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Using Contingent Valuation to Estimate a Neighbourhood's Willingness to Pay to Preserve Undeveloped Urban Land

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Summary. Contingent valuation (CV) is used to estimate a neighbourhood's willingness to pay (WTP) to preserve a 5.5-acre parcel of undeveloped land in Boulder, Colorado, that provides views, open space and wildlife habitat. Households were surveyed to determine bounds on their WTP for preservation. An interval model is developed to estimate sample WTP as a function of distance, income and other characteristics. The model accommodates individuals who might be made better off by development and addresses the accumulation of WTP responses at zero. Weighted sample WTP estimates are aggregated to obtain the neighbourhood's WTP. This application demonstrates that contingent valuation is a flexible policy tool for land managers and community groups wanting to estimate WTP to preserve undeveloped urban land.

1. Introduction

The combination of abundant open space and other natural amenities with urban amenities is motivating the rapid growth of many medium-sized cities in the western US. However, the congestion and development brought by this growth reduces access to and services from natural amenities. Such growth concerns have led several cities such as Eugene (Oregon) and Boulder (Colorado) to initiate programmes to restrict development and expansion in an effort to maximise the well-being of citizens. For example, the Boulder City and County Comprehensive Plan preserves virgin county land by supporting infill within the city limits and slow expansion of the city boundaries.[1] Pressures to develop unused portions of land within or near city limits, especially on the edges of the city, create tension at the local level when neighbourhoods have strong preferences to preserve their scarce remaining open space and natural areas. Our intent is to estimate the neighbourhood's willingness to pay (WTP) for preservation.

We propose the use of contingent valuation (CV) as a method to estimate WTP. Put simply, contingent valuation estimates individuals' WTP for some policy, such as a change in environmental amenities, using survey questions that elicit information on

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how much each sampled individual would be willing to pay to have the policy implemented.[2] To demonstrate, we use CV to value the preservation of the Cunningham property, a small, undeveloped lot in Boulder. The preservation values estimated by CV include both values in active use ('use values') and values in passive use ('passive use values').

By definition, use values from a site-specific resource such as the Cunningham property can be obtained only if one is at or near the site. For example, obtaining use benefits from a mountain requires that one be at or near the mountain. Obtaining the use benefits from hiking requires that one be on site. Enjoying scenic views of the mountain constitutes a use benefit that requires either a trip to the mountain or a residence near it. One does not need to deplete the resource to enjoy use benefits, although some activities such as hunting do use up the resource. Passive use values are those values that one can obtain from a resource without being at or near the resource. For example, the pleasure one gets from knowing that fish live in a quality habitat does not require one to visit the stream.

If a property is preserved, households may have either increased or decreased use benefits because of better or worse views, changes in recreational opportunities and so forth. Additionally, households can experience increased or decreased passive use benefits, such as the contentment associated with knowing that wildlife habitat is being preserved. Use values have the potential to be capitalised into land prices, wage rates or both (see, for example, Roback, 1982; Blomquist *et al.*, 1988; and Graves and Waldman, 1991). Passive use values cannot be capitalised into property values or rents because individuals can realise them without residing near the property.

Contingent valuation is not presented as a replacement for a hedonic property value study to estimate the impact of natural amenities on property values. It is well documented that residential property values are influenced by proximity to site-specific amenities and disamenities. For example, property values are influenced by proximity to undeveloped coastline (Dale-Johnson and Yim, 1990; Frech and Lafferty, 1984), retail sites and highways (Waddell *et al.*, 1993), traffic (Asabere, 1990), clean air (Harrison and Rubinfeld, 1978) and open space (Correll *et al.*, 1978). See also Linneman (1981). A negative effect of development on nearby property values could be a significant reason why property owners would be willing to pay to preserve undeveloped urban land, and hedonic studies can be used to quantify this effect.[3] However, WTP for preservation does not necessarily equal the expected impact that preservation will have on the value of other property. If WTP for preservation is due in part to passive use motives, a hedonic property value study can provide values that are significantly more or less than WTP for preservation. Of course, many individuals may have both use values and passive use values that are positive, which is likely to be the case in our study. If passive use values are positive, a hedonic property value study would underestimate total WTP for preservation.

Even when it is expected that preservation will not affect wage rates (which is true for this study) and that most of the value of preservation is use value, measurement of preservation benefits using a hedonic property value technique is difficult. Complications include disequilibrium in the real estate market, the role that expectations play in determining when the benefits of preservation are capitalised into land prices, and the difficulties associated with factoring out other influences.

While we do not use hedonics explicitly to estimate the impact of the proposed Cunningham development on property values, Correll *et al.* (1978) found that distance to official open space, or 'greenbelt', has a significant effect on property values in Boulder. Assuming that prior to development, the Cunningham property was viewed as equivalent to official open space, and taking into account that the Cunningham property is the closest access to open space for approxi-

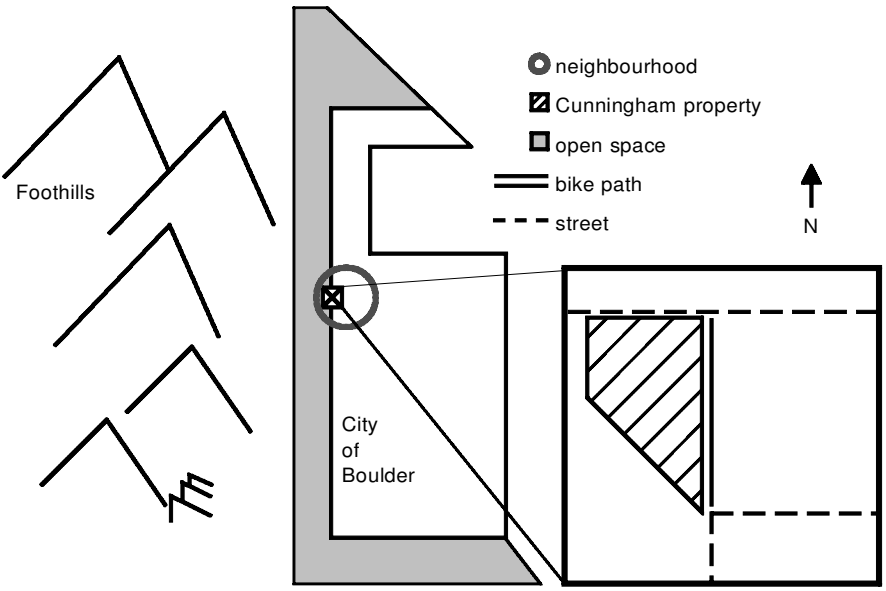

Figure 1. The Cunningham property and Boulder, Colorado.

mately 200 households, the reduction in property values suggested by their rent gradient is in the range of $500 000 to $1.5 million, depending on the specific assumptions adopted.

2. The Cunningham Property and Coalition

The Cunningham property is a 5.5-acre parcel of land that lies on the north-western edge of Boulder, a mid-sized city bounded by mountains on the west and prairie on the east (see Figure 1). In its undeveloped state, including an old, abandoned house and a few fruit trees, the property provides wildlife habitat, views of the mountains to the west, and access to designated open space. The property's northern boundary is an important east–west road that provides access to Boulder for many mountain residents, but the neighbourhood to the east and south of the property is currently buffered from this traffic because there is no northern access for traffic near the property. The single northern outlet from this neighbourhood is a popular bike path.

A construction company purchased the land in 1991 for $600 000 and hoped to build a luxury-home sub-division. A north-south street on the eastern boundary of the property would have been constructed to provide access. In addition to increasing traffic from the additional homes, this street would have eliminated the bike path and created a new route from the mountains to downtown Boulder. For many reasons, the development would have been possible only if the city annexed the land.

A neighbourhood group called the Cunningham Coalition formed to lobby against the proposed development and to raise donations to allow the City's Open Space Program to purchase and preserve the property. The Cunningham Coalition's periodic newsletter solicited donations and described the property and the status of the proposed development plan. One of the newsletters included a pledge card on which one could pledge a cash contribution to the direct purchase of the property or indicate a willingness to pay additional property taxes to purchase the property via a special tax district. The newsletter of 9 January 1992, noted

that $98 600 had been pledged by approximately 130 households in the north Boulder area.

3. Sample and Survey

We restricted our investigation to residents of the City of Boulder who live within one mile of the Cunningham property, hereafter 'the neighbourhood'.[4] The neighbourhood can be envisioned as a pie with the Cunningham property at the centre and the western quarter-slice removed. We estimated that there were 2561 city residences within one mile of the property. An in-person CV survey was administered in 1991 to 75 households, and 72 complete interviews were obtained. Arrow *et al.* (1993), the "Blue Ribbon Panel", recommended in-person interviews as preferable to mail or telephone surveys to elicit contingent values. The survey is presented in the Appendix.

The sampling scheme was designed to obtain a representative sample of city households within one mile of the property. The sampling area was divided into 10 one-tenth-mile-wide bands: the first was 0–0.1 miles from the property, and the outermost was 0.9–1.0 miles from the property. There are 12 residences in the innermost band and 435 in the outermost. The number of households targeted in each band was proportional to the total number of households in the band. Target households were chosen randomly, and interviews varied by time of day and day of week. If no one was at home on the first attempt, the residence was revisited on a different day at a different time. If the individual contacted did not want to be interviewed at the time of first contact, the interviewer attempted to schedule a more convenient time. No residence was visited more than twice.

The response rate for those households successfully contacted with two visits was almost 100 per cent; there was a high level of interest in the neighbourhood about the Cunningham property. Comments indicated that many of those contacted appreciated that the interviewers did not represent the coalition, the city or the developer. The overall response rate was 63 per cent; two visits were not sufficient to contact the rest of the households. A 63 per cent response rate is in the range of many CV studies.[5] Sample selection bias is always a concern with CV studies. For example, households indifferent to the scenario (those with $0 WTP) might be less inclined to be interviewed. Therefore, if a significant proportion of the households contacted refused to be interviewed, attempts should be made to determine why and the results used to model sample selection. In our case, the fact that the response rate among those contacted was effectively 100 per cent indicates that households were not selecting out of the survey on the basis of their WTP.

The percentages of households in the neighbourhood and sample are presented by band in Table 1. Only one household was sampled in the innermost band. Average neighbourhood WTP is calculated as a weighted average of the WTP estimates for the sample households in the next section, where the weights correct for misrepresentation by distance band.

We have no independent estimate of income for the neighbourhood. Percentages of the sample in three income categories are reported in Table 2, and these show that the neighbourhood is relatively affluent. We have no reason to believe that our sample is unrepresentative in terms of income. However, income data by category from the 1990

Table 1. Percentage of households at varying distances from the Cunningham property

Distance (miles)	Sample	Neighbourhood
0.1	1.4	0.5
0.2	2.8	2.5
0.3	5.6	5.3
0.4	5.6	7.2
0.5	8.5	11.1
0.6	11.3	13.1
0.7	14.1	14.3
0.8	15.5	12.7
0.9	15.5	16.5
1.0	19.7	17.0

Table 2. Income distribution for the sample and surrounding ZIP code

Annual income category ($)	Sample (percentage)	ZIP code 80304 (percentage)
Less than 35 000	25.4	47.3
35 000–65 000	35.2	25.4
More than 65 000	39.4	27.3

US Census is also presented in Table 2 for ZIP code 80304, of which the neighbourhood is only a very small component. We do not believe that income statistics for the broader ZIP code should be the basis to gauge the representativeness of the sample in terms of income, because the neighbourhood is more affluent than the rest of the ZIP code. Looking ahead, we feel that the best estimate of neighbourhood WTP is that which weights the sample WTP in terms of distance, but makes no adjustment for income distribution. However, as a conservative estimate of neighbourhod WTP, we also report an estimate that is weighted for both distance and income.

The survey asks the respondent in two separate questions (12 and 13) to state whether she would pay each of an ascending or descending sequence of specific amounts as a one-time payment to preserve all undeveloped land within one mile of Boulder, and to preserve the Cunningham property.[6] To test for potential starting-point bias, we started half of our inquiries for these questions at the top of the range (descending values) and half at the bottom (ascending values). We could not reject the null hypothesis of no starting-point bias. While we are not directly concerned with the answer to Question 12, it was included in an effort to help make clear the distinction between the Cunningham property and other undeveloped land. Kahneman and Knetsch (1992) have provided strong evidence of 'embedding', which is the tendency to value a scenario that is more encompassing than the one presented.

In all CV studies, there is a potential for strategic bias, and a concern is that this will cause households to overstate their WTP. Some respondents might overstate their WTP, hoping to influence a City Council decision, if those respondents thought they would never have to pay. However, the Cunningham Coalition had clear intentions to try to raise the money needed to purchase the property. If respondents thought the Coalition would actually try to collect reported WTP bids, some respondents might instead understate their true values in order to free-ride on others' contributions. (In fact, many of the pledges to the Coalition were substantially larger than comparable WTP values estimated using the CV data.) We made clear that we did not represent any advocacy group that stood to gain or lose from development.

Our survey does not produce a specific estimate of the household's maximum willingness to pay to preserve the Cunningham property, but rather places upper and lower bounds on willingness to pay. For an ascending survey, suppose the individual said yes to $100 but no to $125; $100 is a lower bound on that household's WTP, and $125 is an upper bound. If we were to conduct another Cunningham survey, we would first ask whether the development scenario described would make the household better or worse-off, and then ask Question 13 only of those individuals who indicated that development would make their household worse-off.[7] Knowing whether the household would be better or worse-off would provide a strong validity check on zero bids. A respondent might have a negative WTP if he or she believes that the Cunningham property is an eyesore because of the presence of the abandoned, rundown house, that jobs and increased economic activity are desirable for

Boulder, or that inhibiting growth and development is unethical and élitist. WTP might also be negative for a respondent who believes that homes built on the property would be more expensive than the average home in the neighbourhood and would raise property values. Knowing whether zero bids are true zeros or truncations of negative values is important for modelling purposes and the estimation of WTP values, as discussed in the next section.

WTP questions about other development scenarios for the site might also have been included. We did not anticipate how the developer's proposal would evolve over time, so we asked only about the proposal that was current at the time of the survey (i.e. nine houses and the creation of a north–south connecting street, which would increase traffic and eliminate the bike path). Because the potential connecting street, with its resulting increase in traffic, was the primary negative feature of the development for many, we might have asked those who reported a positive WTP how much their WTP would decrease if the development did not include the street connection.[8]

4. Estimation of WTP

An interval model is used to estimate household WTP as a function of distance, income and other characteristics.[9] The model accommodates individuals who might be made better-off by development (negative WTP) and addresses the accumulation of refusal responses at the lowest possible bid, \$5. Individuals who stated they would not pay \$5 for preservation (the lowest amount in our survey) indicated that their WTP is less than \$5; there is a possibility that these households would benefit from development.

We hypothesise that respondent i's WTP, WTP_i, lies between a lower bound (WTP_{Li}) equal to the highest amount to which he or she responded yes and an upper bound (WTP_{Ui}) equal to the lowest amount to which he or she responded no. Assume that expected WTP for respondent i, $E(WTP_i)$, is a function of the respondent's household characteristics:

$$\begin{aligned} WTP_i &= E(WTP_i) + \varepsilon_i \\ &= \beta_0 + \beta_1\ DIST_i + \beta_2\ DIST_i^2 \\ &\quad + \beta_3\ HINC1_i + \beta_4\ HINC2_i \\ &\quad + \beta_5\ PRSVLAND_i + \varepsilon_i \end{aligned} \tag{1}$$

where *DIST* is the distance to the property in tenths of a mile, *HINC1* equals one if household income is between \$35 000 and \$65 000 and zero otherwise, *HINC2* equals one if household income is greater than \$65 000 and zero otherwise, and *PRSVLAND* is the response to Question 2 on the importance of preserving land (where 1 is not at all important and 7 is very important). The random term, ε_i, is distributed normally with mean 0 and standard deviation $\sigma_i = \alpha_0 + \alpha_1 DIST_i + \alpha_2 HINC1_i + \alpha_3 HINC2_i$ This specification of σ_i allows the variance on WTP to vary in a systematic way as a function of distance and income to correct for heteroscedasticity.

The probability that WTP_i lies between WTP_{Li} and WTP_{Ui} is:

$$\begin{aligned} &\text{Prob}(WTP_{Li} < WTP_i < WTP_{Ui}) \\ &\quad = \text{Prob}(WTP_i < WTP_{Ui}) \\ &\qquad - \text{Prob}(WTP_i < WTP_{Li}) \\ &\quad = \Phi\left(\frac{WTP_{Ui} - E(WTP_i)}{\sigma_i}\right) \\ &\qquad - \Phi\left(\frac{WTP_{Li} - E(WTP_i)}{\sigma_i}\right) \end{aligned} \tag{2}$$

where Φ is the standard normal cumulative distribution function. The maximum likelihood programme in the computer package Gauss (Aptech Systems, Inc., 1995) was used to find the values of the parameters that maximise the log of the likelihood function.[10]

$$\begin{aligned} \text{Log } L = \sum_{i=1}^{71} \log\Big[&\Phi\left(\frac{WTP_{Ui} - E(WTP_i)}{\sigma_i}\right) \\ &- \Phi\left(\frac{WTP_{Li} - E(WTP_i)}{\sigma_i}\right)\Big] \end{aligned} \tag{3}$$

Likelihood ratio tests indicate that distance, income and *PRSVLAND* are all significant determinants of WTP. No other variables were found to be significant, but others may

Table 3. Interval-model parameter estimates

	Estimated coefficient	*t*-statistic
WTP parameters		
Intercept (β_0)	896.96	1.74
DIST (β_1)	− 2 407.66	− 1.98
DIST (β_2)	1 027.82	1.32
HINC1 (β_3)	21.42	0.36
HINC2 (β_4)	152.27	1.90
PRSVLAND (β_5)	75.59	2.26
Standard deviation parameters		
Intercept (α_0)	858.34	4.83
DIST (α_1)	− 742.00	− 4.24
HINC1 (α_2)	− 57.40	− 1.24
HINC2 (α_3)	54.04	0.66
NOBS	71	
Pseudo-R^2	0.72 (final model compared to a model that assumes WTP is randomly distributed across the real numbers)	
	0.16 (final model compared to a model that estimates β_0 and α_0 but sets coefficients on household characteristics to 0).	
	Based on likelihood ratio tests, the final model is significantly better in explaining WTP than the two simple models.	

be important in similar applications of CV. Number of children in the household, gender, political affiliation, hours spent participating in outdoor recreation each week, home-ownership status and north versus south portion of the neighbourhood were found to be insignificant determinants of WTP. The WTP and standard deviation parameter estimates and *t*-statistics are reported in Table 3. All coefficient estimates in the WTP equation are significant at the 10 per cent level or better using a one-tailed test, except for the coefficient on *HINC1* (β_3). The estimated coefficient on distance in the standard deviation equation (α_1) is significant at the 1 per cent level. Allowing σ_i to vary with distance and income significantly improves the fit of the model. (A likelihood ratio test indicates that the null hypothesis of homoscedasticity can be rejected.)

WTP increases with income, decreases at a decreasing rate with distance, and increases with *PRSVLAND*. A household in the \$35 000–65 000 income range is willing to pay, on average, \$21 more than a household with an income less than \$35 000. A household with income greater than \$65 000 is willing to pay \$131 more than a household in the \$35 000–65 000 range. *Ceteris paribus*, a household located 0.1 miles from the property has a WTP \$716 higher than a household 0.5 miles away. Table 4 presents estimated WTP for all combinations of distance and income categories, holding *PRSVLAND* constant at the sample mean, 6.2. These estimates demonstrate the decreasing effect of distance on WTP, and the increasing effect of income.

The estimated sample mean WTP is \$294; the median is \$234. The standard deviation of mean WTP for the sample is \$46, which was derived using the method of bootstrapping.[11] The mean WTP for households within 0.1 of a mile is \$1197 (standard deviation of the mean is \$345), and the mean WTP for households between 0.9 and 1.0 miles is \$47 (standard deviation is \$33). Figure 2 depicts how estimated WTP varies across the 71

Table 4. Estimated WTP (in $) as a function of income and distance category

	Income category		
Distance (miles)	Less than $35 000	$35 000–65 000	More than $65 000
0.1	1 135	1 157	1 287
0.2	925	947	1 077
0.3	736	757	888
0.4	567	588	719
0.5	419	440	571
0.6	291	312	443
0.7	184	205	336
0.8	97	119	250
0.9	31	53	183
1.0	−14	7	138

Note: Estimated values are computed holding PRSVLAND constant at the sample mean, 6.2. A few respondents had much lower values for this variable, which has a strong negative effect on estimated WTP.

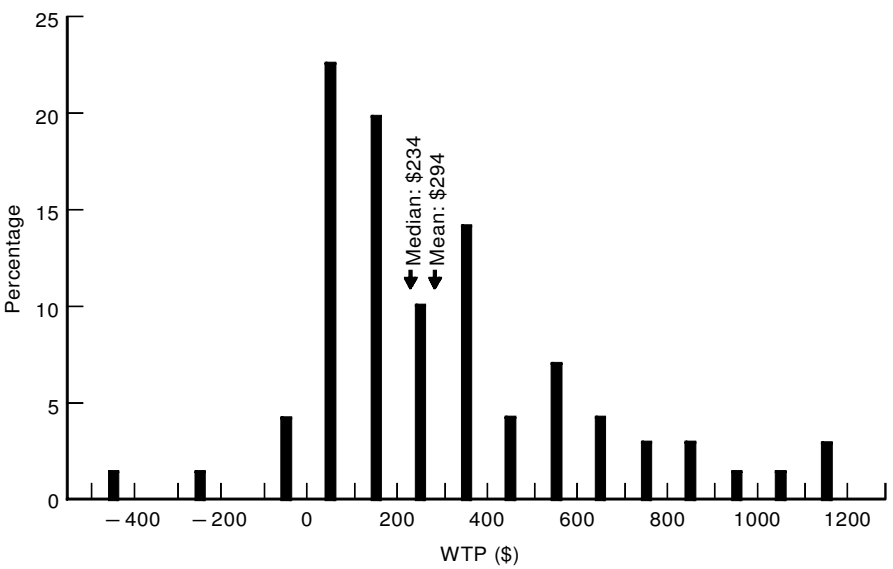

Figure 2. Distribution of estimated sample WTP to preserve the Cunningham property.

households in the sample. The negative estimated values are for households far from the property with low income who place little importance on preserving undeveloped land.[12]

The data suggest that passive use values are a small but significant portion of the total WTP for preservation of the Cunningham property. Passive use motives for WTP were frequently reported in survey comments. In addition, the finding that WTP is significantly greater than $0 for households in the outermost distance shell, where WTP is largely unrelated to property value effects and use, is another indicator that preservation would provide some passive use benefits.

It is of interest to compare our WTP estimates to the Cunningham Coalition's pledges, which averaged $760 per household for the 130 households that pledged. Most

(95 per cent) of the households within 1 mile of the property did not pledge and were not directly asked to pledge. It is our understanding that most of the pledges came from households relatively close to the property, the area where the coalition focused its fundraising activities. The pledges ranged from a few dollars to two pledges of $20 000; removing these two high pledges reduces the average pledge to $458. We were unable to match pledges and WTP survey responses by household; the coalition felt that giving us this information would violate confidentiality. However, because we sampled up to 1 mile from the property and chose our sample to be representative in terms of distance from the property, and because the coalition's main solicitation efforts were directed towards households within a few blocks of the property, it is unlikely that there is much overlap between the two groups. In one case, a surveyed household indicated that it chose its response to our survey to be consistent with its pledge to the coalition. That household had pledged $5000 to the coalition, and it reported its WTP as greater than $2000, the highest amount queried on the survey. This was the largest indicated WTP in our sample. In contrast to the population that pledged, 11 of the 71 households in our sample reported a WTP of close to zero ($\leqslant$$5). It is reasonable to assume that few of these households pledged to the coalition.

The largest CV-estimated household WTP is $1197, which is an order of magnitude less than the two $20 000 pledges. This result demonstrates that the model is not overestimating maximum WTP. Estimated average WTP for the households within 0.5 miles is $709, which is also less than the average pledge, so based on the pledges it would be difficult to argue that CV is overestimating the neighbourhood's WTP for preservation.

Sample estimates of WTP are extrapolated to derive an aggregate estimate for the neighbourhood using weights that account for differences between the sample and the population in terms of distance. Multiplying the weighted mean WTP of $302 by the 2561 city households within 1 mile of the property generates an expected neighbourhood WTP of $774 000. The bootstrapping analysis indicates that the standard deviation of expected aggregate WTP is $121 000, and the probability that neighbourhood WTP is greater than $600 000, the developer's purchase price, is 92 per cent. Weighting for income in addition to distance is possible, but as noted in section 3, we have doubts that comparing household income for the entire ZIP code to this specific, relatively affluent neighbourhood is appropriate. Weighting for both ZIP code income and distance, the estimate of neighbourhood WTP would be $642 000 with a standard deviation of $122 000.

5. Conclusion

The best estimate of neighbourhood WTP, $774 000, is greater than what it might have cost to purchase the property from the developer. The estimated model suggests the likelihood of raising sufficient funds is maximised by first collecting voluntary contributions, and then administering a local referendum to determine whether a special property-tax district should be constructed to raise the additional revenues. Given the incentive to free-ride on the contributions of others, it is unlikely that voluntary funds would be sufficient, which is corroborated by the Cunningham Coalition's pledges of only $98 600. To raise the rest of the funds, the city could consider a neighbourhood bond issue. Based on the estimated model, a neighbourhood bond issue that increased every household's property taxes one time by $192, the median neighbourhood WTP, would just pass and would raise $493 000. Because there are more voters farther from the property and WTP decreases with distance, more money could be raised if the proposed tax varied by distance. For example, if the tax varied by increments of one-third of a mile, $831 000 could be raised by referendum, suggesting that a distance scheme is a vital component of a referendum intending to maximise revenue. Income was also found to be a significant determinant of WTP, so the

likelihood of the bond issue passing might increase if low-income households were made exempt.

This study demonstrates that CV is a flexible policy tool for both government land managers and private community groups concerned about whether to preserve undeveloped urban land. Each study could be uniquely designed to meet limited local budgets, yet provide definitive policy guidance. Our survey and model, with relevant modifications including those discussed in section 3, could be used as templates for similar applications.

6. Epilogue

At one point, the Cunningham Coalition entered into an agreement with a private individual. The coalition agreed to subsidise that individual's purchase of the property subject to a restrictive covenant in the title so that only one house could be built, and the rest of the property would have to remain undeveloped forever. This individual made an informal proposal to purchase the property, but the proposal never came to fruition because the parties could not agree on timing.

Because of this study and other factors, the City of Boulder decided that annexing the property was not in the best interest of the community, ending all plans for a housing development. At that point, the coalition's attempts to purchase the property ended. However, the developer sold the property to another buyer who, in accordance with county regulations, built one home with a pool, tennis court, artificial ponds, golf greens, expansive grass and a tall iron fence. While development was limited to one house, these modifications are not consistent with the coalition's original vision of preservation.

Notes

1. This strategy for limiting 'urban sprawl' is quite common. Whether it is efficient is discussed by, among others, Clawson (1962), Cooley and LaCivita (1982), and Gatzlaff and Smith (1993). That growth controls can affect property values is well documented (Schwartz *et al.*, 1981).
2. We know of no application of CV to value the preservation of urban land. We know of one contingent behaviour study conducted to estimate supply functions for undeveloped land (Conrad and LeBlanc, 1979). More generally, CV is widely used to estimate environmental benefits and costs (see Portney, 1994; Hanemann, 1994; Carson, 1991; Carson *et al.*, 1993; and Randall, 1993). CV is also heavily criticised, particularly with respect to passive use values (see, for example, Diamond and Hausman, 1994; Desvousges *et al.*, 1993; and Neill *et al.*, 1994).
3. According to Jim Breffle, a Metro Denver real estate broker for over 20 years, "a home backing to a mountain view in Boulder is worth at least 10 per cent more than it would be worth without the view, possibly 20 per cent. If something is built between the home and the view, the home loses that value instantly". A 1978 study by Correll *et al.* corroborates that opinion, finding that the value of properties in Boulder directly adjacent to greenbelt is 32 per cent higher than the value of properties approximately half mile away, *ceteris paribus*.
4. Pre-testing of the survey instrument indicated there was positive WTP for preservation at least up to a mile from the property. Households outside this region may also have a positive WTP to preserve the property, in part because they derive passive use benefits from the property.
5. See, for example, Brown and Duffield, 1995 (34 per cent response rate); Cummings *et al.*, 1994 (42 per cent); Whitehead and Groothuis, 1992 (61 per cent); Carson *et al.*, 1992 (75 per cent); and Cameron and Huppert, 1989 (79 per cent). Ideally, each targeted household should have been revisited until a successful contact was made. We recommend that if initial contact is not made after two or three visits to the residence, telephone numbers be obtained from a computerised directory matching addresses to numbers, and that the interviewers attempt to contact the resident to set up a convenient time for the in-person survey.
6. The alternatives are to ask the individual either to state her maximum willingness to pay (open-ended format) or to answer yes or no to one specific value where that specific value differs across the sample (referendum format). See Mitchell and Carson (1989) and Cameron and Huppert (1991). We pre-tested with the first approach. A number of individuals said they did not know how much they would pay, but when informally prompted

many were clear about whether they would pay within specific ranges. Our iterative-bidding approach gives one some time to home in on the correct value. We considered but rejected the idea of using the referendum approach. While sound, this technique requires that more households be sampled (Cameron and Huppert, 1987).

7. For those few who might prefer development, the researcher could, in theory, ask for willingness to accept (WTA) payment for preservation, but such a question could pose problems. It is difficult to ask for WTA and difficult to interpret the responses.
8. Residential property values are, for example, a function of traffic levels and whether the street is a through street. Asabere (1990), using a hedonic approach, found that houses on cul-de-sacs "generated a 29% premium over the grid-street pattern".
9. The data set and programmes may be obtained from the first author. For an application of this type of model to environmental valuation, see Cameron and Huppert (1989).
10. One $0 bidder was removed from the sample based on consistency check criteria for protest bids first proposed by Rowe and Chestnut (1985). This individual reported that preserving undeveloped land in Boulder is important to her. She gave a $0 bid because she believes she already pays enough in taxes, which is a type of scenario rejection that distorts answers to Questions 12 and 13.
11. The estimated parameters and co-variance matrix imply a distribution function for the parameters. We randomly drew 500 parameter vectors from this distribution. For each of these parameter vectors we derived a WTP for each sampled individual. This process generated an estimated WTP distribution for each sampled individual, and an estimated mean WTP distribution for the sample.
12. While negative WTP is plausible, the large negative values for two households are most likely to be artefacts of the specification of equation (1).

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Appendix. Cunningham Survey

(*Instructions to interviewer in italics.*)

Hello, my name is _____, and I am a graduate student at the University of Colorado. I am conducting a survey about undeveloped land in Boulder and specifically a proposed development site within one mile of your home. I'd like to take a few minutes to tell you some facts about the proposed development site and ask you questions about undeveloped land in Boulder County and more specifically about the site. I do not represent the government, the potential developer, or any interest group, and you will remain anonymous.

If respondent unable to spend time, ask:

Is there a more convenient time when I could ask you some questions?

Date:_____ Time: _____

The proposed site that I will be asking you about is called the Cunningham property. It is a 5.5-acre parcel of land between Kalmia and Linden just west of Fourth Street that is being considered for annexation by the City of Boulder. If annexed, approximately nine luxury homes will be built on the property, the bike path running through the land will be removed, and Fourth Street will be extended to Linden.

QUESTIONS: (Male___ Female___)

1. Had you ever heard of the Cunningham property and the plans to develop it before this survey?
   Yes No If so, where did you hear about it?_____
2. How important is undeveloped land in Boulder County to you on a scale from 1 to 7 with one being "not at all important" and seven being "very important"?
   "Not at all" 1 2 3 4 5 6 7 "Very important"
3. How many hours on average do you spend participating in outdoor recreational activities per week?
4. How do you feel about the Boulder City laws dealing with housing and business development on a scale from 1 to 7 with one being "not restrictive enough" with respect to development and seven being "too restrictive"?
   "Not restrictive enough" 1 2 3 4 5 6 7 "Too restrictive"
5. How many years have you lived in this neighbourhood?_____
6. How many years have you lived in Boulder?_____
7. What is your occupation?_____
8. Do you rent or own your home? Own Rent
9. Are you a member of any environmental organisation: Yes No
   (*If Yes*) Which one(s)?_____
10. How many children aged 15 or under are currently living in your home?
    0 1 2 3 4 5 6
11. Politically, would you consider yourself to be more of a Democrat or more of a Republican?
    Democrat Republican

Q12 & Q13: start every other survey with the lowest amount, and increase until the individual states the household would not pay that amount. Start all others with the highest value of $2 000 and descend until the individual states his or her household would pay that amount. Record interviews that were ascending to which the individual answered "no" to $5 as zero.

12. Suppose you were asked how much your family would be willing to pay above and beyond what it already pays, if anything, as a one-time payment this year and this year only to keep presently undeveloped land within one mile of Boulder city limits from being developed forever. Would you pay:
    $5 $10 $20 $50 $75 $100 $125 $150 $200 $300 $400 $500 $600 $700 $800 $900 $1000 $2000
13. Suppose you were asked how much your family would be willing to pay above and beyond what it already pays, if anything, as a one-time payment this year and this year only to keep the Cunningham property from being developed forever. Would you pay:
    $5 $10 $20 $50 $75 $100 $125 $150 $200 $300 $400 $500 $600 $700 $800 $900 $1000 $2000
14. Why would you pay _____to keep the Cunningham property undeveloped?

Comments:

(*For those who bid zero, circle a response below on the basis of the answer.*)

1. Preserving the land as open space has no value to me.
2. The survey design is inappropriate.
3. I cannot place a dollar value on preserving the land
4. I already pay enough taxes.

15. This last question is of great importance in determining people's preferences in preserving undeveloped land. I am going to read off four income brackets. Could you please tell me into which range your family income falls?
    1. Less than $35 000/year
    2. $35 000 to $65 000/year
    3. $65 000 to $100 000/year
    4. Over $100 000/year

Thank you very much for your time and effort. I really appreciate your input.

DISTANCE IN TENTHS OF A MILE (*Circle One*) 1 2 3 4 5 6 7 8 9 10