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Estimating the economic value and impacts of recreational trails: a case study of the Virginia Creeper Rail Trail

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Many communities are interested in developing and maintaining recreational trails to benefit trail users and as tourist attractions to stimulate economic growth. In this paper, a study is described which estimates the net economic value to trail users and the local economic impacts of the Virginia Creeper Rail Trail in south-western Virginia, USA. The monetary valuation results suggest that the trail is a highly valuable asset to the people who enjoy using it and to local businesses who benefit from trail-related tourist expenditures. The integrated valuation methodology and results can facilitate quantification of recreational trail economic benefits in other locations.

Keywords: recreational trails; trail user economic value; tourist expenditures; local community economic impacts

Government agencies and private organizations have invested much time, effort and money developing and maintaining trails for bicycling and hiking. These trails provide a variety of benefits to users, including opportunities for exercise,

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nature enjoyment and spending time with family and friends. Recreational trails also benefit communities by providing a place for local people to gather and relax and by attracting tourists who spend money in the local economy. Given limited budgets and the costs of developing and maintaining trails, there is a growing interest on the part of government agencies and private organizations to quantify, monetarily, the benefits of recreational trails. This would allow commensurate comparison of trail benefits to the costs of trail development and maintenance. Quantification of benefits and costs also allows comparison of the economic benefits of trails to other types of competing uses of public and private resources, including scarce funds and land.

The benefits to people themselves from trail biking and hiking can be measured in terms of net economic value or willingness-to-pay (WTP) above and beyond what a person actually has to pay to bike or hike on a trail. Siderelis and Moore (1995) measured the net economic value of three trails located in California, Iowa and Florida, USA, and Bennett *et al* (2003) measured the net economic value of countryside trail access in the UK. In another study, Betz *et al* (2003) measured the net economic value of a proposed rail-trail in Georgia, USA.

The benefits to local communities of trail tourist spending can be measured in terms of economic impacts. Economic impact analysis measures the changes in total output, income and/or employment resulting from changes in tourist spending (Bergstrom *et al*, 1990; Stynes, 2004). Total economic impacts are composed of the direct, indirect and induced effects. Direct effects are equivalent to total tourist spending. Indirect effects are the 'ripple effects' of tourist spending as expenditures on secondary inputs are increased in order to meet tourists' spending demands.

Moore *et al* (1994) measured tourist spending in local economies associated with visits to recreational trails in California, Florida and Iowa. Bennett *et al* (2003) measured tourist spending in local economies associated with visits to a recreational trail in the UK. By measuring only tourist spending, both of these studies captured the direct effects of trail-related expenditures.

As indicated above, only a few studies have measured the net economic value and economic impacts of recreational trails, but they represent a very small fraction of the multitude of trails across the USA, Europe and the rest of the world. The study reported in this paper helps to fill this gap and goes beyond previous studies by estimating not only the direct effects of trail-related spending but also the indirect and induced effects.

Another rather unique feature of this study is that state-of-the-art methods for estimating recreation trail use, net economic value and total economic impacts (direct, indirect and induced effects) are employed and reported in an integrated framework. In particular, trail visitation is explicitly estimated using primary data, in addition to modelling economic benefits and impacts per person per trip. In contrast, previous recreational valuation studies often use secondary estimates of recreational visits to calculate aggregate net economic value and impacts per trip.

The study reported in this paper quantifies the economic value to individuals and the economic impact to the local community of the Virginia Creeper Trail (VCT). The VCT is a rail-trail in the south-western part of Virginia which was developed and is maintained by federal, state and local government agencies,

together with private organizations. The trail is well known regionally and is often considered a model for rail-trail development elsewhere.

This paper is organized as follows. First, a brief description and history of the VCT are provided. Next, a conceptual background discussion of economic value and impact concepts and measurement is provided. Then, empirical estimation of economic value and impacts are discussed and results presented. The paper concludes with a summary and discussion of the interpretation and implications of key findings.

The Virginia Creeper Trail

The VCT is a 34-mile long rail-trail from Abingdon (elevation 2,065 ft) to Whitetop Station (3,576 ft), Virginia (see Figure 1). It is completely situated within Grayson and Washington counties. The midpoint of this rail-trail is Damascus, Virginia. Damascus (1,930 ft) is known as 'Trail Town, USA', being located at the intersection of five major trails: the Appalachian National Scenic Trail, the Virginia Creeper National Recreation Trail, the Transcontinental Bicycle Trail, the Iron Mountain Trail and the Daniel Boone Trail, all or parts of which are included in the Jefferson National Forest and the Mount Rogers National Recreation Area. The VCT has a number of public access points along its length. Permitted uses of the trail include foot travel, horseback travel and biking.

The VCT's origin as a recreation resource can be traced to the abandonment, by Norfolk and Western in 1977, of the rail line connecting White Top and Abingdon (Davis and Morgan, 1997). Around this time, citizens of Abingdon suggested transforming the corridor into a rail-trail. They faced stiff opposition from local landowners wanting the right-of-way returned to them and constraints due to the timetable for the scheduled destruction of the bridges and trestles along the corridor (Davis and Morgan, 1997).

Around this time, the USDA Forest Service (FS) bought most of the right-of-way above Damascus for use as a hiking/biking trail; later becoming part of the Mount Rogers National Recreation Area. Damascus received funding from the Virginia Commission for Outdoor Recreation (VCOR) to buy the right-of-way connecting to the FS lands. Later, Abingdon, with Tennessee Valley Authority (TVA) funding for the land purchases and bridge repair, bought the section connecting Abingdon and Damascus and the 34-mile corridor was now protected (Davis and Morgan, 1997). Today, the VCT is an interesting mix with half of the corridor owned and managed by the federal government and half privately owned and managed by local governments. It represents a unique collaboration between city and federal governments and local private efforts.

Conceptual background

The net economic value and impacts of recreational trails are derived from an individual's demand for trail visits. For example, an individual's demand curve for visits to a recreational trail is illustrated in Figure 2.

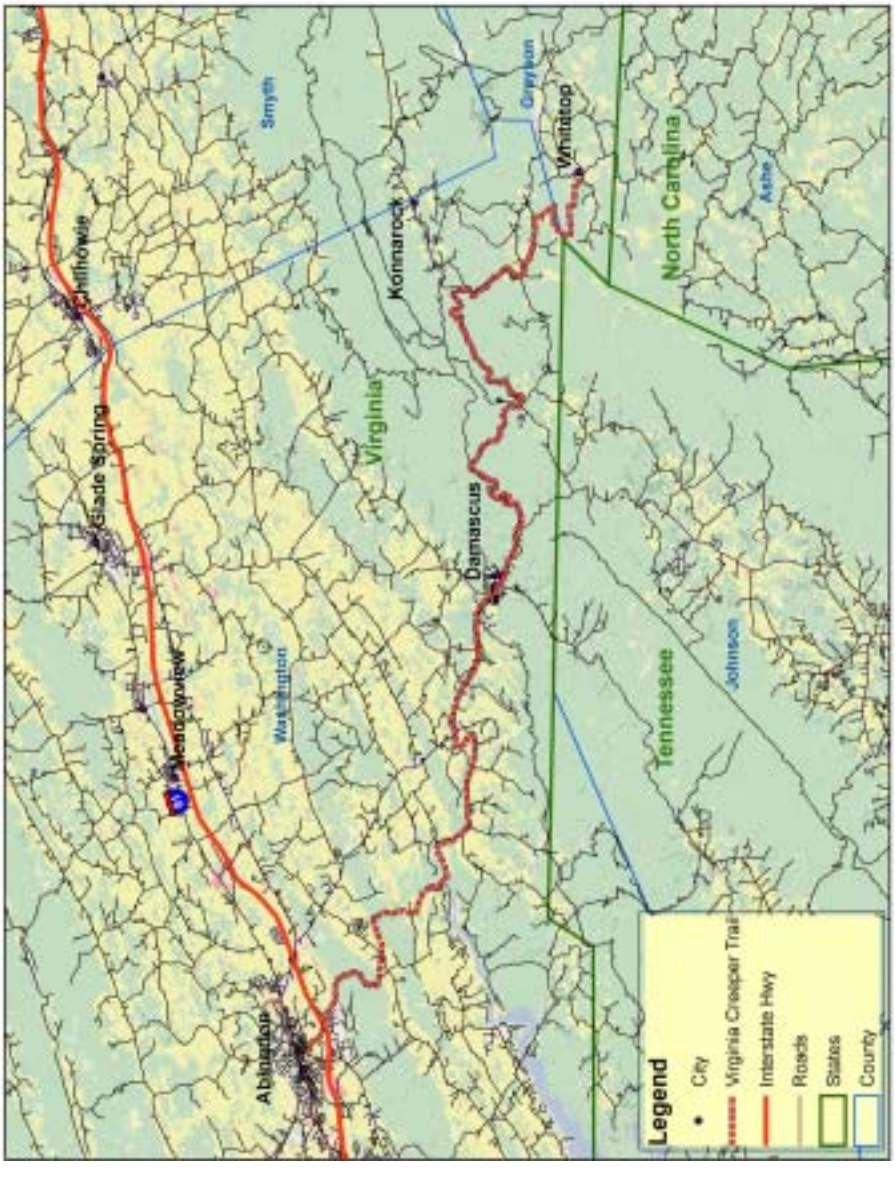

Figure 1. The Virginia Creeper Trail.

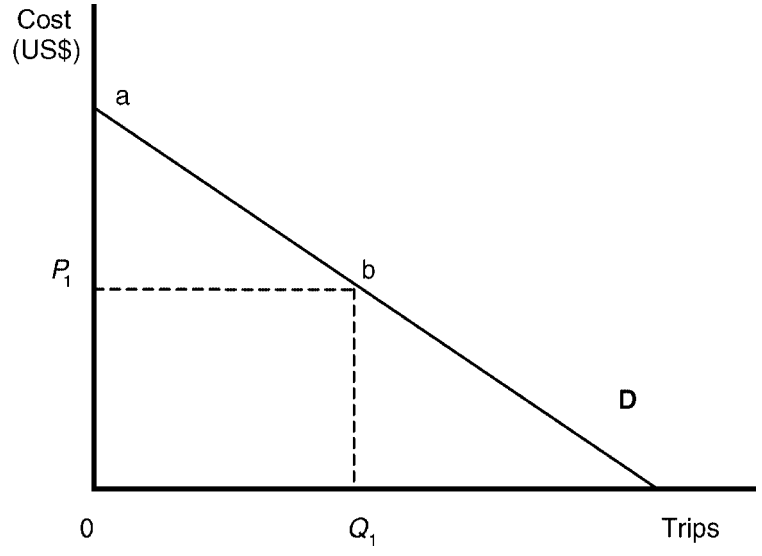

Figure 2. Illustration of recreational trail demand curve.

In Figure 2, the number of trips an individual takes to a recreational trail is measured on the horizontal axis. The cost per trip (for example, petrol and oil) is measured on the vertical axis. The individual's demand curve for trips is illustrated by the line labelled D. Given this demand curve, at a cost of P_1 per trip, the individual would demand or take Q_1 trips to the trail. Expenditures associated with Q_1 trips are illustrated in Figure 2 by the area (rectangle) $P_1,b,Q_1,0$. Net economic value (WTP above and beyond expenditures) associated with Q_1 trips is illustrated by the area (triangle) P_1,a,b.

Hundreds of studies have examined the economic value and impacts of a wide variety of recreational activities and resources. Most of these studies have focused on measuring net economic value only. Far fewer studies have measured just economic impacts (Loomis and Walsh, 1997; Rosenberger and Loomis, 2000). Trail-related policy and management decisions frequently deal with questions and issues related to both net economic value (such as economic efficiency, benefit–cost analysis) and economic impacts (such as regional economic development and growth). Hence, it is increasingly important to measure both of these general types of economic benefits of recreational activities and resources including recreational trails.

The overall research objective of this VCT study is to measure both net economic value and total economic impacts in an integrated framework using a common primary data set that includes trip-taking behaviour, expenditures and visit counts. This research objective involves several integrated tasks, including: (1) measurement of average individual net economic value per trip (illustrated in Figure 2 by area P_1,a,b divided by Q_1); (2) measurement of average individual expenditures per trip (illustrated in Figure 2 by area $P_1,b,Q_1,0$ divided by Q_1); (3) measurement of total visits; and (4) aggregation of these economic measures across the expected user population. The theory behind these tasks is described in more detail below.

Estimation of individual net economic value

For many recreation venues like the VCT, market clearing prices are unavailable as indicators of value. Consequently, alternative valuation methods have been developed for unpriced goods and services, such as access to recreation trails. We use the travel cost method (TCM) to model visitor behaviour and estimate average individual net economic value (consumer surplus) for recreation access to the VCT (Haab and McConnell, 2002). The technique relies on establishing a relationship between the round-trip costs incurred by travellers to a site and the number of trips taken. Hof (1993, p 54) demonstrates that this relationship can be exploited to derive individual consumer surplus for recreation access to a site.

As an economic value measure, net economic value or consumer surplus is the amount by which an individual's willingness to pay for a good exceeds what the individual must pay for the good. While not directly comparable to market price, consumer surplus is accepted for use in economic efficiency analysis and benefit–cost analysis (Pearse and Holmes, 1993; USDA Forest Service, 1995). TCM has been used extensively to value recreation site access, as well as changes in site quality (Siderelis and Moore, 1995; Bowker and Leeworthy, 1998; Haab and McConnell, 2002; Betz *et al*, 2003). The general travel cost demand curve (or equation) for visitor behaviour is typically specified as:

$$\text{TRIPS} = f\,(TC,\ SC,\ INC,\ SE,\ TP,\ OTH) + u \qquad (1)$$

where, for the *i*th individual, TRIPS is the annual number of primary purpose trips to a recreation site; *TC* is the travel cost per trip; *SC* is the cost of visiting a substitute site; *INC* is annual income; *SE* is a vector of socio-economic variables that could include variables like age, gender and race; *TP* is a vector of taste and preference variables that could include activity preferences and previous experience at the site or in a given activity; and *OTH* is a vector that could include site quality indicators. The variable *u* is included to account for random error.

Estimation of local economic impacts

Changes in total output, income and employment stimulated by VCT tourist (non-local user) spending on the local economy defined by Washington and Grayson counties were quantified using economic impact analysis. The three components of impact analysis are: obtaining an accurate number of users and user types (for example, day users, overnight users), estimating average spending per person per trip for each user type, and estimating the direct, indirect and induced effects of tourist spending.

The *direct effects* represent the initial spending by VCT tourists in the local economy. For example, when a person comes to the VCT to hike or bike for the weekend, he or she spends money on petrol and oil, food and lodging. This initial spending stimulates secondary spending in the economy. For example, when VCT tourists buy food or meals at a local grocery store or restaurant, the grocery store or restaurant increases purchases of inputs needed to provide their products (for example, labour, farm produce, business services). These sectors,

in turn, need to increase input purchases (for example, farmers increase expenditures on labour, fuel and fertilizer) to provide more of their products. The 'ripple effect' expenditures made by all business sectors in order to meet VCT tourist demands for goods and services are the *indirect effects* of VCT tourist spending.

The additional economic activity stimulated by the direct and indirect effects of VCT tourist spending results in increased income in the local economy (for example, increased profit to business, increased wages and compensation to employees). As household incomes grow, households spend more money on goods and services, stimulating additional economic activity. This additional economic activity and its impacts represent the *induced effects* of VCT tourist spending.

In this study, the direct, indirect and induced effects of VCT tourist spending in Washington and Grayson counties were estimated using IMPLAN. IMPLAN (IMpact Analysis for PLANning) is a computer-based, input–output economic modelling system designed specifically to conduct economic impact analysis, which has been in use since 1979 (Taylor *et al*, 1992; MIG, Inc, 1999). IMPLAN is a widely applied and accepted tool for measuring the total economic impacts of recreation and tourism (Bergstrom *et al*, 1990; Cordell *et al*, 1990; English and Bowker, 1996; Loomis and Caughlan, 2006).

Empirical estimation and results

In this section, the empirical procedures for estimating VCT economic value and impacts are discussed and results presented. First, data collection is discussed. Then, net economic value and economic impacts estimation and results are presented.

Trail use survey design and implementation

Primary data collected in the VCT survey design consisted of two major components: exit counts and user surveys. Trail counts were obtained using a stratified random sampling approach (Cochran, 1977). A similar methodology is being used by the USDA FS to estimate visitation at all national forests (English *et al*, 2002). Strata were identified by an expert panel of locals and non-locals from the recreation retail trade, USDA FS, National Park Service (NPS), Virginia Department of Conservation and Recreation (VDCR), the Nature Conservancy (TNC) and Virginia Creeper Trail Club (VCTC).

Strata included two seasons, two exit types and three day types. Seasons were winter (November–April) and summer (May–October). High-use exits included trailheads at Abingdon and Damascus. Low-use exits included Whitetop Station, Green Cove, Creek Junction, Taylor's Valley, Straight Branch, Alvarado and Watauga. Day types were Saturdays (S), Sundays/Fridays/Holidays (SFH) and non-holiday weekdays (WD). During the winter, sampling units included the complete day. In the summer, days were segmented into morning (8 am to 12 noon), afternoon (12 noon to 4 pm) and evening (4 pm to 8 pm).

Trained interviewers (pairs at high-use sites and singles at low-use sites) counted each exiting trail user and used a two-stage procedure for administering

survey questionnaires. First, a screener survey was used to determine if the trail user was local (living or working in Washington or Grayson counties) or non-local. Additional information on the screener was directly observable; for example, race, group size, gender, activity mode and approximate age. Individuals were asked to participate in a more detailed five-minute interview.

After responding to the screener, the exiting user received a detailed local survey or one of two versions of the non-local survey (Local, Non-local A, Non-local B). Common to all survey versions were sections about current trip, annual use and household demographics. Local and Non-local A contained questions about benefits from trail use, attitude and preference questions about trail management, area amenities, fees and acceptable uses. Non-local B contained trip expenditure questions for both the local area and for the entire recreation trip. The local area was defined by a radius of 25 miles from the trail. Tourists, unlike locals, are often unaware of county boundaries and 25 miles captured most commercial entities within the two-county area without reaching those in surrounding counties. The survey procedure and instruments were pre-tested among the expert panel and then for two days on trail users. The pre-test resulted in the original non-local survey being broken into the two versions mentioned above to accommodate the five-minute time constraint.

Trail use results

Seventy-seven site-day combinations, randomly selected, were sampled for trail use in the winter season across the six winter strata for exit density and day type. Following Cochran (1977, pp 89–99), means and variances, along with relative population weights, for each stratum were estimated. Total VCT winter (2002/03) recreation visitation, with a visit defined as one person exiting the trail for a non-trivial time span, is estimated to be 23,614 with a 95% confidence interval around the mean of [20,629–26,599].

One hundred and seven site-day combinations, randomly selected, were sampled for trail use in the summer season across the six summer site-day combinations. Unlike the winter, sampling occurred during a randomly drawn four-hour time period only (morning, afternoon, evening) on any randomly selected site-day combination. Summer 2003 visitation is estimated to be 106,558 with a 95% confidence interval around the mean of [99,276–113,840]. The annual VCT visitation estimate for the one-year period beginning 1 November 2002 to 31 October 2003 is 130,172 with a 95% confidence interval estimate for the mean number of visits during the sample period of [119,905–140,439].

A total of 1,430 screener and 1,036 detailed survey questionnaires were completed during the sample period, implying an effective response rate of 72%. Almost no trail users refused the screener survey. Local users screened totalled 618 (47%), while non-locals totalled 690 (53%). Screener percentages led to the decomposition of annual visits into 68,669 non-locals and 61,503 locals. About 9% of screener respondents did not indicate their origin.

The economic modelling objectives of this study required further decomposition of visits by user type and conversion from visits to person-trips. Table 1 reports visits and person-trips by four common user type categories; primary purpose day user (PPDU), non-primary purpose day user (NPDU),

Table 1. Annual VCT visitation and trips by user type.

	Primary purpose day use	Non-primary purpose day use	Primary purpose overnight use	Non-primary purpose overnight use
Non-local visits	40,034	9,473	10,305	8,857
Local visits	61,503	N/A	N/A	N/A
Visits by type	101,537	9,473	10,305	8,857
Non-local person-trips	33,642	7,578	5,725	3,918
Local person-trips	61,503	N/A	N/A	N/A
Person-trips by type	95,145	7,578	5,725	3,918

primary purpose overnight user (PPON) and non-primary purpose overnight user (NPON). Primary purpose implies that the VCT was the major reason for the person's trip. A non-primary user was in the impact region for another purpose, but chose to spend a portion of time on the VCT. For locals, a visit and trip are equivalent. For non-locals, the number of visits to the trail during any trip to the area was often greater than one.

Visits and person-trips for each non-local category were estimated by first calculating shares from non-local questionnaire responses. Visit shares (VS_i) for each of the four categories (i = 1,2,3,4) were estimated using the category's sample per cent (SP_i), average annual trips (AT_i), average visits per trip (VT_i) and average party size (GS_i), as follows:

$$VS_i = [SP_i * AT_i * VT_i * GS_i] / \Sigma [SP_i * AT_i * VT_i * GS_i] \quad (2)$$

Each visit share was then multiplied by the total non-local visits (68,669) to determine non-local visits by category. Dividing each category's visits by AT_i provided an estimate of person-trips by category (Table 1).

As indicated in Table 1, day users make up about 85% of all visits, with PPDUs accounting for 77% of total annual visitation. For non-locals, day users account for 73% of their visits, while PPDUs make up 58% of non-local visitation. Overnight visitors comprise about 27% of non-local visits and about 15% of all visits.

Accounting for multiple trail visits per trip in the non-local categories, the 130,172 annual visits translates to 112,366 annual person-trips. Non-locals comprise about 45% of this total, while local and non-local day users combined account for 85% of total person-trips. Non-local overnight users make up about 9% of all trips, while primary purpose overnight tourists account for only about 4% of all person-trips. Primary purpose users (day use and overnight) together represent 100,870 person-trips, or 90% of annual VCT usage as measured by person-trips

Two caveats should be noted pertaining to our estimates of 130,172 visits and 112,366 person-trips. First, because of an unusually rainy summer in 2003, Virginia experienced about a 20% decrease in usage across its state park system. Second, because of the time windows used in summer sampling (8 am to 12 noon, 12 noon to 4 pm, 4 pm to 8 pm), visits were probably undercounted during the middle of the summer when day length was greatest. While both

factors are likely to influence visitation estimates conservatively, it is unclear whether spending per trip would be affected.

A final caveat pertains to the 'trap shyness' phenomenon. Here, a person once sampled could have a tendency to avoid further contact with the interviewer for either the screener or the detailed questionnaire. Given the higher probability of this happening to those who are frequent visitors, that is, locals, there is a chance that the estimated ratio of locals to non-locals is slightly biased toward non-locals.

Trail user profiles

Results of the VCT survey suggest that users were predominantly white, educated, reasonably affluent and middle-aged. The average age of respondents was 47, with over 50% of the users between the ages of 36 and 55 and another 18% between 56 and 65. Users over the age of 65 accounted for 9% of the population. The average household income for the population was US$72,315. Fifty-four per cent of respondents reported a household income between US$40,000 and US$120,000, with 16% less than US$40,000, 12% greater than US$120,000 and 18% preferring not to answer this question. Sixty-nine per cent of those interviewed were employed full-time, while 18% were retired. The average household size for VCT users was 2.82.

Local users travelled an average distance of 7.8 miles in 15 minutes to reach the VCT. Non-local users, on average, travelled 260 miles in 4.6 hours. Non-locals averaged 4.8 trips annually, but 77% took fewer than four trips. The remaining 23% took from 5 to 300 annual trips. Local users averaged almost 12 visits per month. The average time spent on the VCT by all users was 2.2 hours with an average on-trail travel distance of 12.9 miles.

The VCT was the primary reason for 72% of users to be in the area. The primary activity for users was biking (55%), followed by walking (33%), with the remaining 12% comprised of jogging, camping, nature viewing, horseback riding and fishing. Eighty-eight per cent of respondents travelled the trail in groups of less than four individuals.

Estimation of net economic value

Data for estimating the empirical VCT demand model were obtained from the trail user survey discussed above. Following convention, only on-site visitors listing the VCT as their primary purpose or destination are included. This avoids attributing full consumer surplus, or some portion thereof, to an ancillary site visit. With an on-site survey, data are zero-truncated (all responses represent one or more trips) and endogenously stratified (the probability of being sampled depends on how often one visits the site). Failure to account for zero-truncation has been shown to have large effects on parameter estimates (Zawacki *et al*, 2000), while the effects of endogenous stratification have been shown to be relatively minor (Ovaskainen *et al*, 2001). For the VCT, a zero truncated negative binomial regression specification was used (Englin and Shonkwiler, 1995). A number of preliminary specifications and assumptions were explored. Across these specifications, the TC parameter estimate was robust. As expected, a number of variable subsets (for instance, income and education) indicated the

Table 2. VCT travel cost model variable definitions.

Variable	Definition
TRIPS	Annual VCT trips by the travelling unit (mean = 71)
TC	Distance (US$0.131/mile) and time (valued at a quarter of the household wage rate) travel cost (US dollars) per VCT trip
SUB	Binary variable indicating whether or not the respondent felt there was a viable substitute for the VCT
INC	Annual household income (1,000s)
NUM	Number of people living in the household that use the VCT
AGE	Age of respondent (years)
SEX	Gender variable (male = 1, female = 0)
BIKE	Activity variable (1 = biking, 0 = all other activities)
HIGH	Avidity variable (1 = annual trips > 30, 0 = annual trips < 30)

presence of multicollinearity, which required dropping some variables (for instance, education).

The final empirical model was parameterized as follows:

$$\ln \text{TRIPS} = \beta_1 + \beta_2\, TC + \beta_3\, SUB + \beta_4\, INC + \beta_5\, HIGH + \beta_6\, AGE + \beta_7\, NUM + \beta_8\, BIKE + \beta_9\, SEX + u \quad (3)$$

Variables listed in Equation (3) are defined in Table 2. Travel distances and times used to compute travel costs were estimated using PCMiler. Two models are reported based on alternative assumptions about the unresolved issue of travel time. One omits the opportunity cost of travel time, while the other assumes a time cost equalling one quarter the household wage rate. The error term *exp(u)* is assumed to follow a gamma distribution with a mean of 1.0 and constant variance σ.

Net economic value results

Regression results for the travel cost model estimated using LIMDEP are reported in Table 3. The estimated parameter for TC in both models (with and without time cost) is highly significant and has the expected sign. Also highly significant are estimated parameters for *BIKE* and *HIGH*. The negative sign for *BIKE* implies that for any given distance, the number of trips bikers take will be less than non-bikers (primarily walkers). This result is probably driven by the large number of locals regularly walking the trail and by the fact that walkers living farther away are likely to have better substitutes than bikers. The positive sign on the *HIGH* coefficient suggests the presence of a group having a strong attachment to the trail, which cannot be explained by cost and other socio-economic variable differences. The *SEX* and *INC* variables are marginally significant. Other factors equal, males are likely to take more VCT trips than females. This is common for many outdoor recreation activities.

The negative sign on the *INC* coefficient suggests that, as income increases, people take fewer trips. This condition is common in outdoor recreation studies and could be caused by wealthier participants having more types of substitute activities and destinations available to them. The coefficients on the *AGE* and

Table 3. Truncated negative binomial regression parameter estimates with standard errors for two travel cost models of annual VCT trips.

Variable	US$0.131 per mile No time cost N = 801	US$0.131 per mile ¼ the wage rate N = 800	Mean
Constant	2.173	2.1648	
	(0.157)	(0.1599)	
TC	–0.0235***	–0.0137***	#
	(0.0011)	(0.0006)	
SUB	0.0546	0.0236	0.37
	(0.0684)	(0.0684)	
INC	–0.000002**	–0.0000018*	70,300
	(.000001)	(.0000011)	
HIGH	2.961***	3.0108***	0.46
	(0.0855)	(0.0834)	
AGE	0.0022	0.00209	47
	(0.0023)	(0.0023)	
NUM	0.0019	–0.02705	2.39
	(0.0261)	(0.0271)	
BIKE	–0.2909***	–0.3137***	0.55
	(0.0716)	(0.0719)	
SEX	0.1115*	0.0999*	0.54
	(0.0608)	(0.0621)	
Overdispersion σ	0.6360***	0.6449***	
	(0.0567)	(0.0577)	

Notes: Significant levels: *** 0.01; ** 0.05; * 0.10.
Mean travel costs are US$25.01 and US$40.22 for no-time cost and one-quarter of the wage rate time cost, respectively.

SUB variables are not statistically significant. These variables are nevertheless retained in the model for theoretical reasons. However, the *NUM* variable was retained to convert trips and consumer surplus per group to a per person basis, facilitating aggregation with trail counts reported above.

Following standard TCM procedures (for example, see Haab and McConnell, 2002), average per trip consumer surplus estimates for groups travelling to the VCT can be estimated as a function of the travel cost coefficient ($CS = -1/\beta_2$). Assuming no cost for time, average consumer surplus per group per VCT trip is US$42.54 with a 95% confidence interval of [US$38.53–US$46.54]. Using the opportunity cost of time model, the per trip group consumer surplus is US$72.63 with a 95% confidence interval of [US$65.98–US$75.28]. On a per person per trip basis, the estimated consumer surplus assuming no time cost is US$22.78, while assuming an opportunity cost of one quarter the household wage, the per person per trip consumer surplus is US$38.90.

Total annual recreation access value for users of the VCT can be obtained by combining the estimated number of primary purpose person-trips (100,870 from columns 1 and 3, Table 1) with estimated per person per trip consumer surplus. The annual net economic value of primary purpose VCT trips valued at zero opportunity cost of time is US$2,297,818. The annual net economic

value of primary purpose VCT trips with opportunity cost of time valued at one quarter of the wage rate is US$3,923,843.

These aggregate values are consistent with previous trail-related studies. Siderelis and Moore (1995) reported a range of US$1.9 million (Lafayette/ Moraga Trail in California), US$4 million (Heritage Trail in Iowa) and US$8.5 million (St Mark's Trail in Florida) in aggregate value. Adjusted to 2003 US dollars, these values would be US$2.3 million, US$5 million and US$10.6 million, respectively. The Heritage Trail, a 26-mile rural rail-trail, is most similar to the VCT. The estimated use reported by Siderelis and Moore (1995) for the Heritage Trail was about 135,000 annual visits.

Price elasticity results

The TCM regression results can also be used to calculate the price elasticity of demand, ε_p, a unit-less measure representing the percentage change in trips in response to a given percentage change in price. Here, price elasticity can be estimated as $\varepsilon_p = \beta_{2*}TC$, where β_2 and TC are as defined above. For the no-time cost and the one-quarter wage rate time cost models above, the price elasticities calculated at the mean travel costs are –0.605 and –0.567, respectively. These values are within the ranges reported by Siderelis and Moore (1995) and Betz *et al* (2003) of –0.207 to –0.430 and –0.681, respectively.

Price elasticity between 0 and –1 suggests that as price or travel cost increases, visits will decrease. However, price response is considered inelastic; for instance, the percentage decrease in visits will be less than the percentage increase in price. For example, consider ε_p = –0.605 and an average per trip travel cost of US$25.01 from the no time cost model above. Imposing a US$5 per group use fee would increase the price by 20%, but visitation would be expected to decline by about 12% only. This assumes, of course, that visitors respond to a use fee as they would to an increase in petrol price. In the short run, given emotional and political situations, this assumption may be tenuous.

Estimation of economic impacts

Estimation of total economic impacts first requires estimation of recreation visitation from outside the local economy. Estimating economic impacts with IMPLAN required the conversion of trail visits to person-trips. A person-trip is defined as one person taking one trip to the VCT. Given the nature of recreation on the VCT, it is common for overnight tourists to visit the trail multiple times during a single trip to the area. Visits and person-trips to the VCT were estimated as described above and reported in Table 1.

Non-local expenditures represent 'new' money brought in to the local economy, which increases total wealth in the economy, resulting in economic growth. These tourist expenditures, by major spending categories, were estimated from responses to spending questions included in the Non-local B questionnaire. These questions elicited group expenditures, both for the entire trip and within 25 miles of the VCT, and the size of the spending party. Using this information, average per person expenditures made within 25 miles of the VCT per user type were estimated. Expenditure categories included private lodging, public lodging, food consumed in a restaurant or bar, food consumed outside of a

restaurant or bar, primary transportation, other transportation expenditures, bicycle rentals, shuttle or guide service, entry fees and other expenditures.

For primary purpose users, all expenditures are attributed to the VCT. For non-primary purpose users, expenditure shares for the VCT are estimated based on the ratio of total trail time to total time spent in the area. A more conservative approach would be to drop the non-primary purpose expenditures from the study. Examples of various expenditure apportioning approaches can be found in the literature (Bergstrom *et al*, 1990; Cordell *et al*, 1990; English and Bowker, 1996). Here, we employ a method for non-primary users similar to that used by Loomis and Caughlan (2006). For non-primary day users, we used the ratio of minutes spent on the trail to minutes in a 12-hour day (0.24). For NPONs, we used the ratio of time spent on the trail to time spent in the impact area. Overnight users indicating more than 14 consecutive nights in the impact area (less than 1%) were deleted.

The direct, indirect and induced effects of recreation expenditures per 1,000 person-trips by the VCT user categories described in the previous section were estimated by first multiplying average expenditures per person-trip for each user category by 1,000. These direct expenditures per 1,000 person-trips were then entered into the IMPLAN model to calculate the economic impacts (direct, indirect and induced effects) of tourist expenditures by user category. Total economic impacts of non-local trips to the VCT were estimated by multiplying the estimates of total person visits by user category (in units of 1,000 trips) by the estimated impacts per 1,000 person-trips and then summing up these total impacts by category.

Expenditure and economic impacts results

Group and individual expenditure profiles for each of the four VCT tourist (non-local user) types are reported in Table 4. Average per person expenditures by tourist type were: primary purpose day use US$17.16, primary purpose overnight US$82.10, non-primary purpose day use US$12.31 and non-primary purpose overnight US$7.02. As expected, primary purpose overnight trips generate the largest expenditures because overnight tourists spend more on lodging, food and other trip expenses.

Economic impacts of VCT tourist expenditures per 1,000 person visits are shown in Table 5. Common to other recreation impact studies, the key tourist group is the primary purpose overnight tourist, accounting for nearly five times as much stimulated economic output per 1,000 person-trips as the next nearest category (primary purpose day tourists). However, this group accounts for only slightly more than 10% of the tourist trips to the area. Increasing the percentage of primary purpose overnight trips would generate relatively high economic activity and impacts in the local economy.

Aggregating impacts per 1,000 person-trips by total person-trips for each tourist type and summing across tourist types results in the estimates of total economic impacts to the economy of Washington and Grayson counties, as reported in Table 6. Output in Table 6 refers to the total value of goods and services produced. Employment refers to full- and part-time jobs. Thus, VCT tourist visits generate US$1.6 million in output and more than 27 jobs in the local community. VCT tourist visits also generate about US$921,000 in total

Table 4. VCT expenditure profiles by tourist (non-local user) type.

Expenditure type	Group w/in 25 miles	Group entire trip	Per person w/in 25 miles expenditure	Per person per trip expenditure	Group w/in 25 miles	Group entire trip	Per person w/in 25 miles expenditure	Per person per trip expenditure
	Primary purpose day use (N = 169, spending party = 3.34 persons)				Primary purpose overnight use (N = 147, spending party = 4.5 persons)			
Private lodging	0.00	14.69	0.00	4.39	126.95	211.86	28.21	47.08
Public lodging	0.00	0.09	0.00	0.02	22.29	29.30	4.95	6.51
Food in restaurants	21.29	38.13	6.37	11.41	99.43	137.02	22.09	30.44
Carry-out foods	2.65	6.49	0.79	1.94	27.69	40.02	6.15	8.89
Primary transportation	11.42	18.68	3.41	5.59	36.45	61.50	8.10	13.66
Other transportation	0.06	0.06	0.01	0.01	1.90	2.53	0.42	0.56
Bike rentals	11.68	12.98	3.49	3.88	17.28	18.44	3.84	4.09
Shuttle/guide	9.17	10.51	2.74	3.14	19.26	20.95	4.28	4.65
Use fees	0.14	0.14	0.04	0.04	0.00	0.00	0.00	0.00
Other expenses	0.89	1.42	0.26	0.42	17.56	18.32	3.90	4.07
Total	*57.32*	*103.22*	*17.16*	*30.90*	*369.47*	*539.34*	*82.10*	*119.85*
	Non-primary purpose day use (N = 23, spending party = 4.30, time share = 0.24)				Non-primary purpose overnight use (N = 94, spending party = 3.40, time share = 0.09)			
Private lodging	0.00	165.13	0.00	6.63	125.17	175.53	2.50	4.40
Public lodging	0.00	31.18	0.00	1.38	46.19	47.89	0.27	0.30
Food in restaurants	51.00	154.18	3.71	7.00	97.32	120.51	2.07	2.79
Carry-out foods	5.90	23.63	0.19	1.09	17.23	28.19	0.25	0.62
Primary transportation	59.00	82.18	4.86	5.71	44.73	100.51	0.80	1.74
Other transportation	0.00	72.72	0.00	2.73	6.80	29.19	0.02	0.15
Bike rentals	47.13	47.13	2.66	2.66	17.25	17.59	0.38	0.41
Shuttle/guide	3.90	3.90	0.13	0.13	8.50	9.03	0.21	0.22
Use fees	0.00	0.18	0.00	0.00	0.00	1.06	0.00	0.00
Other expenses	54.81	100.95	0.76	2.66	3.40	3.93	0.45	0.47
Total	*162.74*	*681.18*	*12.31*	*30.05*	*366.59*	*533.43*	*7.02*	*11.15*

Table 5. Estimated economic impacts of VCT tourists (non-local users) per 1,000 person-trips in Washington County and Grayson County, VA, 2003 US dollars.

Economic impact indicators	Economic impact per 1,000 person-trips			
	Primary day use	Primary overnight	Non-primary day use	Non-primary overnight
Output	US$23,606	US$114,398	US$14,968	US$6,411
Employment	0.4	2.1	0.2	0.1
Total value added	US$11,592	US$ 62,956	US$ 6,864	US$3,611
Labour income	US$ 7,647	US$ 41,867	US$ 4,506	US$2,379
Other property type income	US$ 2,623	US$ 4,077	US$ 1,508	US$ 821
Indirect business taxes	US$ 1,323	US$ 7,012	US$ 851	US$ 411
Output multiplier	1.35	1.33	1.32	1.35
Employment multiplier	1.33	1.23	1.00	1.00
Total value added multiplier	1.44	1.37	1.44	1.37

Table 6. Estimated total economic impacts of VCT tourists (non-local users) in Washington County and Grayson County, VA, 2003 US dollars.

Economic impact indicator	Total economic impact
Output	US$1,587,627
Employment	27.4
Total value added	US$921,362
Labour income	US$610,372
Other property type income	US$126,098
Indirect business taxes	US$104,153

value added in the local economy. As shown in Table 6, the components of total value added are labour income, other property type income and indirect business taxes.

The US$1.6 million dollars in total output shown in Table 6 was generated by US$1.2 million in direct expenditures by VCT tourists. Moore *et al* (1994) report direct local expenditures (in 2003 US dollars) by non-local rail-trail users as follows: US$844,200 for the Heritage Trail in Iowa, US$536,000 for the St Mark's Trail in Florida and US$393,960 for the Lafayette/Moraga Trail in California. Direct local expenditures by non-local rail-trail users are very similar for the VCT and the Heritage Trail, which offer similar rail-trail experiences in rural areas.

Summary and conclusions

This paper reports on a study quantifying the net economic value to users and the economic impacts on the local community of the Virginia Creeper Trail in south-western Virginia. Net economic value measures the benefits to users

themselves of recreating on the VCT. Individual net economic value for recreation access to the VCT was estimated at US$23–US$38 per person per trip. Aggregate net economic value of the VCT to users was estimated at US$2.3 million to US$3.9 million. Economic impacts measure the commercial benefits to local communities of VCT tourist (non-local user) spending. VCT tourists spend about US$1.2 million directly in the two-county community around the trail. This tourist spending in the local economy generates about US$1.6 million in total economic activity. The combined aggregate net economic value and total economic impacts of the VCT indicate that the trail is a highly valuable asset both to users of the trail and to people in the local community who benefit economically from tourist expenditures.

In policy and management, measures of net economic value are typically used in economic efficiency and benefit–cost analysis. Economic efficiency is concerned with maximizing welfare to people subject to limited resources. For example, government agencies have limited budgets, land and labour that can be allocated to provide recreational opportunities and other services to people. Measures of net economic value can be used to prioritize or rank resource allocations (for example, budget allocations) for the provision of recreational opportunities and other services that provide people with the most net economic value (welfare). The relatively high individual and aggregate net economic value of the VCT indicates that recreational trails should receive serious consideration for the allocation of limited resources, such as government funding.

Benefit–cost analysis typically examines whether the benefits of a single project are at least as great as the costs. For example, suppose that government agencies and local community groups were interested in investing more money in a VCT improvement or expansion project that would attract more visitors. The aggregate net economic value (or aggregate net benefits) of the proposed project could be estimated by multiplying the estimates of net economic value per trip reported in this study by the estimated increase in trips. Aggregate net economic value could then be compared to the project costs (for example, construction, maintenance and operation costs) to determine if the proposed project is economically feasible from a benefit–cost analysis standpoint.

In policy and management, measures of economic impacts are used to assess the impacts of an existing or proposed activity on output, income and jobs in a regional economy. Economic development is often a primary concern of local citizens and governments, especially in rural areas where jobs and income may be relatively low. The results of this study indicate that trail-related expenditures by VCT tourists (non-local users) are relatively large. Non-local expenditures are important from an economic development standpoint because these expenditures represent 'new money' coming in to the economy. This new money stimulates economic growth and increases overall wealth in the economy. Based on the results reported in this study, promoting trail-related recreation and tourism appears to be a viable strategy for increasing economic growth in a local community. Because overnight tourists spend more on lodging, food and other goods and services, economic growth would be stimulated the greatest by promoting more multiple-day visits and providing many opportunities for local spending (for instance, local hotels, restaurants and other attractions).

Government agencies and local businesses may be concerned about the effects of trip costs on the local recreation and tourism industry. For example, at

present, some local communities may be worried that increasing petrol prices may result in out-of-town tourists taking fewer recreation trips to their community. The results of this study reveal that recreation demand for VCT trail use is somewhat inelastic with a price elasticity of –0.6. This suggests that trail use is unlikely to be highly sensitive to increasing trip costs caused by increases in petrol prices or other trip costs. Moreover, the inelasticity suggests potential for the use of access fees as a source of revenue for trail-related operation and maintenance expenses.

This study has several limitations worth noting. First, although data were collected following a scientific sampling plan, a limited research budget restricted the number of places, days and times VCT trail users could be interviewed. A larger budget would have allowed more sampling, resulting in a more representative sample of users. Also, this study measured only the economic benefits of the VCT. A more comprehensive study should also measure the economic costs of the VCT, including construction, maintenance and operating costs, opportunity costs of alternative uses of the land where the trail is located, and costs imposed on government agencies by VCT users (for example, litter control, environmental damage restoration, public services).

In addition to examining future use and management of the VCT, the methodology used in this study and reported results can also be applied to help compare the economic benefits and costs of new trails similar to the VCT. An interesting avenue for related future research would be to examine the relationship between existing trails in a region, like the VCT, and new trails developed in the region. If a complementary relationship were to develop, then it may be easier to entice overnight tourists and consequently bolster the regional economy.

A unique feature of this study is that net economic value and total economic impacts were estimated from a common user sample and survey instrument that collected both individual net economic value and expenditure information from respondents. This integrated approach ensured consistency in use estimates for aggregation of net economic value and economic expenditures and impacts. It also ensured consistency in the sample and survey questions used to estimate individual net economic value and expenditures prior to aggregation.

Estimating and reporting both net economic value and impacts in an integrated study also broadens the range of policy and management questions and issues that can be addressed by the study results; for example, economic efficiency, benefit–cost analysis and economic development questions and issues can all be addressed using consistently estimated value and impact measures. More studies of the economic value and impacts of recreational trails following the integrated primary data collection and analysis approach described in this paper would provide important information and insight on how these values and impacts vary across different geographic regions. These studies would also provide important information for comparing the development of recreational trails to other competing land uses, such as residential and commercial development. As competition for scarce land for alternative users intensifies, having information on the net economic value and impacts of recreational trails will become increasingly important for informing land use policy and planning decisions.

Following a scientific sampling plan, future studies should attempt to

increase the sample size to make the resulting use and valuation data as representative as possible, given research budget constraints. Measures of the economic costs of trails in addition to the economic benefits would also help to better inform policy and management decisions related to recreational trails. The VCT study discussed in this paper will hopefully stimulate and facilitate such additional trail valuation research.

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