can be expected, from the results, that just 30% (from margins result *0.2993333*) of the time would any respondent opt for their status quo, choosing alternative 3. Furthermore, the remaining 70% of the time there exists a choice which would be expected to gain more utility at a given cost, than remaining at the status quo with zero increase in an individual's council tax payment. Choosing Candidate C essentially means that no choice is preferred to what is already in place for the individual, and as assumed by RUT, this is the utility maximising option for the respondent. Together with the socio-

demographic information collected, having a sample whereby upwards of 80% have access to a local park within easy walking distance and 70% having their own private garden (many with both) we can be assured that all respondents have a sufficient level of understanding of the utility benefits provided from urban green space. These results therefore suggest that despite many currently having access to a green space within their urban community, there is still the belief that there is room for improvement. This further illustrates the importance of understanding the value and corresponding WTPs for the components of urban green spaces so that the changing needs of residents can be met in what is offered in such a space.

Outputs of the main estimating model disclosed in '***Figure 5.2.1***' provide the statistical results necessary to generate figures for the economic value of components. When testing at the 5% significance level the null hypothesis that some coefficient is equal to zero, against the alternative that the same coefficient is different from zero, we can gauge and make note on whether or not results are statistically significant. The hypotheses in the test for statistical significance can be formalised by:

(6.1) $H_0: \beta_{i,j} = 0,\ H_1: \beta_{i,j} \neq 0$

Using the values in the same '***Figure 5.2.1***' section where '*z-values*' and '*p-values*' for a two-tailed test of the null stated are readily available. The 5% significance level chosen to test against means we compare '*p-values*' (P>|z|) against the alpha set at 5% (0.05). Those coefficients with a '*p-value*' that is less that the alpha chosen for the two-tailed test can be argued as being statistically significant where the null hypothesis that the parameter is equal to zero can be rejected, and hence conclude that the coefficient is different from zero.at the 5% significance level, all coefficients other than the coefficient on the parameter '*paths_seating*'

which represents the infrastructure attribute at the second defined level where both paths and seating are included in the urban green space. A WTP approximation can still be calculated by following equation *(4.3.2)*, yet it may be more meaningful to look at the 95% confidence interval to make comment on the coefficient itself, and the effect it has on impacting a choice being made, while not dwelling on this as limited economic value can be uncovered via the coefficient alone which is the reason the DCE was adopted, instead just basic conclusions. While not statistically significant, research indicates that it can be said with 95% confidence (statistically) that the coefficient on paths_seating lies between the values [-.0.067, 0.306]. Estimated at 0.119, in conjunction with the 95% confidence interval, the coefficient can be predicted as very marginally positively impacting the choice being made, in comparison to the same attribute at the higher level ('*paths_seating_physicalactivity*' indicating the urban green space with the added component of a space for physical activity) which significantly impacts the likelihood of a choice, both statistically and in terms of the size of effect. As expected, when including a space for physical activity, respondents are more inclined to opt for that candidate. It can be said with conviction that, due to the statistical significance of the parameter on paths, seating, and a space for physical activity, respondents clearly share the opinions of prior academic work, and what this paper estimates to be the case. Infrastructure in the urban green space at the differing levels as discussed reveals the extent to which individuals assess the significance and inherent value of the physical and mental benefits that these spaces can have – several papers trumpet the value of physical activity within an urban green space. Specifically, Nalecz *et. al.* (2018) recognises that outdoor gyms are growing in popularity, with these 'green gyms' becoming very popular in many Chinese cities. The general results of the study conducted demonstrate that outdoor gyms are currently the most popular types of infrastructure in urban green areas which is confirmed by the results of the DCE. It is then crucial to obtain the economic value through the WTP formula to make comment on how much

individuals would be willing to pay for the stated component of green spaces within urban communities, and essentially answer the answer. From equation *(4.3.2)*, the WTP estimate for the attribute would therefore be:

(6.2) WTP for paths, seating, and a physical activity area $WTP_i = \frac{\beta_{8,i,j}}{-\beta_{price}} = \frac{0.5735243}{0.1810431} = 3.17$

Essentially, it can be stated that the WTP for the highest level of urban green space infrastructure – paths, seating, and a specific area for physical activity (such as an outdoor gym found in the green space) – is an additional 3.17% increase in council tax. Urban green infrastructure is therefore essential to individuals who will be paying for the space in terms of a rise in council tax.

The power of the DCE really lies here, where it is made possible to derive the WTP for individual attributes of urban green spaces, inferred as the additional council tax residents are willing to pay in the case of this paper. There are clear relationships uncovered for the attributes of the urban green space, as deciphered from the results of the mixed logit model found in '***Figure 5.2.1.***' Biodiversity, being a major provider of benefits to both people and the natural environment is another key attribute worth taking the time to understand how much individuals are willing to pay. While a candidate planning to introduce more biodiversity in an urban green space would undoubtedly be more likely to receive a vote, this alone is not enough to realise a corresponding WTP for specific forms of biodiversity within urban green spaces. Both the promise of flowerbeds and woodland; and flowerbeds, woodland, and a pond, have positive WTP estimates detailed in *(6.3)* and *(6.4)* below, as expected. However, the significant difference in the council tax increase individuals are willing to pay could be explained by the further introduction of pond as a "urban blue space," promoting an additional form of biodiversity.

(6.3) WTP for flowerbeds and woodland $WTP_i = \frac{\beta_{9,i,j}}{-\beta_{price}} = \frac{0.2451771}{0.1810431} = 1.35$

(6.4) WTP for flowerbeds, woodland, and a pond $WTP_i = \frac{\beta_{10,i,j}}{-\beta_{price}} = \frac{0.7895165}{0.1810431} = 4.36$

Biodiversity at the highest level in the model – including flowerbeds, woodland, and a pond – would be the component that ignites the highest WTP for individuals based on the results of the DCE. A further 4.36% in council tax would be paid for by residents to enjoy the gains in utility from biodiversity in this form, a substantial jump from when no pond is to be included in the space. This emphasises how the natural environment is becoming increasingly relevant to the lives of individuals, and they too value it higher.

With concerns around Covid-19 still being present in the lives of many, it goes without saying that an overcrowded urban green space would mean a large reduction in the amount an individual is willing to pay would be seen. In the ideal world, the urban green space would be sizeable enough that each person could enjoy in solitude, having sufficient individual space, however as the space becomes busier the amount of council tax extra willing to be paid would need to fall. The distance, in terms of minutes' walk away, that the urban green space is also plays a key role in the value placed on the space. For each additional minute walk away the space is situated, said space would be paid less for, formalised by the WTP estimate in (*6.5)*.

(6.5) WTP for distance $WTP_i = \frac{\beta_{3,i,j}}{-\beta_{price}} = \frac{-0.0293848}{0.1810431} = -0.16$

For a more holistic idea of the estimate above, for every 10 additional minutes-walk that the space is, respondents would be willing to pay around 1.6% less in terms of council tax. On the

flip side, it was discovered that some form of maintenance service weekly was necessary in the urban green space. This research confirmed findings of prior surveys which identified that individuals avoided certain urban green spaces due to improper management, hence why respondents would be willing to pay a positive amount for a maintenance service. The corresponding value of WTP is therefore defined in *(6.6)*.

(6.6) WTP for maintenance $WTP_i = \frac{\beta_{4,i,j}}{-\beta_{price}} = \frac{0.2807089}{0.1810431} = 1.6$

When making comment on the statistical significance of WTP estimates precaution must be taken, because while coefficients on the cost attribute (price) and on urban green space characteristics are statistically significant across the board, aside from '*paths_seating*' discussed above, this does not perfectly translate to statistically significant values of individual WTPs as may be expected. Assuming that the values constructed for the amount individuals are willing to pay are statistically significant because individually the coefficients are, is an assumption that cannot be made. Albeit the results meet criteria to be considered both valid and significant, the potential for distortion when dividing two coefficients cannot be overlooked when calculating WTPs. It is then worth noting that, while WTP estimates can be expected to be telling, they can't be assumed to be statistically significant at a particular level without additional tests.

Controlling for case-specific variables in the mixed logit model – '*weeklyuse*' '*wfh*' '*counciltax*,' indicating the number of times weekly that the respondent currently uses an urban green space, if the respondent works (or studies) from home, and whether or not the respondent pays council tax respectively – permitted further comment to be made about the choices individuals would expect to make given their characteristics that do not vary across alternatives, unlike attributes of the green space. Beforehand, the best guess would be that

individuals that use urban green space more frequently would be more inclined to appreciate the benefits and gain utility from a new urban green space, at the given cost. In the context of the model, it would be less likely for Candidate C to be chosen which equivalates to alternative 3. The coefficient on '*weeklyuse*' confirms this thought, indicating that the individual is less inclined to remain at their status quo if it is the case that they make greater use of urban green space currently. Being someone who uses an urban green space more often thus implies that a new space would provide heightened utility. Similarly, those that work from home are less drawn toward their status quo, with the most likely reason being that as individuals are spending more time in and around the home, they are more aware of the benefits provided by said spaces, hence why they now want more, and would be willing to pay an increased amount for these improved urban green spaces. We can statistically say that at the 5% significance level, that the coefficient on the '*wfh*' parameter is different from zero, and therefore has a statistically significant impact as a case-specific variable. The results of the mixed logit model controlled for the case-specific variables in '***Figure 5.2.1***' also suggest that whether or not a person pays council tax has an impact on whether or not that person is willing to pay for a new urban green space. Stata reveals that those paying council tax increases the chances of individuals option for their status quo, as was anticipated prior to running the model. While this does not suggest that results are inaccurate, it does hint that those that do not pay council tax may overvalue the urban green space due to the added characteristics required to fully understand the hypothetical setting. Essentially, those that pay council tax currently can relate to the hypothetical setting better and are greater inclined to opt for no additional cost in terms of a council tax increase because of this. The importance of inclosing case-specific variables is therefore evident, helping identify why certain results may occur and sound conclusions to be reached given that a sample perfectly representative of the population could not be acquired in the absence of supplementary costs.

Conclusion

All in all, green spaces in any area are incredibly important, yet as pre-empted at the beginning of the paper and becoming increasingly true as preferences are shifting, the importance of having access to green spaces within urban communities has an intrinsic value. Urban green spaces are important in terms of their benefits to the wider community, but on an individual level too as uncovered by through the experiment conducted. These benefits to the utility of individuals come at the cost of an increase in council tax in the research, uncovering the WTP for components of urban green space when it comes to an increase in council tax payment. The Discussion of results clearly supports the predictions made prior to research and confirms the consequences of preference shifts anticipated due to the Covid-19 pandemic. As more are working from home and having the time to make use of the green spaces within their urban communities they are more and more open to change with respect to new urban green spaces being introduced as opposed to their status quo, because there is more time to enjoy and reap the benefits. It was initially postulated how the constant changing of individual preferences has helped shift the general consensus toward urban green space, especially as the natural environment becomes central in the lives of many.

The results of the DCE and following mixed logit model tell the story best, with the appropriate model presented which successfully allowing for the WTP for urban green space components to be unveiled, and the ideal green space to be constructed. Due to the importance of urban green space as a promoter of health benefits when providing a satisfactory area for physical activity, having some form of outdoor gym is increasingly necessary, as well as individuals being willing to pay upwards of an additional 3% in council tax for said area with paths, seating, and an area for physical activity. It can also be concluded, and backed by the WTP for the

component, that biodiversity at an increased level is crucial for an urban green space. Fostering biodiversity in the urban green space is clearly important to individuals living in urban communities, having the largest WTP estimate, hence why flowerbeds, woodland, and a small body of water in the form of a pond would collate the ideal green space. The ideal example of an urban green space can be assumed by the results of the DCE as having some element of maintenance to ensure that those using, and considering using, the space can be confident it is managed correctly. Those making most use of the urban green space and gaining the most utility can be said to be those that have access to the widest range of urban green space that is easily reachable. As a non-physical component of the ideal urban green space then, the distance to the space is important. In regard to the distance to, it can be said that as long as the space lies within 10-mnutes walk, individuals would not lose utility to a point where the added benefits from increasing levels of those physical components – biodiversity and infrastructure.

Similar to literature in the past, this paper does note the continued importance of urban green spaces, adding to this by identifying how recent global events have further shifted the preferences, and therefore values placed on said space, to make informed presumptions about how these spaces can be adapted and financed going forward. The situation with the Covid-19 pandemic is both ongoing and still causing uncertainty within economies and therefore individuals (and their decisions) worldwide, but the findings presented shed light on the importance of urban green spaces to individuals, using past research to highlight the importance of certain components – such as biodiversity as by Sadler *et. al.* (2010). As economies around the globe continue to transition toward being more and more green, it may be important to move beyond the scope of this model to capture supplementary trends on more than just a community level, which is one potential avenue to extending the current research topic.

Bibliography

Anderson *et. al.* (1991). *Simon P. Anderson, Andre de Palma, Jacques-Francois Thisse. Discrete Choice Theory of Product Differentiation, The MIT Press, Cambridge.*

Berman *et. al.* (2015). *Marc G. Berman, John Jonides, Stephen Kaplan. Research report: The Cognitive Benefits of Interacting with Nature. Association for Psychological Science, Vol. 19, No. 12, pp. 1207-1212).*

Chen (2020). *Xianwen Chen. Monetary Valuation of urban nature's health effects: a systematic review. Journal of Environmental Planning and Management, Vol 63 No. 10, 2020, pp. 1716-1737.*

Chow *et. al.* (2020). *Erica Chow, Bess Biscocho, Kaylinda Tran, Chaya Prasad. The Socioeconomic and Health Impacts of Community Gardens. Available online at: https://pnwmsrj.org/meta-analysis/2020/10/the-socioeconomic-and-health-impacts-of-community-gardens/.*

Clark (2022). *Pilita Clark. The Man who predicted The Great Resignation has more big news. Available online at: https://www.ft.com/content/3e561d41-0267-4d40-9c30-01e62fa9c10f.*

Gifford (2007). *Robert Gifford. The Consequences of Living in High-Rise Buildings. Architectural Science Review, Vol. 50, pp. 1-16.*

Gozalo *et. al.* (2019). *Guillermo Rey Gozalo, Juan Miguel Barrigon, Morillas David Montes Gonzalez. Perceptions and use of urban green spaces on the basis of size. Urban Forestry & Urban Greening, Vol. 46, pp. 1-10.*

Kondo *et. al.* (2018). *Michelle C. Kondo, Jaime M. Fluehr, Thomas McKeon, Charles C. Branas. Urban Green Space and its impact on Human Health. International Journal of Environmental Research and Public Health, 15, 445.*

Lancaster (1971). *Kelvin J. Lancaster. A New Approach to Consumer Theory. Journal of Political Economy Vol. 74, No. 2, pp. 132-157.*

Leahy (2019). *Stephen Leahy. London becomes world's first 'National Park City.' What does that mean? National Geographic. Available online at: https://www.nationalgeographic.co.uk/environment-and-conservation/2019/07/london-becomes-worlds-first-national-park-city-what-does-mean.*

Lee *et. al.* (2015). *Young-Chang Lee, Keun-Ho Kim. Attitude of Citizens towards Urban Parks and Green Spaces for Urban Sustainability: The Case of Gyeongsan City, Republic of Korea. Sustainability, Vol. 7, pp. 8240-8254.*

Louviere *et. al.* (2000). *Jordan Louviere, David A. Hensher, Joffre D. Swait. Stated Choice Methods: Analysis and Applications. Cambridge University Press.*

Manski (1977). *Charles F. Manski. The Structure of Random Utility Models. Theory and Decision, Vol. 8, Issue. 3, pp. 229-254.*

Maslow (1943). *Abraham H. Maslow. A Theory of Human Motivation. Psychological Review, Vol. 50, pp. 370-396.*

McFadden (1980). *Daniel McFadden. Models for Probabilistic Choice Among Products. The Journal of Business, Vol. 53, No. 3, Part 2: Interfaces Between Marketing and Economics, pp. S13-S29.*

Molin *et. al.* (1996). *Eric Molin, Harmen Oppewal, Harry Timmermans. Predicting consumer response to new housing: a stated choice. Journal of housing and the built environment, Vol. 11, No. 3, pp. 297-311.*

Nalecz et. al. (2018). *Hanna Nalecz, Anna Ostrowska-Tryzno, Anna Pawlikowska-Piechotka. Outdoor gyms as an example of outdoor recreation activity in urbanized areas. Tourism, Vol. 28, Issue. 1, pp. 65-71.*

Rakotonarivo *et. al* (2016). *Sarobidy Rakotonarivo, Mariie Schaafsma, Neal Hockley. A systematic review of the reliability and validity of discrete choice experiments in valuing non-market environmental goods. Journal of Environmental Management, Vol. 183, pp. 98-109.*

Sadler *et. al.* (2010). *Jon Sadler, Adam Bates, James Hale, Philip James. Bringing cities alive: the importance of urban green spaces for people and biodiversity. Urban Ecology by Cambridge University Press, British Ecological Society, 2010, pp. 230-260*

The United Nations (2018). *Goal 11. Department of Economic and Social Affairs, Sustainable Development. Available online at: https://sdgs.un.org/goals/goal11.*

The World Health Organisation (2017). *Regional Office for Europe. Urban green spaces: a brief for action.* Available online at: https://www.euro.who.int/_data/assets/pdf_file/0010/342289/Urban-Green-Spaces_EN_WHO_web3.pdf%3Fua=1.

Thurstone (1927). *Louis L. Thurstone. A Law of Comparative Judgement, Psychological Review, Vol. 101, No. 2, pp.266-270.*

Tiebout (1956) *Charles M. Tiebout. A Pure Theory of Local Expenditures. The Journal of Political Economy. The University of Chicago Press. Vol. 64, No. 5, 1956, pp. 416-424.*

Tzoulas and James (2014). K*onstantinos Tzoulas, Philip James. Finding links between urban biodiversity and human health and well-being. Research Institute for the Built & Human Environment, School of Environment & Life Sciences, University of Salford, pp. 208-217.*

Wilson (1984). *Edward W*ilson. *Biophilia. Cambridge, Harvard University Press.*

Wood *et. al.* (2021). *Andrew Wood, Anikait Bhardwaj, Cameron Seltzer, Warren Su. Green space in Singapore. Available online at: https://storymaps.arcgis.com/stories/aad59652543445cbb941b13b0b9c35d7.*

Xu *et. al.* (2020). *Feng Xu, Yating Wangam, Nan Xiangh, Jinping Tianc, Luiun Chen. Uncovering the willingness-to-pay for urban green space conservation: A survey of the capital area in China. Resources, Conservation & Recycling, 162, pp. 1-9.*