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Economic Valuation of Cultural Ecosystem Services:

The Case of Landscape Aesthetics in the Agritourism Market

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Abstract

Natural and agricultural landscapes provide a wide range of ecosystem services, among them aesthetic landscapes. Since these services have no market value, land use decision makers often ignore them in favour of urban sprawl, with the result that resource allocation may be suboptimal. Here we suggest a novel method to evaluate the aesthetic landscape services of natural and agricultural ecosystems using the case of the agritourism market in Israel. We model the agritourism market as an oligopolistic market with differentiated products and formulate an equilibrium model with structural, double nested logit demand and pricing equations. The structural equations are expressed as a function of the attributes of the agritourism firm, among which are the components of landscape view. We use aggregate market data and GIS data to estimate the structural model. In the case of urban sprawl, the welfare loss is estimated at between US$108,000 thousand and US$197,000 per km^2, depending on the type of ecosystem that is forgone, while in the case of agricultural sprawl over natural areas, the welfare loss is estimated at US$141,000 per km^2. This welfare loss can be considered the economic value of landscape aesthetics services to the agritourism market. These findings illustrate the potential of using this valuation method for other ecosystems in other markets.

Keywords: Ecosystem services; Cultural services; Aesthetics landscape; Agritourism market; urban sprawl.

1. Introduction

Ecosystem services (ESs), including provisioning, regulating, and cultural services, are crucial to human wellbeing and health (Millennium Ecosystem Assessment, 2005). However, the flow of many ESs has been impaired by anthropogenic pressures. The importance of integrating changes in the flow of ESs into decision making that involves altering ecosystems, such as land use change, has been widely recognized by economists (e.g., Bateman et al., 2013; Lawler et al., 2014). Nevertheless, as some ESs have no market value, such integration requires their monetary valuation in order to establish trade-offs with other economic activities. Indeed, ESs valuation, according to Polasky et al. (2019), is one of the most pressing issues faced by environmental economists today. This task is further complicated by the fact that some ESs are consumed as final services, some as intermediate, and some as both (Johnston et al., 2011). It is especially challenging to measure the non-market value of cultural services in the realms of aesthetics, experience learning, and mental health that result from biophysical changes in ecosystems (Polasky et al., 2019). We rise to this challenge by proposing a novel method for evaluating landscape aesthetics services. Our method integrates landscape as an intermediate service (or as attribute) in the agritourism market and expresses the demand and pricing structural equations as functions of the agritourism firms' attributes. Through this method we are able to estimate the value of aesthetics services, which is revealed as changes in the market's total welfare due to changes in the size of the ecosystem.

Daniel et al. (2012) offer a typology of cultural services, which we adopt here, as well as methods for assessing their contribution to human wellbeing. According to them, cultural services can be divided into four major categories: landscape aesthetics, culture and heritage, recreation and tourism, and spiritual and religious. When describing the valuation methods of these services, they differentiate between (i) monetary assessments (direct and indirect[1]), (ii) non-monetary quantitative

[1] Note that the literature commonly refers to 'stated preference' (SP) as direct methods, i.e., asking directly for values, and to 'revealed preference' (RP) as indirect methods, i.e., inferring the value indirectly from other markets. Here we follow Daniel et al.'s (2012) definition with respect to monetary assessment, where the SP is assessed indirectly through hypothetical markets, and the RP is assessed directly through actual markets.

assessments, and (iii) comprehensive studies of the human–nature interaction. In this study, we focus on the monetary assessment of landscape aesthetics. The prevailing approach of indirect monetary valuation simulates the market demand by means of surveys on hypothetical changes in ecosystem services. These can be done by contingent valuation (CV), i.e., asking for willingness to pay (WTP) to increase or modifying the provision of ecosystem services (e.g., Chiabai et al., 2011; Kapper et al., 2017). The indirect monetary approach may also be implemented through choice modelling (CM), which aims to elicit and evaluate consumers' preferences towards (changes in) ecosystem services by asking respondents to choose between mutually exclusive hypothetical scenarios (e.g., Layton et al., 2000; Naidoo, 2005, Wang et al. 2007). The hypothetical nature of the indirect market approach raises concerns regarding the validity of the estimates (Kontoleon et al., 2007). The main concern relates to the hypothetical bias, that is, to what extent respondents' hypothetical answers would reflect their actual behaviour if they were faced with these costs in real life.

The direct monetary approach is not built on hypothetical answers, but rather actual market data. It mainly includes the hedonic pricing method (HPM) and the travel cost method (TCM). Using these methods, values are inferred from parallel market transactions that are associated with the ES (Pascual et al., 2010). Specifically in environmental cost-benefit analysis (ECBA), the HPM is commonly used in the housing market to estimate the value of environmental attributes such as landscape aesthetics (e.g., Benson, 1998; Pascual and Muradian, 2010; Sander and Haight, 2012) and levels of noise and air pollution (e.g., Cohen and Coughlin, 2008; Kim et al., 2010). The HPM reveals information about the implicit demand for the environmental attribute associated with the housing market, and the differences in housing prices reveal the value of the respective environmental attribute. The TCM is mainly relevant for determining recreational values related to ecosystem services. The value of recreational ESs is inferred by estimating the demand function for visiting recreational sites. The travel cost acts as a proxy for the price, whereas consumer surplus is the estimated value of the ES (Fleischer, 2000; Bateman et al., 2002; Kontoleon et al., 2007;

Fleischer et al., 2018 a). Nevertheless, these methods can be used only if there is a parallel market—in the case of HPM—or information about the travel costs of the users in the case of TCM—which do not always exist.

Under the category of direct monetary approach, very few studies have evaluated ecosystem services as intermediate services in other goods and services markets. One example that we found is the work of Ricketts et al. (2004), who evaluated the pollination services of tropical forest as intermediate services in coffee production. Controlling for everything else, the difference in the coffee revenues between the fields that were pollinated by wild bees and those that were not reveals the monetary value of the regulating (pollination services) ES of the forest. To the best of our knowledge, this approach has not been applied in the valuation of landscape services. In order to fill this gap in the literature, we propose here a method of estimating the value of landscape aesthetics as an intermediate service in the agritourism market in Israel. Our approach can guide policies in their search for environmental sustainability. In particular, it can support land use decision making by providing monetary valuation of ESs (i.e. landscape aesthetics) and establish trade-offs with other economic activities. Applying the concept of ecosystem services to determine land-use change is not a novel approach. Indeed, many studies have applied this concept (e.g. Carreno et al.,2012; Mendoza-Gonzalez et al., 2012) by including the consequences of land-use change on the provision of ecosystem services to the society. However, the local demand or importance of the single ecosystem services has only recently been included (Burkhard et al., 2012). In this study we offer the examination a single ecosystem services, i.e. landscape aesthetics, and we also adopt an economic-theory-based model of demand and supply of agritourism, in which landscape aesthetics are intermediate service.

In particular, we adopted a discrete-choice equilibrium model with a structural demand and pricing equations model to represent the agritourism attraction market as an oligopolistic market with differentiated goods. The attractions in this market differ in their attributes both horizontally (e.g. the geographic region they are located in) and vertically (e.g. the quality of service and facilities). Part of their horizontal differentiation is reflected in their surrounding landscapes, including the landscape aesthetic ES. Based on distributional and other behavioural assumptions, we derived an estimable demand and pricing equations from the structural equations. We estimated the empirical model based on data collected from agritourism attractions in Israel by means of a face-to-face survey conducted in two non-consecutive years. We also integrated data on the surrounding landscape viewed from the attractions by using GIS. Lastly, we conducted counterfactual analyses for few scenarios of urban sprawl over both natural and agricultural lands as well as agricultural sprawl over natural land. The change in welfare under the different scenarios was used as the value of the lost landscape aesthetics services in the agritourism attraction market.

Our key results are as follows: 1) We show that agricultural, natural, and urban landscapes can be treated as attributes in a differentiated goods market such as agritourism attractions. 2) Our empirical estimates reveal that, ceteris paribus, the larger the agricultural and natural landscapes viewed from the agritourism attraction, the higher the market share of the attraction. 3) We show that agricultural and natural landscapes can be considered as substitutes for each other. 4) The counterfactual analyses reveal that urban sprawl of around 30 km^2 over agricultural or natural landscapes results in an average welfare loss of US$108,000 and US$197,000 per lost square kilometre, respectively. In the case of agricultural sprawl of the same magnitude over natural landscape, the average loss is US$141,000 per square kilometre of natural landscape.

This article makes two major contributions. We illustrate that when there is no market for landscape aesthetics services, considering them as intermediate services (or attributes) in the provision of a market good can reveal their value using aggregate market data. This direct approach relies on an economic equilibrium model rather than on hedonic pricing or TCM. We demonstrate how the change of welfare can be used as a valuation for cultural ecosystem services. This is a novel method for ascertaining the market value of cultural services.

2. Background – Ecosystem services and agritourism market in Israel

The Israel National Ecosystem Assessment (I-NEA) was designed to present a comprehensive picture of the state and trends of Israel's ecosystem services across all ecosystems (Lotan et al., 2017). In Israel, abiotic parameters (e.g. geology, soil, precipitation and temperatures) vary substantially over short distances, affecting the variability of ecosystems. This unique ecological diversity dictated the classification of six different ecosystems: Mediterranean, desert, marine, inland waters, agricultural, and urban. We refer here to the Mediterranean, desert, marine, and inland waters as natural landscapes. A national analysis of land use underlines a trend of conversion from open landscapes to urban land uses, at an average rate of 10–13 km^2 per annum (which represent almost 6% of the country's total area), over the past decade. Fragmentation caused by urban sprawl, as well as by some types of agricultural production, rural settlements, and infrastructure have substantially negative effects on the environment, including biodiversity and ecosystem services provided by the different natural and agricultural landscapes. Increased urbanisation may cause a decrease in vegetation distribution, density, and relative cover, which, in turn, may impose severe consequences on some ecosystems and hamper their ability to provide vital services. It is thus imperative to consider these effects on the state of nature in Israel and other countries with similar trends when planning future infrastructure development and urban expansion ('Israel Sustainability Outlook 2030', 2012).

2.1 The Agritourism Market

As in many Western countries, agritourism is an emerging economic activity in the rural areas in Israel(Tchetchik et al., 2008). While initially agritourism mainly involved hospitality services, it now includes agritourism attractions such as agricultural-based recreational activities, agricultural education, and a variety of rural-based outdoor recreation opportunities. The two former types of activity are offshoots of active farms (e.g., pick-your-own ventures, harvest festivals) and the latter, although not agricultural in essence (e.g., outdoor recreation activities), are grounded in the rural ambience, (while their operators may, regardless, run active farms). In any of its forms, agritourism enables the use of an existing idle labour force that consists of family members or employees who are already working on the farm (Fleischer et al., 2018 b).

In Israel, as in Europe and the United States, processes of adopting rural tourism and agritourism as an inseparable element of the rural ambiance are accompanied by supportive policies and government intervention as part of a broader rural restructuring agenda that emphasizes pluriactivity and diversification. Without such intervention, the market cannot achieve national goals such as retaining rural areas populated and preservation of open spaces due to their public-good nature. Over the years, the Ministry of Tourism and the Ministry of Agriculture and Rural Development have supported rural tourism entrepreneurs through subsidies, tax benefits, planning and consulting, tourism incubators, and the establishment of tourist villages. Other means of support consist of granting indirect subsidies to improve infrastructures, physical environment and access, and the initiation of physical or thematic attractions such as visitor centres and festivals that facilitate and increase visitors' demand for any specific rural village. All of these programs improve the competitive environment in which the attraction operates and competes with both other rural attractions in the same or other rural regions and attractions and leisure opportunities in urban centres. Although most agritourism activities depend on infrastructure, accessibility, and other factors, the fundamental importance of natural and agricultural scenery has been demonstrated. Using the TCM, Fleischer et al. (2000) revealed the substantial value of agricultural landscape, which exceeds by far the net returns to farming in the studied region. In this sense, adapting the "new industrial organization" (NIO) approach, the agritourism market can be viewed as a differentiated goods market wherein the goods are defined in the characteristics' space in a Lancasterian sense (Lancaster, 1966). These characteristics include not only the attributes of the attractions, but also those of the surrounding ecosystem. Relying on the NIO, previous research has applied structural and econometric models to estimate the agritourism attraction market, assuming that both the demand and the marginal-cost equations are a function of their characteristics (Fleischer et al., 2018, Tchetchik et al., 2008). These structural and empirical models that derive from economic theory and use consumer and producers' surplus to evaluate environmental effects have largely employed to estimate the effects of fuel taxation policy (Pakes, Berry & Levinson, 1993; Xiao & Ju 2014). Nevertheless, neither have integrated the environmental components that characterize the agritourism attraction into the structural equations nor estimated the contribution of aesthetic ecosystem services to the total welfare in this market. The current study aims to fill this gap in the literature.

3. The model

The framework proposed for analysing the agritourism market applies a discrete-choice equilibrium model with product differentiation. The single attraction is defined over the characteristic space in a Lancasterian manner. This space includes the attributes of the attractions, the adjacent environment, and the region (the latter includes the degree of regional support, i.e., support for improvement of regional infrastructures). These attributes, jointly, affect market performance, i.e., market shares, prices, mark-ups, and welfare. The agritourism market consists of numerous firms that offer attractions that vary in terms of these attributes both vertically and horizontally. Two prominent horizontally differentiated aspects are the attraction themes available in the market (e.g., pick-your-own farms, wineries, farm tours) and their geographical location. Hence, in order to model the differentiation in the industry while preserving the model's tractability, we adopted a two-level nested logit model that allows preferences to be correlated along two discrete dimensions—the type of attraction and the location. (Appendix A elaborates on the development of a one-level system and shows results of one-level nested logit models). The two-level nested logit model allows cross-price elasticities to be greater between attractions from the same type and/or region.

We then follow the framework suggested by Berry, Levinsohn, and Pakes (1995) (henceforth BLP) and extended by Björnerstedt and Verboven (2016). According to the BLP framework, consumer-level demands are aggregated to form market share equations of the incumbent firms, and oligopolistic pricing equations are added to form an industrial equilibrium model. While BLP's unit demand specification measures market shares in terms of volume, the firms studied in the agritourism market (e.g., pick-your-own or agricultural tours) sell different products/services that cannot be aggregated in terms of numbers of units. Thus, Björnerstedt and Verboven's (2016) constant expenditures specification was deemed more suitable for our case. In this specification, the consumer does not choose to buy one unit of goods from firm *j*, but rather to spend a constant portion of his/her income on a particular good. Consequently, the empirical aggregate demand equation is expressed in monetary terms, i.e., aggregate expenditures instead of the number of units sold. Moreover, the constant expenditures specification, which enters price logarithmically instead of linearly, with the additional flexibility of the logarithm functional form, generates a more plausible range of elasticities and more reasonable mark-ups and yields more realistic average predicted price effects than the unit demand specification. The utility, aggregate empirical demand, and pricing equations are depicted below.

3.1 Demand

The utility function of visitor *i* from attraction *j* in market *t* is as follows:

$$(1)\ u_{ijt} = x_{jt}\beta + E_{jt}\beta + \xi_{jt} + \alpha f\left(y_{it}, c_{jt}\right) + \varepsilon_{ijt}.$$

We define two markets t = 1, 2 that capture a time-series dimension (t_1 = year 2014, t_2 = year 2018). This distinction of two markets is based on Kovo and Eizenberg (2017). Since our particular interest in this research is to examine the effect of the environmental attributes, we distinguish between x_{jt}, a vector of observed characteristics of the attraction, and E_{jt}, a vector of environmental attributes around the attraction. ξ_{jt} captures characteristics of the attraction that are observed by visitors and operators, but unobserved by the researcher. y_{it} is the individual's income, and c_{jt} is the cost of visiting the attraction, composed of the entrance fee to the attraction, p_{jt}, and a calculation of travel cost T_{jt} by private car from the largest metropolitan area— the Tel Aviv Metropolitan Area (TAMA)— where most visitors originate from, as follows: $c_{jt} = p_{jt} + T_{jt}$. The fact that TAMA is located in the central region of Israel and is the most populated area of the country, containing approximately half of the Israeli population (Lotan et al., 2017), makes it possible to consider travel cost T_{jt} as an exogenous variable. Hence, T_{jt} depends only on the distance of each attraction *j* from the centre of Israel. β and α are utility parameters and ε_{ijt} is a random utility term or an individual-specific taste parameter for attraction *j* in market *t*. Adopting Björnerstedt and Verboven's (2016) constant expenditure model, income and cost can enter the function non-additively, specifically:

(2) $f(y_{it}, c_{jt}) = \gamma^{-1} \ln y_{it} - \ln c_{jt}.$

Conditional on choosing attraction *j*, a visitor spends a constant fraction of their budget, γ. For specification (2), we can rewrite utility (1) as follows:

(3) $u_{ijt} = \alpha_i \, \gamma^{-1} \ln y_{it} + \delta_{jt} + \varepsilon_{ijt},$

where $\delta_{jt} \equiv x_{jt}\beta + E_{jt}\beta - \alpha \ln c_{jt} + \xi_{jt}$. Intuitively, one can interpret δ_{jt} as the mean utility component of attraction *j* in market *t*.

Each visitor *i* makes a discrete choice and chooses the attraction *j* that maximizes her/his random utility u_{ij}. Yet, the discrete choice model allows opting out, i.e., it does not force visitor *i* to choose from the given set of attractions *J*. Thus, an "outside good" is introduced into the model. A relevant outside good is one that competes with agritourism attractions, but whose price is exogenous to the agritourism market. A natural candidate for the outside good in this case is all other attractions that do not qualify as agritourism attractions. The mean utility of the outside good is normalized to zero, $\delta_{0t} = 0$.

The attractions are partitioned into two markets, t_1 and t_2. Each market is partitioned into *G* attraction type groups, *g* = 0_t,…, G_t (where group 0_t consists of the outside good) and each group *g* is further partition into H_g subgroups, *h* = 1, … , H_{gt} of geographical regions within types. Each subgroup *hg* of group *g* in market *t* contains J_{hgt} attractions, so that $\sum_{t=1}^{T} \sum_{g=1}^{G_t} \sum_{h=1}^{H_{gt}} J_{hgt} = J$.

Figure 1 presents the distribution of *J* agritourism attractions across *G* types and *H* regions.

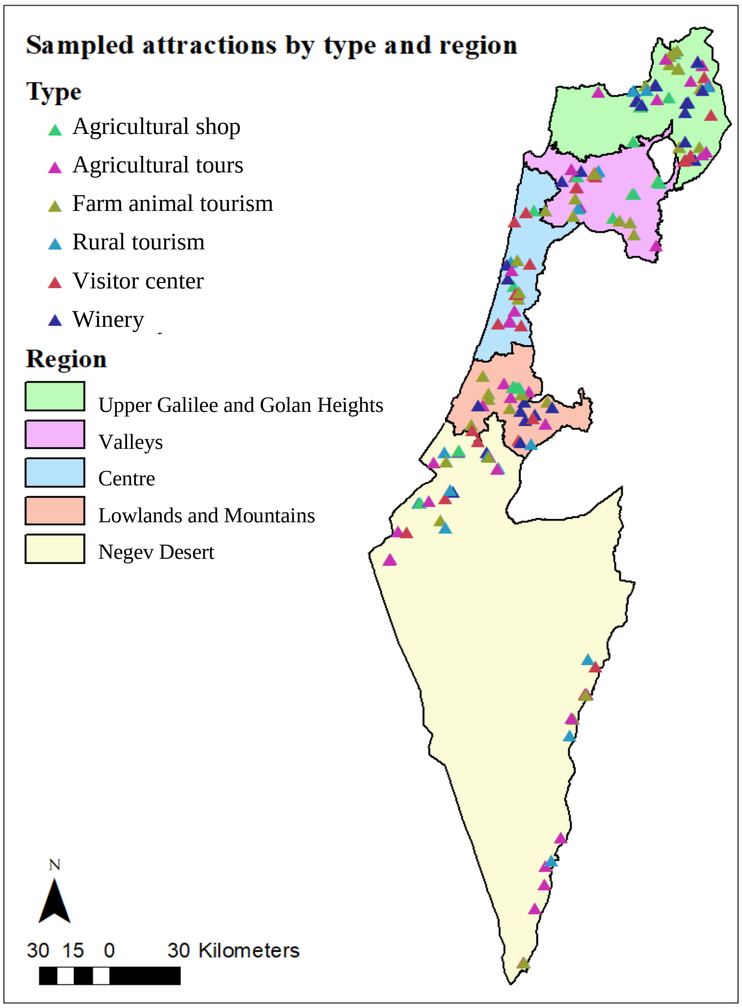

Figure 1: Sampled attractions by type and region

3.2 Aggregate Demand

Assuming that the random utility terms follow the extreme value distributional assumption, the probability that a utility maximizing visitor *i* will choose attraction *j* = 1 … *J* in market *t* takes the following form:

$$(4)\ s_{jt} = s_{jt}(\delta,\sigma) \equiv \frac{\exp(\delta_{jt}/(1-\sigma_1))}{\exp(I_{hgt}/(1-\sigma_1))}\frac{\exp(I_{hgt}/(1-\sigma_2))}{\exp(I_{gt}/(1-\sigma_2))}\frac{\exp(I_{gt})}{\exp(I_t)},$$

where I_{hgt}, I_{gt}, and I_t are the inclusive values or “log sum” formulas (see Appendix B); δ is a $J \times 1$ vector containing the mean utilities δ_{jt}; and $\sigma = (\sigma_1, \sigma_2)$ are the nesting parameters associated with the nested logit distribution. The nesting parameters capture the preference correlation across attractions in both markets (i.e., in t_1 = 2014 and t_2 = 2018) of the same *hg* subgroup, $\sigma_{1,}$ (substitution pattern within attractions at the same *type* and *region*) or *g* group, $\sigma_{2,}$ (substitution pattern within attractions at the same *type*) and should satisfy $1 \geq [\sigma_1, \sigma_2] \geq 0$ (Ben-Akiva et al., 1999). When σ_1 is high, preferences are strongly correlated across attractions of the same subgroup, and when σ_2 is high, preferences show additional correlation across attractions of the same group. If $\sigma_1 = \sigma_2 = 0$, the model is reduced to a simple logit model, so that preferences are not correlated across attractions from the same subgroups or groups.

For each market t, we observe the market size B_t, the number of visitors in each attraction q_{jt}, and its price p_{jt}. The market size B_t is defined as $B_t \equiv \gamma Y_t$ which is the potential visitors' total expenditures allocated to visiting attractions, including the outside good, as a constant share γ of the total income Y_t of the potential visitors in that market. The choice probabilities are thus represented as the market shares in monetary terms. We can then easily calculate the market share for attraction *j* in market *t*, $s_{jt} = \frac{p_{jt}q_{jt}}{B_t}$, and the outside good market share $s_{0t} = \frac{B_t - \sum_1^{J_t} p_{jt}q_{jt}}{B_t}$.

With $\delta_0 \equiv 0$ and $\exp(\delta_0/(1-\sigma_1)) = 1$, an analytical expression can be derived for s_{0t}:

(5) $s_{0t} = s_{0t}(\delta, \sigma) \equiv \frac{1}{\exp(I_{hg}/(1-\sigma_1))} \frac{\exp(I_{hg}/(1-\sigma_2))}{\exp(I_g/(1-\sigma_2))} \frac{\exp(I_g)}{\exp(I)}$.

Based on Berry (1994), in order to obtain the empirical expression of aggregate demand, we divided Equation (4) by Equation (5) and received the log ratio of the market share of each attraction normalized by the market share of the outside good:

(6) $\ln(s_{jt}/s_{0t}) = \delta_{jt} + \sigma_1 \ln(s_{jt|hgt}) + \sigma_2 \ln(s_{ht|gt})$.

s_{jt} is the revenue market share of attraction j_t and s_{0t} is the revenue market share of the outside good, which in our case includes other types of attractions not classified as agritourism. $s_{jt|hgt}$ is the revenue market share of attraction $j_t$within *type-region* subgroup hg, and $s_{ht|gt}$ is the revenue market share of subgroup *type-region*, *hg* in group type *g*. Equation (6) sets the basis for the estimation of the demand model, including the effects of the environmental characteristics on the attractions' market share.

3.3 Pricing

We assume that each attraction operator maximizes profits. In the short run, the decision variable is the price, while other characteristics of the attraction remain fixed. Each operator sets prices that maximize their profit given their attraction's attributes and the prices and attributes of the competing attractions. It is assumed that a Nash equilibrium for this pricing game exists and the equilibrium prices are at the interior of the operator's strategy sets.

In order to obtain the empirical pricing specification, we rearrange the first order conditions to receive:

(7) $$p_{jt} = mc_{jt} - \frac{q_{jt}}{\partial q_{jt}/\partial p_{jt}},$$

where mc_{jt} is the marginal cost of attraction *j* in market *t*, and q_{jt} is the number of visitors in attraction *j* in market *t*.

As Björnerstedt and Verboven (2016) demonstrated, the constant expenditure specification generates simple analytic expressions for the aggregate own-price elasticity of demand:

(8) $$e_{jj_t} = -\frac{dq_{jt}}{dp_{jt}}\frac{p_{jt}}{q_{jt}} = \alpha\left[\frac{1}{1-\sigma_1} - \left(\frac{1}{1-\sigma_1} - \frac{1}{1-\sigma_2}\right)s_{jt|hgt} - \frac{\sigma_2}{1-\sigma_2}s_{jt|gt} - s_{jt}\right] + 1$$

where $s_{jt|gt}$ is the revenue market share of attraction *j* within *type* group *g* in market *t*. Substituting (8) into (7), we receive the following expression for the mark-up:

(9) $$\frac{p_{jt}-mc_{jt}}{p_{jt}} = \frac{1}{e_{jj_t}} \quad .$$

Rearranging (8):

(10)

$$e_{jj_t} = \frac{\alpha\left[\left(1-s_{jt|hg}\right)(1-\sigma_2)+\left(s_{jt|hg}-\sigma_2 s_{jt|g}\right)(1-\sigma_1)-s_{jt}(1-\sigma_1)(1-\sigma_2)\right]+(1-\sigma_1)(1-\sigma_2)}{(1-\sigma_1)(1-\sigma_2)}$$

For the sake of simplicity, the nominator of (10) is defined as:

(11)

$$\varphi = \alpha\left[\left(1-s_{jt|hgt}\right)(1-\sigma_2)+\left(s_{jt|hgt}-\sigma_2 s_{jt|gt}\right)(1-\sigma_1)-s_{jt}(1-\sigma_1)(1-\sigma_2)\right].$$

Substituting (11) into (10) results in:

(12) $e_{jj_t} = -\frac{dq_{jt}}{dp_{jt}}\frac{p_{jt}}{q_{jt}} = \frac{\varphi+(1-\sigma_1)(1-\sigma_2)}{(1-\sigma_1)(1-\sigma_2)}$.

Substituting Equation (12) into Equation (9) results in the following absolute mark-up expression

$$p_{jt} - mc_{jt} = \frac{p_{jt}(1-\sigma_1)(1-\sigma_2)}{\varphi+(1-\sigma_1)(1-\sigma_2)}.$$

The absolute mark-up, then, is an explicit function of the price. Rearranging Equation (9) and taking the natural log from both sides results in:

(13) $\ln\left(p_{jt}\right) = \ln(mc_{jt}) - \ln\left(1-\frac{1}{e_{jj_t}}\right)$,

where $\frac{1}{e_{jj_t}}$ represents the mark-up expression. For $e_{jj_t} > 1$, the mark-up is a positive fraction between zero and one. Substituting Equation (12) for Equation (13) results in:

$$\ln\left(p_{jt}\right) = \ln(mc_{jt}) - \ln\left(1-\frac{(1-\sigma_1)(1-\sigma_2)}{\varphi+(1-\sigma_1)(1-\sigma_2)}\right).$$

By assuming that the marginal cost is log linear in the vector of cost attributes (BLP, 1995), i.e., $\ln\left(mc_{jt}\right) = W_{jt}\gamma + \omega_{jt}$, we obtain the following estimable empirical pricing equation:

$$(14) \quad \ln(p_{jt}) = W_{jt}\gamma - \ln\left(\frac{\varphi}{\varphi+(1-\sigma_1)(1-\sigma_2)}\right) + \omega_{jt},$$

where W_{jt} is the vector of observable cost attributes and ω_{jt} is the vector of unobservable cost attributes of attraction *j* in market *t*. The relationships in the data between the prices, market shares, and subgroup revenue shares will assist in identifying the substitution parameters σ_1, σ_2.

4. Description of data collection

The dataset for this study was collected from two major sources. Data from the agritourism attractions was collected by means of a face-to-face survey. The spatial data describing the ecosystems adjacent to each attraction was obtained by using different layers of GIS. We also used publicly available data for the different support schemes from the Ministry of Agriculture and Rural Development (IMARD) and additional data from the Central Bureau of Statistics (CBS).

4.1 Attraction data

The construction of the sample of agritourism attractions in Israel was based on a comprehensive nationwide census conducted by the IMARD (2013) that maps the entire supply of rural attractions in Israel and includes details about each site's name, geographical affiliation, classification, area of activity, and contact details. In total, 2,604 attractions were documented. For the purpose of our survey, attractions not related to farm activity or rural environment and attractions that were not private businesses (e.g., museums and information centres) were removed. The remaining set includes 566 attractions scattered across five distinct geographical regions, as defined by the IMARD. A sample of the market was conducted in two non-consecutive years, 2014 and 2018 (t_1 = year 2014, t_2 = year 2018). The sample size for each year was set at 20% of the population. A stratified random sampling procedure was employed according to the regions and the types of the attractions.

For the data collection, we used a comprehensive questionnaire that comprised a wide range of questions about (i) the attractions' characteristics, and (ii) a description of the activity offered by the attraction. Another group of questions referred to the annual economic performance in terms of (i) number of visitors, (ii) visitors' expenditure on site, including admission fees, (iii) capital investment, and (iv) labour inputs. Operators with active farms were also asked about their agricultural activity. The survey was conducted by means of face-to-face interviews and a tour around each attraction. Eventually, 84 attraction operators took part in the surveys in 2014 and 116 in 2018, representing 15% and 20% of the market in each year, respectively. Approximately18 attractions appear in both samples.

4.2 Data structure

The two markets t = 1, 2 that capture a time-series dimension (t_1 = year 2014, t_2 = year 2018) make it possible to examine changes in the agritourism market between these two time periods. In each year t, we observe a market consisting of a set of agritourism attractions J_t. The observations are divided into G_t groups representing different *types* of attractions, g = 1_t,…, 6_t. These types consist of (i) farm animal attractions, (ii) agricultural shops, (iii) wineries, (iv) agricultural tours (including pick-your-own), (v) visitor centres, and (vi) rural tourism (i.e., not directly agricultural but rural-based tourism, e.g., historical tours, educational workshops). We assumed that visitors choose either agritourism attractions or other tourist attractions. We therefore defined group 0_t as an outside good (i.e., all other attractions that do not qualify as agritourism attractions). The observations are then further partitioned into H_{gt} subgroups of attractions of the same type in the same region, h = 1_{gt}, …, H_{gt}. The regions are five geographical districts as determined by the IMARD (Figure 1 describes the distribution of the total attractions sampled by region and type). Each subgroup h of group g in market t contains J_{hgt} attractions, so that $\sum_{t=1}^{T} \sum_{g=1}^{G_t} \sum_{h=1}^{H_{gt}} J_{hgt} = J$, which is the total number of attractions.

4.3 Geo-spatial Data

In order to obtain variables that represent the natural and agricultural landscapes, we processed spatial GIS data from different sources. We first used an SRTM (Shuttle Radar Topography Mission) layer, based on an international research effort that obtains digital elevation models and generates a high-resolution topographic database of Earth.

We then used a land cover layer that was available on HaMaarag database (Israel's National Ecosystem Assessment Program), and divided it into three landscape categories; (i) natural, (ii) agricultural, and (iii) urban. Next, we applied the Viewshed tool on ArcGIS to calculate the km^2 of landscape visible from each attraction j. (Figures 2–4 describe the procedure of generating the main landscape variables.)

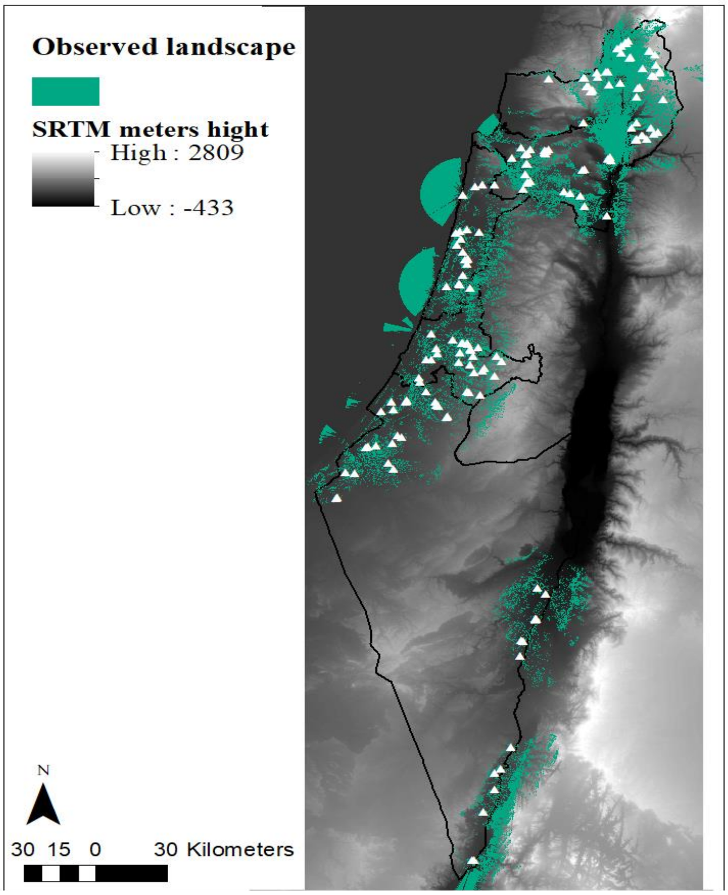

Figure 2: observable landscape from each attraction j

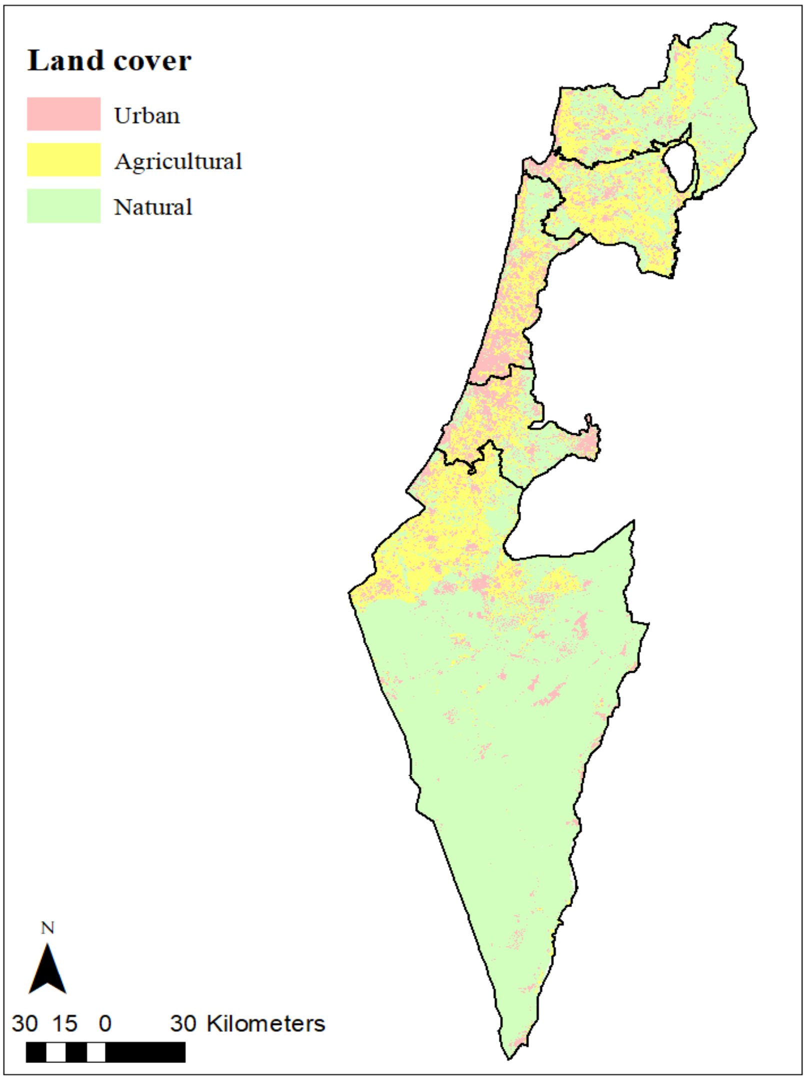

Figure 3: HaMaarag land-cover categories

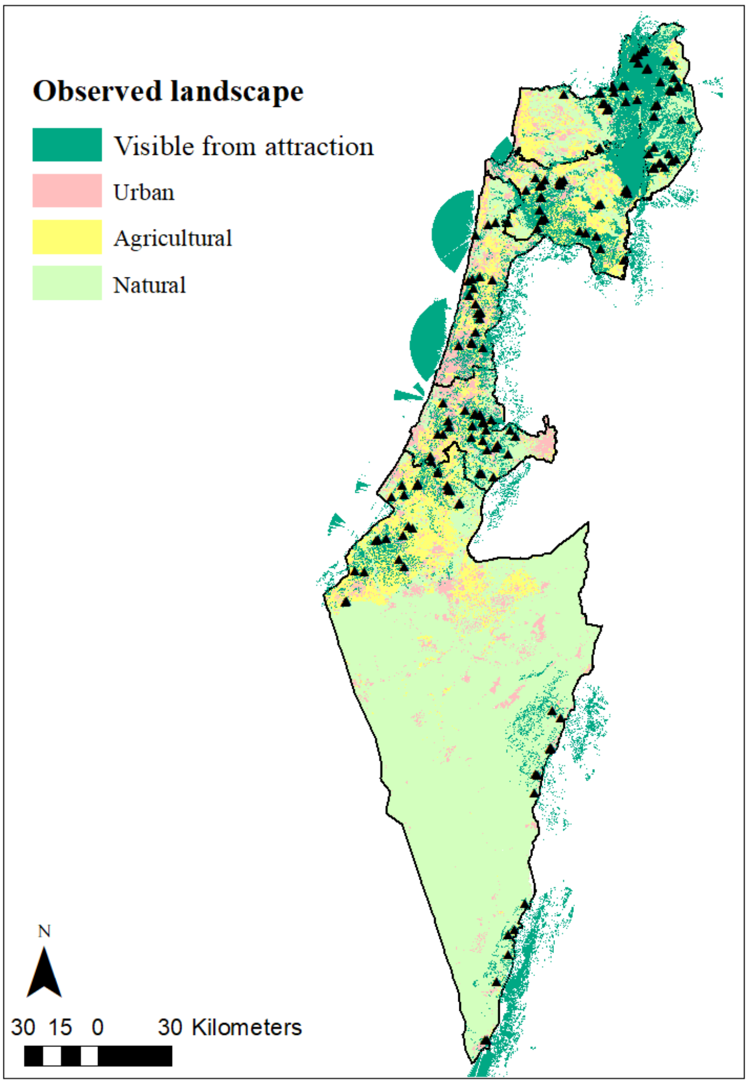

Figure 4: observed landscape from each attraction *j* by land-cover categories

The observed landscape of all three ecosystems reaches a distance of up to 20 km, which is assumed to represent the farthest edge of human eyesight. We also collected data on other spatial variables, such as the number of natural attractions (national parks and nature reserves) within a two-kilometre radius of each attraction. Another variable we calculated was the distance of each attraction from TAMA, the central and the most populated part of Israel. This variable was used mainly to control for accessibility to the market. *The additional spatial data were drawn from The Hebrew University of Jerusalem's GIS Centre*.

4.4 Governmental support data

Based on the Rural Development Plan as initiated by IMARD during the years 2006 to 2014, information on governmental support was retrieved from the Regional Anchors Program (RAP, 2008), which provides annual support by financing the infrastructure of walking paths, bike trails, signage, and site reconstruction in rural regional councils in Israel. The level of support granted to agritourism was examined both directly by the amount of regional financial support provided by the RAP, and indirectly by the strength of each regional council, i.e., peripheral index, socio-economic index, population density index, and so on. Population and socio-economic data were retrieved from the CBS data.

Table 1 presents the descriptive statistics of the variables collected and processed for the econometric estimation.

Table 1. Description and summary statistics of the variables

Variable	Description	Mean	SD
Estimated variables			
Revenue	Revenue of attraction *j* in market *t* in thousands of ILS	666.33	1,084.18
Subgroup revenue	Revenue of attractions within subgroup *type-region* in market *t* in thousands of ILS	2,897.08	2,936.33
Group revenue	Revenue of attractions within group *type* in market *t* in thousands of ILS	12,115.04	5,446.73
Price	Attraction *j* entrance fee in market *t* in current ILS	55.11	47.56

Variables in GMM simultaneous equations

Centre district	Distance from TAMA in km	107.66	73.82
Year 2018	=1 if attraction *j* was observed in 2018	0.58	0.49
Support district	Total RAP governmental support by district in 10^6 ILS	4.96	3.20
Agricultural landscape	Visible $km^2$of agricultural landscape from attraction *j*	15.78	19.27
Natural landscape	Visible $km^2$of natural landscape from attraction *j*	56.14	65.95
Urban landscape	Visible $km^2$of urban landscape from attraction *j*	8.57	9.59
Natural sites 2km	Number of national parks and forests within 2 km radius around attraction *j*	1.97	2.07
Attraction size	m^2 area that serves visitors	6.77	1.76
Food serve	=1 if food and beverages are offered at attraction *j*	0.62	0.49
Access index	Level of accessibility to attraction *j* scaled 1-10*	4.05	0.90
Non-agr. sale	=1 if non-agricultural goods are offered for sale in attraction *j*	0.29	0.45

Currently farmer	=1 if attraction *j*'s operator is an active farmer	0.78	0.42
Farm-based attraction	=1 if attraction *j* offers farm-based activities	0.40	0.49
Own agri. sale	=1 if agricultural produce are offered for sale in attraction j	0.65	0.48
Cooperation	=1 if respondent indicates cooperation with other operators	0.74	0.44
Excluded instrumental variables			
Av. *p* of other types within region	Average price of other types of attractions within the same region in market *t*	162.77	64.79
Av. *p* within region	Average price of all other attractions within the same region in market *t*	162.77	65.12
Peripheral index*	As determined by Israel CBS (1, most peripheral to 10, least peripheral)	4.29	1.84
Density soc-econ*	Integrated index of population density and socio-economic level assigned to attraction *j*’s regional council	241.34	64.09

Ad costs	Annual advertisement costs in ILS	15,369.50	24,150.63
# type	Number of similar attractions in market *t*	19.67	5.30
# region	Number of attractions in region in market *t*	28.11	12.59
# type-region	Number of similar attractions within the same region in market *t*	6.24	3.49

Notes: The exchange rate for $1 = 3.7 ILS in December 2018.
* of the regional council.

5. Results

We estimated a two-level nested logit model that defines attraction type as the upper nest and region as the lower nest, implying that visitors would tend to choose as a substitute the same type of attraction in another region rather than a different type of attraction in the same region (we also tried the reverse nested structure; see discussion below).

Estimating aggregate discrete choice models requires determining the size of the potential market, which in the constant expenditure specification is the total potential budget *B* allocated to the consumption of the market's goods, including the outside good (i.e., agritourism attractions as well as other tourism attractions). According to the Israeli CBS and as of 2013, the total domestic tourism consumption of recreational, cultural, and entertainment activities is estimated at ILS 747 million. We used this figure as the potential budget in 2014 and multiplied it by the relevant Consumer Price Index (1.05) to obtain the potential budget in 2018—ILS 784 million.

5.1 Estimation Procedure

The empirical demand and pricing equations, (6) and (14) respectively, consist of a system of nonlinear simultaneous equations. The system yields an equilibrium model of the agritourism attraction market in Israel across time. The estimation of this system raises several econometric difficulties. First, the variables q_{jt} and p_{jt} (that also comprise the market-share variables $s_{jt|gt}$, $s_{jt|hgt}$ and $s_{ht|gt}$) are endogenous, which means that instruments are required. Note that the equations include observable attributes. Accordingly, by construction, the error terms ξ_{jt} and ω_{jt} include unobserved attributes of the attractions. Since the error terms are both functions of the unobserved characteristics of the same attraction, they might be correlated. This implies that efficiency and hypothesis testing require treating the estimated equations as a system. An additional challenge is posed by the nonlinearity of the equations and the fact that cross-equation restrictions are required, since the parameters σ_1, σ_2, and α appear in both equations. To address these difficulties, the equations are estimated as a system using the generalised method of moments (GMM). The GMM estimator takes into account the above econometric issues and provides consistent estimates of the above system. Moreover, GMM requires no additional assumptions regarding the joint distribution of the error terms. It also allows for heteroscedasticity of all kinds as well as for combining more moments than required and thus exploiting most of the sample's information.

5.2 Excluded Instruments

Instruments are required to overcome the simultaneity and endogeneity of the different levels of revenue share variables and the price variable. We started from the commonly used identification assumption that the attraction characteristics (not including the different revenue shares and price) are uncorrelated with the error terms, i.e., are exogenous. The attraction's characteristics and its adjacent environmental attributes are thus natural instruments, but additional instruments are required to identify the coefficients of the different revenue shares and the price.

We used three types of instruments in both equations. The first was the average prices of rival attractions, which are positively correlated with the price of attraction j, and negatively correlated with the revenue share of attraction *j*. Berry et. al. (2016) suggested using cost shifters (also known as “BLP instruments”) as instruments for the price . These are functions of competing products. The intuition that led to the choice of these instruments follows from one of the features of oligopoly pricing—goods with close substitutes will tend to have low mark-ups, whereas other goods will have high mark-ups and thus high prices relative to marginal cost. Hence, these instruments shift equilibrium mark-ups while shifting market shares conditional on prices.

The second type, the instruments used for *type-region* revenue share, which appears in both the demand and pricing equations, consists of counts of the number of attractions in the same type-region nest. They are negatively correlated with the firm’s sub-nest share. Björnerstedt and Verboven (2016) used these instruments to reveal substitution patterns.

Lastly, we used other exogenous demand and cost shifters. The instrument for the price coefficient in the market share equation is an exogenous socio-economic cost shifter, the peripheral index, which is uncorrelated with the demand’s shocks. This variable is negatively correlated with costs, meaning that the less peripheral the firm is, the more it enjoys infrastructure and accessibility to services and thus the less costly it is. An excluded demand shifter that is uncorrelated with the pricing equation’s shock is the firm’s engagement in advertisement (since our structural equations are defined over the attributes’ space, the latter does not qualify as an attribute (see Fleischer et al., 2018). This instrument represents managerial efficiency and proactivity, correlated significantly and positively with market shares. A detailed list of instruments, including their descriptive statistics, is presented in table 1. Tables 2 and 3 present the first-stage regressions of the endogenous variables on the instrument set.

In order to determine the instruments’ validity, correlation with the endogenous variables was tested by regressing each endogenous variable on the entire set of excluded instruments and assessing the F test results. All relevant instruments were included, so that there are more instrumental variables then endogenous variables and the system is over-identified. The F test for the joint significance of the excluded instruments is significant and sufficiently high, indicating that the instruments are appropriate (see tables 2, 3).

Table 2: Demand Nested Logit First-Stage Estimates

	$\ln(p_j)$	$\ln(s_{j\|hg})$	$\ln(s_{h\|g})$
Average *p* within region	0.002***	0.001	-0.005***
	(0.001)	(0.003)	(0.001)
Peripheral index	-0.242***	0.308**	-0.109
	(0.046)	(0.152)	(0.082)
Density soc-econ	0.001	-0.005**	0.002**
	(0.001)	(0.002)	(0.001)
# region	0.003	-0.004	0.022***
	(0.003)	(0.011)	(0.006)
# type	-0.004	0.006	-0.034***
	(0.006)	(0.02)	(0.011)
# type-region	-0.008	-0.212***	0.158***
	(0.012)	(0.041)	(0.022)
F-test excluded instruments	27.87	11.92	28.67

Table 3: Pricing Nested Logit First-Stage Estimates

	$\ln(s_j)$	$\ln(s_{j\|hg})$	$\ln(s_{j\|g})$
Average *p* of other types within region	-0.01***	-0.004**	-0.009***
	(0.002)	(0.002)	(0.002)
Ad costs	0.00001***	0.00001***	0.00001***

	(0.000)	(0.000)	(0.000)
# type-region	-0.018	-0.232***	-0.046
	(0.028)	(0.026)	(0.028)
Density soc-econ	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
F-test excluded instruments	12.41	27.20	10.76

5.3 Demand and Pricing Parameters in the Agritourism Attraction Market

Table 4 presents the estimated demand and pricing parameters for the two-level nested GMM. In general, logit models of nests partitioned into sub-nests are valid at every level of the nesting. Clearly, the number of potential structures reflecting the correlation among alternatives can be very large. According to Ben-Akiva et al. (1999), no technique has yet been proposed to identify the most appropriate structure directly from the data. We focus here on the two-level nested logit system, since of the three systems that were tested—two-level nested GMM, one-level type-nested GMM, and one-level region-nested GMM—we chose the most informative model (see Appendix A for further elaboration on the one-level nested GMMs). We also estimated a model with the reverse nesting order (where the upper nest σ_2 represents a substitution pattern within attractions in the same *region*, i.e., visitors would prefer to engage with another region rather than another type), but this led to inconsistent and insignificant estimates of the nesting parameters where σ_1 σ_2 approach zero. We therefore ruled out this reverse nesting structure.

Table 4 - GMM Estimates of Two-Level Nested Logit Demand and Pricing Parameters

	Coefficient	Standard error
Demand		
Year 2018	0.07	0.18
Support district	0.002	0.02
Ln agri. landscape	0.38**	0.2
Ln nat. landscape	0.19**	0.08
Interaction	-0.04*	0.03
Ln urban landscape	-0.46	0.34
Nat sites $2km$	0.06**	0.03
Ln attraction size	0.10***	0.04
Food serve	0.36**	0.15
Access index	0.11	0.09
Non-agr. sale	0.07	0.12
Pricing		
Year 2018	-0.2**	0.09
Support district	-0.01	0.01
Currently farmer	-0.25**	0.11
Agri-based attraction	-0.31***	0.09
Access index	0.09*	0.05
Own good sale	0.22**	0.09
Cooperation	-0.24**	0.1
Non-agr. sale	-0.20**	0.08
Joint Parameters		

Price α	0.57*	0.31
Type-region sub-nest σ1	0.47***	0.17
Type nest σ2	0.55***	0.19
Number of observations	200	

Notes: There are 84 observations from 2014 and 116 observations from 2018.
Significance levels are determined by * $p<0.10$, ** $p<0.05$, *** $p<0.01$

The price coefficient, the subgroup nest, and the group nest parameters have satisfying significant estimates with the expected signs, i.e. α = 0.57, σ_1 = 0.47, and σ_2 = 0.55, respectively. These estimates satisfy the requirements for the model's consistency with the discrete choice theory, $1 \geq \sigma_1, \sigma_2 \geq 0$ (Ben-Akiva et al., 1999) with statistically significant strict inequalities. In their article on the analgesics market, Björnerstedt et al. (2016) followed a strict requirement that the nesting parameters should satisfy—$1 \geq \sigma_1 \geq \sigma_2 \geq 0$, implying that when σ_1 is high, preferences are strongly correlated across the same subgroup, and when σ_2 is high, preferences show additional correlation across the same group. In our case, the implications are slightly different. The results reveal that visitors perceive attractions within the same type as preferable to attractions of different types, regardless of the region.

The coefficients of the ecosystem variables (the area of visible natural and agricultural landscape and number of natural sites within a two-kilometre radius) are positive and significant, while the coefficient of the urban landscape variable is not significant. The results suggest that visitors prefer agricultural and natural landscapes over urban landscapes. The negative coefficient of the interaction variable indicates that agricultural and natural landscapes are substitutes for each other. The latter result is in accordance with the findings of Fleischer and Tsur (2003) that the different open spaces in Israel are considered substitutes for each other. As noted in the background section, there is considerable variability among natural landscapes in Israel. This scenic diversity within natural landscapes is not expressed in the model, which in turn treats different natural landscapes as though they possess equivalent values (e.g., desert landscape is not necessarily as valuable as Mediterranean landscape).

An examination of the coefficients of the control variables in table 4 reveals that visitors did not significantly change their preferences towards the agritourism market across time, as denoted by the coefficients of the year dummy variable, which is insignificant. Furthermore, attractions that serve food and beverages and greater size of the site are also favourable attributes.

Let us now consider the results of the estimated parameters of the pricing equation. Note that the coefficients should be interpreted as the impact of the different attributes on the marginal cost, and not directly on price (BLP, 1995). Accordingly, the negative significant coefficient of the year variable 'Year 2018' in the pricing equation suggests that attractions have become more efficient over time, resulting in lower marginal costs. The negative coefficients of 'currently farmer' and 'farm-based attraction' indicate that attractions operated by active farmers (regardless of whether the attraction is based on an active farm) and attractions that are based on active farms and/or are inherently agricultural result in lower marginal costs than other attraction types. Active farmers who operate non-agricultural attractions and agritourism attractions that are inherently agricultural can enjoy scope economies, i.e., use idle labour on their farms while operating agritourism businesses, or by using the farm production factors as an intermediated good at the attraction in the latter case (e.g., tractor ride, a winery tour), lowering marginal costs. These results confirm the aforementioned beliefs stated in the literature that it is more cost-efficient for farmers to diversify to tourism attractions that are linked to active farms. Sales of farm produce at the attraction venue raise marginal costs. This result is similar to that described in Fleischer et al. (2018). It might be that the sales of farm produce are considered part of the experience, especially in agricultural-based attractions. Thus, the operator offers them below marginal costs prices, also as a way to self-promote the farm brand. In contrast, additional sales of other non-agricultural goods lower marginal costs. The coefficient of *Non-Agr Sale,* i.e., non-agricultural goods that are offered for sale at attractions, is negative and significant, meaning that firms that offer non-agricultural goods for sale enjoy lower marginal costs. The coefficient of the variable *Access Index* indicates that better access to the attraction raises marginal costs. Finally, it appears that better cooperation between attractions lowers marginal costs.

5. Counterfactual Analysis

In order to provide market values for landscape services of agricultural and natural ecosystems to the agritourism market, we used counterfactual scenarios of urban sprawl. The I-NEA (2017) report underlines the continuous trend of conversion from natural and agricultural land to urban land use. The decisions regarding land conversions are based mainly on market values of other ecosystem services, such as the value of agricultural produce. Nevertheless, due to the absence of specific markets, the value of the lost landscape is not always considered and is not rigorously estimated. The counterfactual scenarios make possible the valuation of welfare lost in the agritourism market as a result of lost landscapes. We used this lost welfare as the value of the lost landscape services to the agritourism market.

We conducted three counterfactual scenarios. For the sake of comparison, in each scenario an area of approximately 80 km^2 was converted from one use to the other. In order to maintain the size of the land conversion, we chose the following scenarios: (1) We increased the urban landscape viewed from each attraction by five percent at the expense of the natural area that was visible from the attractions before the simulation; (2) We increased the urban landscape viewed from each attraction by five percent at the expense of the agricultural area that was visible from the attractions before the simulation; (3) we increased the agricultural landscape viewed from each attraction by 2.5 percent at the expense of the natural area. The third scenario was chosen in order to demonstrate how the value of natural landscape changes when the natural landscape is not overrun by urban sprawl. Since there is a substitution effect between natural and agricultural landscapes (as revealed by the estimated demand coefficients), we expected the value of the natural landscape to differ depending on whether it was being replaced by urban or agricultural landscape. The total lost area in each scenario was similar and was approximately 80 km^2 over the two periods.

In order to obtain the change in the different market performance indicators resulting from the above counterfactual analyses, we used Frontline Systems Analytic Solver to solve the system of 200 equations, each one of which represented an observation. The endogenous variables in each equation are the revenue share and the price. Thus, the solution for this system yields the equilibrium revenue shares for each one of the agritourism attractions. Once we have the equilibrium revenue shares, the number of visitors and prices are readily calculated. Using the counterfactual mechanism makes it possible to determine how prices, number of visitors, distribution of profits, consumer surplus, and market welfare change in response to policy measures regarding land-use change and urban sprawl (see Appendix B for the formulation of consumer surplus).

Column (a) in table 5 presents the equilibrium values of the sampled attractions before employing the counterfactual scenarios. It includes the number of visitors, revenue shares, and size of the observed landscapes. Column (b) presents the same information, but this time it is extrapolated to the entire market of agritourism attractions based on the IMARD census (see Section 4.2). In 2014, the values were multiplied by a factor of 6.74 (i.e., the total number of agritourism attractions, 566, divided by the sample observations, 84), and in 2018 by a factor of 4.88 (i.e., 566 agritourism attractions divided by 116 sampled attractions). The total area of natural and agricultural landscapes in column (b) is their current total size in Israel, based on the I-NEA GIS database.

Columns (c) and (d) present the percentage of change relative to the current state of market performance as a result of a 5% increase in urban sprawl over natural and agricultural areas, respectively, while column (e) presents the relative change as a result of a 2.5% increase in agricultural sprawl over natural landscapes (as mentioned above, we chose this level as it results in the same loss of natural and agricultural areas as in (c) and (d), respectively). Scenarios (1)–(3) refer to the market year 2014. Scenarios (4)–(6) refer to the market year 2018.

The counterfactuals show that agricultural and natural landscape loss causes declines in the number of visitors, profits, consumer surplus, and market welfare. We also observed that, compared to agricultural landscape loss, natural landscape loss takes a higher toll on the agritourism attraction market across all indicators and in the two market years, in line with the assumption that, in general, natural landscape is conceived as more valuable than agricultural landscape.

Based on the change in total welfare in each scenario, we could evaluate the economic value per km^2 of natural and agricultural landscapes lost as a result of competitive land use sprawl by dividing the total loss in welfare by the size of the lost landscape area in km^2. The average weighted values per km^2 of open landscapes for the years 2014 and 2018 are reported at the bottom of table 5. We show that when the urban sprawl takes over natural landscape, the value of a lost km^2 is higher than when it takes over agricultural landscape. The value of the lost km^2 of natural landscape in favour of agricultural land expansion is lower than the loss value in the case of urban sprawl, presumably due to the substitution effect.

Table 5. Counterfactual analysis for sprawl over agricultural and natural landscapes (LS)

			5% change		2.5% change
	Sample current state (a)	Estimated market current state (b)	Urban sprawl over natural LS (c)	Urban sprawl over agricultural LS (d)	Agricultural sprawl over natural LS (e)
Market year 2014			(1)	(2)	(3)
Total visitors(000')	1.2	7.8	-9%	-1%	-7%
Consumer surplus (M)	66.0	444.7	-9%	-3%	-6%
Producer surplus(M)	31.1	209.5	-9%	-5%	-7%
Welfare(M)	97.1	654.2	-9%	-3%	-7%
Landscape km^2	4,139 (1,111) †	14,941 (4,112)†*	-1%	-3%	-1%
LS value ILS per km^2			282,647	117,143	214,664

			5% change		2.5% change
	Sample current state	Estimated market current state	Urban sprawl over natural LS	Urban sprawl over agricultural LS	Agricultural sprawl over natural LS
Market year 2018			(4)	(5)	(6)
Total visitors (000')	1.6	7.9	-6%	-1%	-3%
Consumer surplus (M)	113.4	553.5	-5%	-3%	-3%
Producer surplus (M)	34.7	169.2	-10%	-8%	-7%
Welfare (M)	148.1	722.7	-6%	-4%	-4%
Landscape km^2	3,471 (2,046)†	14,941 (4,112)†*	-2%	-3%	-1%
LS value ILS per km^2			155,091	102,992	101,695

Weighted average of landscape value in the years 2014 and 2018	Value in ILS per		
	Urban sprawl over natural LS	Urban sprawl over agricultural LS	Agricultural sprawl over natural LS
Landscape value (M)	196,545	107,586	141,436

Notes: explanations regarding current states, landscapes' values and weighted values are provided in Section 6.
† Landscape km^2: natural landscape (agricultural landscape). *Total landscape by I-NEA, 2016

7. Concluding remarks

By 2050, the world population is predicted to reach 9.7 billion and urban population to expected to increase by 2.5 billion. As a result, the total area covered by the world's urban areas is set to triple in the next 40 years at the expense of the surrounding countryside, including agricultural areas (*United Nations*, 2019). This phenomenon encompasses many social, economic, and environmental implications and poses a major threat to the future sustainable development of the planet. Thus, it is crucial for urban planners and policy makers to account for the economic value of the entire range of ecosystems services provided by open space when making decisions regarding land use allocation.

While agritourism attractions depend on their own tangible and intangible attributes, the essential contribution of the surrounding landscape aesthetics to the agritourism market has been shown. This study suggests a framework to translate this contribution into a monetary value and raises several key points that may contribute to land management decision making. We introduce a novel direct monetary method for the valuation of cultural services, in particular, landscape aesthetics, for both the natural and agricultural ecosystems in Israel. We achieve this by estimating a structural economic model of the agritourism attraction market and implementing counterfactual scenarios to simulate changes in land use and calculate their impact on market welfare.

Our results suggest that natural landscapes are more valuable to the agritourism market in Israel than agricultural ones. This specific result cannot be generalized to other countries or regions, as these preferences depend on the composition of different landscapes, which differ across countries, regions, and cultural contexts. Nevertheless, we can generalise that increasing the share of urban landscape to which visitors are exposed when visiting attractions is probably the least favourable alternative. Moreover, this study unveils a range of substantial benefits to society that can be obtained by using an economic framework in environmental valuation. We hope that these understandings and their demonstration through the model and counterfactuals illustrate the practical potential for the application of direct, market-contingent, economic valuation to decision making.

It should be noted that when measuring the total economic value of ecosystems, all services must be considered, and their contributions should be measured as a whole in relation to all human wants and needs. Thus, it is important to emphasize that this study examines only one particular facet of cultural ecosystem services (setting aside other important services), in one particular market (setting aside all other markets that benefit from ecosystem services). Accordingly, while we revealed important aspects of the value of landscapes to the agritourism market, their economic value would increase substantially if additional benefits, such as their contribution to other markets and in other non-market settings, were considered in future research. Policy makers who take into consideration these values would then be able to provide economic incentives for open space conservation.

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