Measuring the Recreational Value of Agricultural Landscape

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Abstract

In addition to food and fibre, agricultural land provides public amenities in the form of wildlife habitat, protection of natural resources, open spaces, aesthetic scenery, and cultural preservation. Most previous studies have used contingent valuation methods to measure the value of these services. We use an alternative procedure, which provides a value of the agricultural landscape *per se*, as measured against a specific alternative, and based on whether agricultural landscape had an influence on visitation decisions. Our procedure involves a travel-cost model estimated by count-data regression techniques using (truncated) samples of visitors. An application to two regions in Israel reveals a substantial value for agricultural landscape, as compared with the traditional returns to farming.

Keywords: Agricultural landscape, Recreation, Travel Cost, Farm land

JEL classification: Q26, Q15

1. Introduction

Agricultural land has long been recognised as providing, in addition to food and fibre, public amenities in the form of wildlife habitats, protection of natural resources, open spaces, aesthetic scenery and cultural preservation. The landscape value of farmland consists of the benefits derived from the scenic beauty generated by rural landscape, such as open fields, orchards, and herds of livestock grazing in green meadows. As such amenities are of a public good nature, market forces fail to allocate them correctly, hence the need for some sort of policy intervention. This, in turn, requires measurement of the value of this public good and the design of effective policies for its preservation (Gardner, 1977; Roberts and Roberts, 1988; McConnell, 1989; Bromley and Hodge, 1990; Fox and Cox, 1992; OECD, 1993; Hackl and Pruckner, 1997). In this work, we measure the recreational use value of agricultural landscape for two regions in Israel, combining travel cost (TC) methods (based on actual visitation data) with contingent-based information regarding the influence of agricultural landscape on visitation decisions.

TC and contingent valuation (CV) methods are the two most widely used approaches for measuring the economic value of environmental amenities (see Clawson and Knetsch ,1966, for an early account of TC methods, and Mitchell and Carson, 1989, for a comprehensive account of CV methods as well as comparison with TC and other methods). In its pure form, CV consists of direct elicitation (via interviews) of willingness to pay (or accept) in order to maintain a status quo welfare level for different intended changes. TC methods, on the other hand, are based on actual behaviour, making use of actual visitation data. Each approach has its pros and cons, and a lively debate has emerged regarding their accuracy (and legitimacy) in different circumstances (see Arrow et al., 1993, Portney, 1994, Hanemann, 1994, and

Diamond and Hausman, 1994). An intermediate approach that combines actual visit data with contingent behaviour has recently emerged, attempting to minimise the reliance on hypothetical, contingent behaviour underlying CV while exploiting the revealed-behaviour nature of TC (Cameron, 1992; Kling, 1997). The present effort belongs to this latter approach. We use actual trip data to estimate the demand for visiting each region, as in TC models. We then use visitors' stated affinity to agricultural landscape to detect the change in their visitation decision due to a (hypothetical) change in agricultural landscape. As it is based on contingent behaviour, this change in visitation demand is akin to CV.

A similar model has recently been used by Rosenberger and Loomis (1999) to evaluate the value of ranch open space in Arizona. These authors use the stated (contingent) change in the number of visits due to a (hypothetical) change in ranch open spaces to estimate the change in visitation demand. In Rosenberger and Loomis (1999), therefore, the (hypothetical) change in the number of trips replaces hypothetical willingness to pay statements that underlie CV analyses, the advantage being that the former is less sensitive to strategic biases. Data on (hypothetical) changes in the number of visits associated with changes in agricultural landscape are not available in our case. While not as informative as number of trips, the variable we use is also less arbitrary, requiring the visitor only to indicate whether or not agricultural landscape has played an important role in the decision to visit the site. Obviously, an ideal situation would be to estimate demand based on actual visitation data before and after the change, as Hausman et al. (1995) do in their analysis of the Exxon Valdez oil spill in Alaska (they used panel data relating to before and after the accident). This is impossible when effects of intended changes are sought before they are carried out.

Israel is currently undergoing a massive land reallocation, whereby large chunks of agricultural land cease to be cultivated (as returns to farming no longer sustain the rising living standards and farmers engage increasingly in off-farm activities) and become fallow or fall prey to urban developers (Egoz, 1996; Alterman, 1997). Assessment of the effects of this process, which irreversibly changes the rural/urban landscape, should take account of all costs and benefits, including the positive externality of rural landscape as well as negative environmental effects. We apply our analysis to two regions: the Hula Valley and the Jezreel Valley. Both attract many tourists (Fleischer and Pizam, 1997) and are dominated by agricultural landscape: 60-80 per cent of the land area is used for field crops, plantations and natural meadow (see Table 1). For both regions, we find that the value of agricultural landscape is substantial, exceeding by far the net return to farming.

The following section briefly discusses measures of the value of agricultural landscape. Section 3 sets up the empirical model, followed by a description of the data (Section 4) and a discussion of the estimation results (Section 5). Section 6 concludes with some policy assessments.

2. The value of agricultural landscape

Agricultural landscape is a public good and its economic value should be analysed as such (see for a general exposition Nicholson, 1972 and Freeman, 1992, for the case of environmental quality). In this framework a rural recreational area is characterised *inter alia* by its agricultural landscape. While the agricultural landscape in a particular recreational area is rather heterogeneous and takes different shapes and forms, we assume it can be represented by a single index, denoted A. Such an index may take the form of a weighted sum of the shares of total land covered by the different agricultural crops (pasture, grapes, orchards, field crops etc.). The demand for the recreational site is measured by the number of visitors it attracts each year. Consequently, the recreational value of agricultural landscape is revealed through its effect on the number of visitors. Thus, the recreational use value of agricultural landscape can be defined and measured by changes in consumer surplus associated with varying levels of the agricultural landscape index A.

The change in consumer surplus associated with a change in agriculture landscape from an initial level A^0 to a level A^1 is defined as follows. Let $N(p,A)$ denote the (Marshallian) tourism demand for the site under consideration, indicating the number of visitors when the cost of a visit is p and the agricultural landscape index is A, and let $p = D(N,A)$ be the inverse demand function. In the initial situation, with $A = A^0$, rural tourism is consumed at the level $N^0 = N(p^0,A^0)$ (see Figure 1) and the consumer surplus is

$$CS^0 = \int_0^{N^0} D(n, A^0)dn - p^0 N^0 \quad \text{(the area } abc \text{ in Figure 1).} \tag{1}$$

As agricultural landscape changes to A^1, N changes to $N^1 = N(p^0,A^1)$ and

$$CS^1 = \int_0^{N^1} D(n, A^1)dn - p^0 N^1 \quad \text{(the area } dec \text{ in Figure 1).} \tag{2}$$

The change in consumer surplus associated with the change $A^0 \rightarrow A^1$ is given by

$$S = CS^0 - CS^1 \quad \text{(the area } abed \text{ in Figure 1).} \tag{3}$$

Figure 1

Under some "regularity" conditions (see Mäler, 1974, Chapter 5, and Freeman, 1979, Chapter 4), S is a good approximation of the equivalent and compensating variations, and hence can serve as the welfare measure of the agricultural landscape change.

3. Empirical specification

Our observations are drawn from the population of potential visitors, which means that we have a truncated sample with data on the dependent variable (the number of visits) that are all positive. Our model is therefore specified as such (see Grogger and Carson, 1991, for truncated specifications and Haab and McConnell, 1996, for specifications that deal with many zero responses).

The demand function

Let N_{ij} represent individual *i*'s demand for visiting region *j*, i=1,2,…,I_j, j=1,2,…,J (I_j is the number of visitors in region *j*, *J* is the number of regions--2 in the present case) expressed in terms of number of visits. The data realisations of the random variable N_{ij} are counts on the number of times individual *i* has visited region *j* during a year. The visit price, p_{ij}, consists of the travel cost and is taken to be proportional to the distance travelled.[1] We use the notation

$E\{N_{ij}|p_{ij},z_{ij},\varepsilon_{ij}\} = \lambda(p_{ij},z_{ij},\beta_j,\varepsilon_{ij}) \equiv \lambda_{ij}$ [please check notation here – the expected value of N_{ij}, given p_{ij} and z_{ij}, would normally not also be conditional on ε_{ij} – the expectation would be taken over ε_{ij}. In addition, I would prefer you to write sinply : $N_{ij} = N_{ij}(p_{ij},z_{ij},\beta_j,\varepsilon_{ij})$, getting rid of the redundant λ_{ij} notation altogether, since it is not used beyond equation (4). Log λ_{ij} in equation (4) can easily be replaced by logN_{ij}] {λ_{ij} is, as defined, the expectation of N_{ij} conditional on p_{ij}, z_{ij}, β_j and ε_{ij}. We can replace log λ_{ij} with log $E\{N_{ij}|p_{ij},z_{ij},\varepsilon_{ij}\}$ but not with log N_{ij} ; we prefer to use λ_{ij} since it simplifies notation. The expectation over ,ε_{ij} is taken in equation (5)}

where z_{ij} is a K-dimensional vector containing information on individual *i*'s (socioeconomic) and region *j*'s (landscape) characteristics, β_j is a K+1 dimensional

[1] Since no data on income of visitors is available (except for a rough classification into five groups), the opportunity value of time is ignored in this work.

vector of unknown coefficients and ε_{ij} is an error term representing effects of unobserved variables and measurement errors. The semi-log specification

$$\log\lambda_{ij} = p_{ij}\beta_j^p + \sum_{k=1}^{K} z_{ijk}\beta_{jk}^z + \varepsilon_{ij} \equiv x_{ij}\beta_j + \varepsilon_{ij} \tag{4}$$

is adopted, where $x_{ij} = (p_{ij}, z_{ij})$ and $(\beta_j^{p\prime}, \beta_j^{z\prime}) = \beta_j'$. It is assumed that the $e^{\varepsilon_{ij}}$, i=1,2,…,I_j, are independently drawn from the same distribution with $E\{e^{\varepsilon_{ij}}\} = 1$ and $Var\{e^{\varepsilon_{ij}}\} = \eta_j^2$, j=1,2,…,J. The unit-mean assumption entails no loss of generality when x_{ij} contains a constant term. When the ε_{ij} are independent of x_{ij} for all i,j, then (see Gourieroux et al., 1980)

$$E\{N_{ij} \mid x_{ij}\} = e^{x_{ij}\beta_j} \equiv m_{ij}, \qquad Var\{N_{ij} \mid x_{ij}\} = m_{ij} + \eta_j^2 m_{ij}^2 \tag{5}$$

The negative binomial model arises when the errors $e^{\varepsilon_{ij}}$ have a gamma (α_j,1/α_j) distribution with $\alpha_j = 1/\eta_j^2$ (the harmless normalisation $E\{e^{\varepsilon_{ij}}\} = 1$ requires that the product of the first and second parameters equals unity), i.e.,

$\Pr\{e^{\varepsilon_{ij}} = y\} = \dfrac{y^{\alpha_j - 1}e^{-y\alpha_j}}{\Gamma(\alpha_j)(1/\alpha_j)^{\alpha_j}}$. In this case N_{ij} has a negative binomial distribution with parameters $1/(1+m_{ij}/\alpha_j) \equiv \pi_{ij}$ and α_j:

$$\Pr\{N_{ij} = n \mid x_{ij}\} = \frac{\Gamma(n+\alpha_j)}{n!\,\Gamma(\alpha_j)}\left(\frac{m_{ij}/\alpha_j}{1+m_{ij}/\alpha_j}\right)^n\left(\frac{1}{1+m_{ij}/\alpha_j}\right)^{\alpha_j} \tag{6}$$

When $1/\alpha_j = \eta_j^2 \to 0$, the negative binomial reduces to the Poisson distribution and

$$\Pr\{N_{ij} = n \mid x_{ij}\} = m_{ij}^n e^{-m_{ij}}/n! \tag{7}$$

The Poisson specification is therefore nested in the negative binomial model and will be adopted if justified by the data.

Consumer surplus

The mean demand function is $m_{ij} = \exp\{p_{ij}\beta_j^p + z_{ij}\beta_j^z\}$ and the corresponding inverse demand is $p_{ij} = [\log m_{ij} - z_{ij}\beta_j^z]/\beta_j^p$, where β_j^z, β_j^p are defined in (4). [what is the symbol p? Presumably it has nothing to do with price but is related to previously defined parameters. Please clarify] {p_{ij} is cost to individual *i* of visiting region *j*, as defined above; β_j^p is the coefficient of p_{ij} in the demand function} The individual consumer surplus, evaluated at the mean demand, is[2]

$$CS_{ij} = \int_0^{m_{ij}} [\log(s)/\beta_j^p - z_{ij}\beta_j^z/\beta_j^p]ds - pm_{ij} = \frac{m_{ij}}{-\beta_j^p}. \tag{8}$$

This is a measure of the benefit derived from recreational visits as a whole, of which only part emanates from the agricultural scenery. To identify this latter part requires evaluating the demand without (or at a different level of) agricultural landscape and the associated consumer surplus. Hausman et al. (1995) in their estimation of the consumer surplus loss due to the Exxon Valdez oil spill used panel data before and after the accident. The difference between the consumer surpluses before and after the spill constitutes the loss inflicted by the damage. In our case, the post-event situation corresponds to reduction or lack of agricultural landscape as a result, say, of transforming it into resort or urban use. For the sites under study this is a future contingency for which no actual visit data are available. We thus had to elicit this information by means of hypothetical questions regarding the importance of the agricultural landscape in the decision to visit the area. To that end, we use the visitors' response to the question "to what extent has the agricultural landscape influenced your decision to visit this region?" The interviewees had to select between "very much,"

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[2] Alternatively, let $N = me^v$ such that the distribution of N is induced by that of e^v, where the latter random variable is independent of $x = (p,z)$ and satisfies $E\{e^v\} = 1$ (see Haab and McConnell, 1996). The corresponding (random) demand and consumer surplus are, respectively, $p = [\log(N) - z\beta^z - v]/\beta^p$ and $CS(N) = N/(-\beta^p)$. Thus, $E\{CS(N)|x\} = E\{N|x\}/(-\beta^p) = m/(-\beta^p) = CS(m)$.

"some" and "not at all" [3]. Consequently, we define the variable $V_{ij} = 1$ if individual i's response was "very much" and $V_{ij} = 0$ otherwise[4]. Now, V_{ij} is contained in z_{ij} such that $z_{ij} = (V_{ij}A_j, s_{ij})$, $\beta_j^{z\prime} = (\beta_j^{v}, \beta_j^{s\prime})$ and $z_{ij}\beta^{z} = V_{ij}A_j\beta_j^{v} + s_{ij}\beta^{s}$, where A_j is the agricultural landscape index for region j defined above (an index for the fraction of the region's land that is cultivated and its aesthetic value), β_j^{v} is a parameter that translates the agricultural landscape index A_j to conform with the demand units (may be viewed as the visitors' perception of the attractiveness of the agricultural landscape), and s_{ij} and β_j^{s} are (K-1)-dimensional vectors of observations and parameters, respectively. [you must rationalise your notation: for equation (4) you define x_{ij} – not used again – and now s_{ij}. There is a more efficient way of setting out these equations so that you need only one of the two] {z_{ij} consists of $V_{ij}A_j$ and s_{ij}, so if we do away with z_{ij}, we must always use $(V_{ij}A_j, s_{ij})$ instead of z_{ij}, which seems cumbersome; we prefer the notation as is.} This specification is equivalent to imposing different β_j^{v} values for the two groups by requiring that $\beta_j^{v} = 0$ for visitors that are not influenced by agricultural landscape, i.e., those with $V_{ij} = 0$.

Obviously, for individuals that are unaffected by agricultural landscape, i.e., those with $V_{ij} = 0$, the disappearance of agricultural landscape entails no change in visitation plans and no loss of welfare. For individuals that gain benefit from agricultural scenery (those with $V_{ij} = 1$), such disappearance means a reduction in the benefit they derive from a visit, a reduction that can be measured through the change

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[3] Agricultural land was defined for respondents as "cultivated fields, orchards and farms". Before respondents had to answer the question about the influence of agricultural landscape on their decision to visit the area, agrisultural landscape was also contrasted with "natural landscape", "urban landscape" and "parks and forests".

[4] The reason for lumping together individuals that chose "some" with those that chose "not at all" is empirical: considering each category separately yielded insignificant effects. For the "some" respondents, this may bias downwards the importance of agricultural landscape and its measured benefit.

in their visitation plans. The coefficient of V_{ij}, namely $A_j\beta_j^v$, measures the latter change and permits the evaluation of the welfare loss (see below).

Rosenberger and Loomis (1999), in their analysis of the value of ranch open space to tourists, employ a similar approach. They asked each individual about the number of trips he or she would have taken had the site been stripped of ranch open spaces. They then combined the actual and hypothetical number of trips in a panel-like data set to estimate the effect of agricultural landscape thorough a (0,1) dummy variable similar to our V_{ij}. In our case, no information on (hypothetical) number of trips is available and we use instead the response to the agricultural landscape affinity question, as explained below.

Let A_j^0 be the referenced (actual) level of the agricultural landscape index in region j and $m_{ij}^0 = \exp(p_{ij}\beta_j^p + s_{ij}\beta_j^s + V_{ij}A_j^0\beta_j^v)$ the associated mean visits demand of individual i. Suppose that the agricultural landscape index changes to A_j^1. Then the mean visits demand of individual i changes to

$$m_{ij}^1 = \exp(p_{ij}\beta_j^p + s_{ij}\beta_j^s + V_{ij}A_j^1\beta_j^v) = m_{ij}^0 \exp(V_{ij}[A_j^1 - A_j^0]\beta_j^v)\,. \tag{9}$$

Now, since the agricultural landscape index is subject to arbitrary normalisation, we may as well, without loss of generality, set the actual level to unity, i.e., $A_j^0 = 1$ (if the data were pooled for the two regions, this normalization is possible for one region and the A^0 of the other region would be set accordingly). Also, this index is equal to zero when the entire agricultural landscape vanishes. Since, in this study we are interested in comparing the actual situation with that of zero agricultural landscape (recall that we seek to measure the value of the agricultural landscape as a whole), we can set $A_j^0 = 1$ and $A_j^1 = 0$. Thus, when the alternative scenario is that of a vanishing agricultural landscape, the mean demand, as given in (9), simplifies to

$$m_{ij}(A_j^1 = 0) = m_{ij}^0 \exp(-V_{ij}\beta_j^v) \tag{10}$$

and the corresponding consumer surplus changes to

$$CS_{ij}(A_j^1 = 0) = \frac{m_{ij}(A_j^1 = 0)}{-\beta_j^p} = \frac{m_{ij}^0 \exp(-V_{ij}\beta_j^v)}{-\beta_j^p} = CS_{ij}^0 \exp(-V_{ij}\beta_j^v) \tag{11}$$

The surplus due to agricultural landscape as a whole can now be specified as

$$S_{ij} = CS_{ij}^0 - CS_{ij}(A_j^1 = 0) = \frac{m_{ij}^0[1-\exp(-V_{ij}\beta_j^v)]}{-\beta_j^p} = CS_{ij}^0[1-\exp(-V_{ij}\beta_j^v)]. \tag{12}$$

Thus, according to equation (12), a person that is affected by agricultural landscape will have his welfare reduced by $e^{-\beta_j^v} \times 100$ per cent.

4. Data

Data were collected by face-to-face interviews of visitors in two regions: the Hula and the Jezreel valleys. These regions are intensively cultivated (see Table 1) and attract many recreationists. The Hula Valley is in the northern tip of the northeastern Upper Galilee region. Its agricultural landscape contains field crops (mainly cotton), citrus and apple orchards, some fishponds and grazing meadows (cattle). The Jezreel Valley is located halfway between Israel's main urban center (Tel Aviv and its surrounding cities) and the Upper Galilee. Vegetables and field crops with some fruit orchards mainly dominate its agriculture landscape. The landscape value that we estimate for each region depends on the agricultural activities that existed at the time of the survey. Although it is not impossible to visit both regions in the same trip, this is rather uncommon and we assume that visitors choose one region per trip.

The interviews were carried out in 1997 during the spring - a high tourist season. About 250 visitors were selected randomly for interview in each area. Data include socio-economic information, number of visits during the past year, and the importance of agricultural landscape in the decision to visit the area. The latter underlies our estimates of rural landscape values, as explained earlier.

Table 2 presents the means and standard deviations of the variables relevant to the current study for the whole sample. The table shows that the average price of a visit to the Hula region is higher than to Jezreel due to its relatively greater distance from urban centres. Both groups of visitors have similar socio-economic characteristics.

5. Estimation Results

In view of equation (6), the likelihood that individual *i* makes n_{ij} trips to region *j* given that she has visited the region at least once (we have a truncated sample drawn from the population of potential visitors) is specified as:

$$L_{ij}(\beta_j,\alpha_j) = \Pr\{N_{ij} = n_{ij} \mid N_{ij} \geq 1, x_{ij}\} = \frac{\dfrac{\Gamma(n_{ij})}{n_{ij}!}\left(\dfrac{m_{ij}/\alpha_j}{1+m_{ij}/\alpha_j}\right)^{n_{ij}}\left(\dfrac{1}{1+m_{ij}/\alpha_j}\right)^{\alpha_j}}{1-\left(\dfrac{1}{1+m_{ij}/\alpha_j}\right)^{\alpha}} \qquad (10)$$

[As you have already defined N_{ij} as the actual demand, I think n_{ij} and N_{ij} should be interchanged in this formula – please check this point] {n_{ij} is actual choice and N_{ij} is the random variable} If $1/\alpha_j = \eta_j^2 = 0$, the negative binomial likelihood reduces to the Poisson likelihood [you say in section 3 that this simplification should be justified by the data. One would expect you to test the necessary assumption before imposing it, or at least to give a qualitative justification for using it] {This was done--see footnote 5}

$$L_{ij}(\beta_j,\alpha_j) = \frac{m_{ij}^{n_{ij}} e^{-m_{ij}} / n_{ij}!}{1-e^{-n_{ij}}}. \qquad (11)$$

Maximising the sample log-likelihood, $\Im_j = \sum_{i=1}^{I_j} \log L_{ij}$, gives the parameter estimates for the *j*-th region[5]. The results for the Hula and Jezreel regions are presented in Table 3.

Table 3

We see that the coefficient for the travel cost is negative and highly significant, as expected. The coefficient for the income variable is negative, but insignificant at a 5 per cent level. The negative gender coefficient reveals a higher rate of participation for women (consistent with previous studies such as Hawes, 1998).

The coefficient of the 'ag. landscape' variable is (significantly) positive, suggesting that agricultural landscape increases the number of visits for the individuals who responded positively to the agricultural landscape question. This variable represents the effect on the number of visits had agricultural landscape been missing when only shifts in the intercept of the visit demand function are considered, as we assume here (see Figure 1).

Based on these estimates, the total consumer surplus and the agricultural-landscape-induced surplus for each individual are calculated, as explained earlier. Averaging over visitors in each region, we obtain the surplus measures reported in table 4. The average total consumer surplus in the Hula Valley is \$925, of which \$167 is due to agricultural landscape. In the Jezreel Valley, on the other hand, the average total consumer surplus is \$514 and only 10 per cent of it is generated by the agricultural landscape. When aggregating over the total number of visitors, the difference between the values of Ag. Landscape in the two regions diminishes (\$82 million in Hula vs. \$37 million in Jezreel) as the Jezreel region attracts a larger number of visitors.

[5] Estimation was carried out using the maximum likelihood facility of EViews 3.1, using the Logl object (see EViews 3.1 Supplemental Documentation, 1998). For both regions the hypothesis that $1/\alpha_j = 0$ was rejected and the truncated negative binomial specification (10) was used.

Finally, table 4 presents the net returns to farming for the two regions based on farm budget data taken from Dlayahu and Hadas (1996). The figures are $12 million and $13 million for the Hula and Jezreel regions, respectively.

Table 4

For the two regions combined we find that the landscape value of farmland is substantial, far in excess of returns to farming: $119 million per year vs. $ 25 million per year, respectively (Table 4). This finding is consistent with Drake (1992) who estimated the willingness to pay (WTP) to preserve agricultural land against conversion into forest in Sweden and found that agricultural landscape value (about $130 per hectare) is higher than the return from agricultural production in most parts of Sweden.

Our estimates were based on visitors' survey, hence they do not account for non-use and residents' values. These latter values can be significant, as Garrod and Willis (1995), and Hanley et al. (1998) found in two separate studies of the Environmentally Sensitive Areas (ESA) program in the UK. It should also be noted that our estimation suffer from flaws common to many TC studies due to data limitations. Lack of proper income data forced us to ignore the opportunity value of time, which should be part of the cost of travel; also, substitute sites are not accounted for. Recent studies have found that including the alternative value of time increases the welfare derived from visits to the site (Feather and Shaw, 1999; McKean et al., 1996), while existences of substitute sites decreases the welfare estimates (Hausman et al., 1995; Walsh et al., 1992).

6. Conclusions

As the benefit tourists derive from the scenic view of farmland is of a public-good nature, land allocation fails to account for it, hence the need for some policy intervention. Any such correction policy must rely on the value of agricultural landscape, which can only be measured via extra-market valuation methods. In this paper we estimate the value of agricultural landscape using actual data of visitors in two rural areas in Israel. A demand function, with the number of recreational visits as the quantity demanded and the travel cost as the price, is specified and estimated using actual samples of visitors. The integer nature of the dependent variable and the fact that our samples contain visitors only give rise to truncated, count-data regression models. The consumer surplus associated with recreation is calculated and the part of this surplus that is derived from the agricultural landscape, which constitutes the landscape value of farmland, is determined.

Clearly, the socially desirable allocation of farmland should take account of all external effects, including landscape services as well as negative externalities such as soil and groundwater contamination. Ignoring the landscape effect in a cost-benefit evaluation may lead to undersupply of farmland. Because urban sprawl processes are practically irreversible, agricultural/urban misallocation may turn out to be a costly mistake. For this reason an array of policy measures has emerged in different countries to preserve agricultural landscapes (Alterman, 1997; Pruckner and Hackl, 1997; Cooke and Gough, 1997; Bromley, 1994; Kline and Wichelns, 1996; Rosenberger, 1998; Fleischer and Pizam, 1997). None, however, makes use of estimated landscape values, perhaps because of the difficulty in obtaining such estimates. We hope that the present paper will facilitate the incorporation of agricultural landscape values in such policies.

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Table 1: Distribution of land by use and region in 1993 (thousand hectares)

Region	Uncultivated land	Natural parks	Urban	Agricultural land	Total
Hula	1.4	2.1	3.5	27.6	34.6
	4%	6%	10%	80%	100%
Jezreel	11.3	0	4.8	31.3	47.4
	24%	0%	10%	66%	100%
All Israel	856.9	599.8	196.6	573.7	2150.2
	41%	25%	9%	25%	100%

Source: Israel, Ministry of Agriculture (1996)

Table 2: Means and standard deviations (in parenthesis) for sample data

Variable	Hula	Jezreel
Number of visits per person	3.61	3.07
	(4.5)	(4.3)
Travel cost[a]	403.7	151.4
	(137.1)	(123.7)
Education[b]	4.09	3.96
	(1.04)	(1.10)
Age	32.8	32.2
	(10.4)	(11.4)
Income[c]	3.33	3.4
	(1.17)	(1.08)
Gender[d]	0.41	0.52
	(0.49)	(0.5)
Ag. Landscape[e]	0.36	0.44
	(0.48)	(0.49)
Number of observations (after deletion of observations with missing data)	142	161

Notes:

[a] number of kilometers from residence to destination
[b] 1 = elementary, 2 = partial high school, 3 = high school, 4 = vocational or partial college, 5 = university degree(s).
[c] 1 = far below average, 2 = below average, 3 = about average, 4 = above average, 5 = far above average.
[d] 1 = male.
[e] 1 if individual answered "very much" to the question "To what extend has the agricultural landscape influenced your decision to visit this region?"; 0 otherwise.

[b and c: I assume that you tested to make sure you can use these codes as if they are cardinal variables – instead of using dummies for each group, as one would expect. Please clarify] {We are unaware of any obvious specification test in the NB-Poisson regression context. The Schwartz criterion supports our specification (i.e., is smaller) against using dummies for education and income in both regions, but this is not something we would comfortably use to justify our specification}

Table 3: Parameter estimates for demand functions

Variable	Hula	Jezreel
Constant	1.2286*	1.7898**
Travel cost[a]	-0.0010**	-0.0015**
Education[b]	0.1115*	-0.0688
Age	0.0071	0.0032
Income[c]	-0.1394*	-0.1407*
Gender[d]	-0.4386**	-0.2444**
Ag. landscape[e]	0.4301**	0.2066**
Wald test for the hypothesis that all coefficients except intercept are zero (the statistic is a χ_6^2 under the null)	720.63	589.84
Number of observations (after deletion of observations with missing data)	142	161

* Different from zero at 10 % significance level.

** Different from zero at 5 % significance level

Please provide some goodness-of-fit information. At least a likelihood ratio test of each model against a fully restricted null for each model] {provided above}

Table 4: Consumer Surplus and Return to Farming by Regions

	Hula	Jezreel
Average total consumer surplus ($ per visitor)	925	514
Average consumer surplus due to Ag. Landscape only ($ per visitor)	167	49
Number of visits to the region during the year preceding the survey (thousands)[a]	490	749
Total consumer surplus due to Ag. Landscape (million $ per year)	82	37
Total net return from farming (million $ per year)[b]	13	12

[a] Based on a survey of a representative sample of the Israeli population (Fleischer et al., 1997).

[b] Farm profits in 1995 were $488/hectare and $382/hectare in the Hula and Jezreel, valleys respectively (Dlayahu and Hadas, 1996). Total net return was calculated by multiplying profit per hectare by the number of cultivable hectares in each region. Adjustment for 1997 prices used the agricultural output price index.

Figure 1: Visit demand functions with (A^0=1) and without (A^1=0) agricultural landscape. The area *abed* is the surplus due to agricultural landscape