Annals of Tourism Research 86 (2021) 102971

Contents lists available at ScienceDirect

Annals of Tourism Research

journal homepage: www.elsevier.com/locate/annals

RESEARCH NOTE

Estimating tourism social carrying capacity

Oksana Tokarchuk [a,*], Roberto Gabriele [b], Oswin Maurer [a]

[a] *Competence Centre in Tourism Management and Tourism Economics (TOMTE), Faculty of Economics and Management, Free University of Bolzano, Piazza Università 1, Bolzano, Italy*
[b] *Department of Economics and Management, University of Trento, Via Inama, 5, Trento, Italy*

ARTICLE INFO

Associate editor: Muzaffer Uysal

Keywords:
Tourism intensity
Social carrying capacity
Residents' satisfaction with life
Urban tourism
Overtourism

Introduction

Tourism social carrying capacity has been defined by Saveriades (2000) as the maximum number of tourists that can be present at a destination without their activities being unacceptable to local residents and without precluding tourists from enjoying the destination. When the number of tourists at a destination surpasses this social carrying capacity, the phenomenon of overtourism is observed (UNWTO et al., 2018). Tourism destinations are in search of novel methods that could be easily embraced to identify and measure social carrying capacity before overtourism happens (Peeters et al., 2018).

In the literature, social carrying capacity is measured in terms of the perceived impacts of tourism on residents' lives. Perception of a positive impact has been interpreted as an indicator that a particular destination had not yet reached the limit of its social carrying capacity (e.g., Saveriades, 2000). This approach, however, does not allow for the quantitative definition of a threshold value at which, at certain points in time, the negative impacts of tourism outweigh its benefits for a local population, making this approach not suitable for defining overtourism. Additionally, it requires costly primary data collection which many destinations cannot afford.

We attempt to fill this gap, proposing a way of measuring social carrying capacity and of determining thresholds by using measures of satisfaction with life as one of the indicators of quality of life. Moreover, we show that it is possible to use secondary data to accomplish this task.

Measures of quality of life have attracted attention of governments worldwide as being more comprehensive than traditional economic measures of prosperity (Diener, Oishi, & Tay, 2018). Nowadays, they are treated as indicators for measuring overall net benefits of public policies encouraging many countries to collect large datasets.

Since the late 1990s, quality of life has gradually substituted the cost-benefits analysis, becoming the main focus of investigations into the impacts of tourism (Uysal, Sirgy, Woo, & Kim, 2016). Today, the relationship between tourism and the quality of life of residents is well established (e.g. Andereck & Nyaupane, 2011; Nawijn & Mitas, 2012; Woo, Kim, & Uysal, 2015) and recently Uysal

* Corresponding author.
E-mail addresses: oksana.tokarchuk@unibz.it (O. Tokarchuk), roberto.gabriele@unitn.it (R. Gabriele), oswin.maurer@unibz.it (O. Maurer).

https://doi.org/10.1016/j.annals.2020.102971
Received 8 December 2019; Received in revised form 25 May 2020; Accepted 29 May 2020
Available online 18 June 2020

Table 1
Regression results of the fixed effect model with cluster standard errors at Post codes level. Dependent variable: Satisfaction with life.

Independent variables:	Fixed effect with clustered standard errors
nightsXres	0.1246***
	(0.034)
nightsXres ^{2}	−0.0023***
	(0.001)
Neig	−0.2036**
	(0.075)
SatHeallth	0.1983***
	(0.034)
SatWork	0.0801***
	(0.026)
WorkTime	−0.0070
	(0.005)
NetLAbInc	0.0001**
	(0.000)
homeowner	0.3361**
	(0.150)
WorriedImmi	0.2152***
	(0.052)
WorriedCrime	−0.1050*
	(0.059)
WorriedEnvir	−0.0900
	(0.060)
BeHappy	0.4093***
	(0.040)
SatFamLife	0.2389***
	(0.018)
Constant	1.2512***
	(0.285)
Observations	1424
R^2 overall	0.424
rho	0.537
sigma_e	0.627
sigma_u	0.921

*** $p < .01$.
** $p < .05$.
* $p < .10$.

and Sirgy (2019) have suggested the use of satisfaction with life indicators as performance measures in tourism.

Social carrying capacity of a destination is seen as the optimum level of net benefits brought by tourism to the destination (Canestrelli & Costa, 1991). Marginal benefits of tourism outweigh marginal costs when tourist presence is low. With the growth of tourism intensity marginal benefits decrease while marginal costs are increasing. The resulting overall net benefits curve follows an inverted U-shape pattern, the peak of which corresponds to social carrying capacity.

We treat satisfaction with life as a measure reflecting overall net benefits of tourism on community (Diener et al., 2018; Uysal & Sirgy, 2019). Accordingly, we formulate the following hypothesis:

> Hypothesis: *relationship between tourism intensity and residents' satisfaction with life takes an inverted U-shaped form. Social carrying capacity corresponds to the vertex's abscissa of this inverted parabola.*

In this research note, we follow the model developed in Tokarchuk, Gabriele, and Maurer (2017) to relate tourism and individual's satisfaction with life.

We empirically validate our hypothesis using the city of Berlin as an example. The city almost doubled tourist overnight stays between 2008 and 2017, from 17.6 million to 31.1 million (Statistical Office Berlin-Brandenburg, 2019). This disruptive growth has led to residents' discontent and even protests against tourists (Füller & Michel, 2014), suggesting that a saturation point has been reached.

Empirical method and data

The empirical analysis is based on panel data, with all single observations being aggregated at post code level in a specific year. The variable of interest is represented by the tourism intensity, which is aggregated at district level with each postal code belonging to only one district.[1] We estimated the regression model as:

[1] See Table A.1 for the correspondence between postal codes and districts of Berlin.

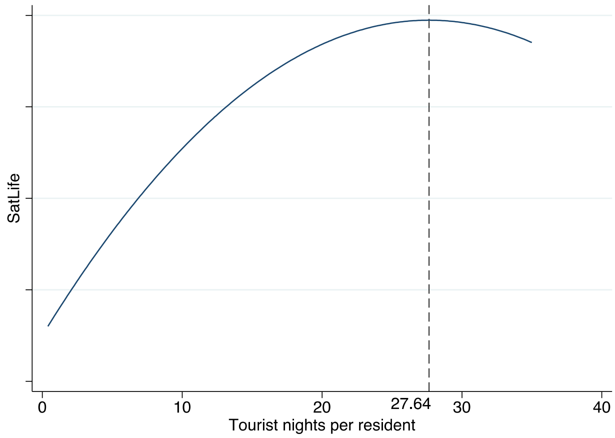

Fig. 1. Marginal impact of nights per resident on average satisfaction with life of residents.

$$sat_{it} = \alpha + \beta_1 nightsXres_{jt} + \beta_2 nightsXres_{jt}^2 + X_{it}^{'} Y + \varepsilon_{it} \tag{1}$$

where: *i* = *1, …,186; j* = *1, …,12; t* = *2008, …,2017*. The dependent variable, sat_{it}, is the average value of satisfaction with life of individuals living in post code zone *i* of Berlin in year *t*; $nightsXres_{jt}$ denotes the number of tourist nights per resident in district *j* in year *t* (see Table A.1); and X_{it} is a vector of control variables referring to post code *i* in year *t* in which a set of factors is included similar to the model reported in Tokarchuk et al. (2017).[2]

Following Moulton (1990), we clustered standard errors (ε_{it}) at the district level to avoid downward biased estimations due to correlation of standard errors.

The parameters of interest are β_1 and β_2. Our hypothesis suggests that coefficient β_1 should be positive, while coefficient β_2 should be negative, corresponding to an inverted parabola. Social carrying capacity is calculated as the abscissa of the vertex of this parabola as:

$$Social\ carrying\ capacity = -\frac{\beta_1}{2 \cdot \beta_2}, \tag{2}$$

The study data are drawn from the German Socio Economic Panel (SOEP, 2019). To build the database, a Berlin subset of SOEP respondents for the period 2008–2017 was selected, resulting in 10,005 individual observations. These data were then aggregated at the post code level, using appropriate statistics for each measure included in the model. Finally, data on tourism nights per resident for each of the 12 districts of Berlin (Statistical Office Berlin-Brandenburg, 2019) have been added. Overall, the regression models are based on 1,435 observations at post code level for the years 2008–2017.[3]

Results

Table 1 reports the results obtained by using a fixed-effect estimator with clustered standard errors at district level to avoid a Moulton bias (Moulton, 1990).[4] Both the linear –coefficient $\beta_1 = 0.12$ – and the quadratic component of tourism intensity –coefficient $\beta_2 = -0.002$– have a significant impact on the satisfaction with life of Berlin residents. The significance of β_2 and its negative value is the necessary condition for the existence of an inverted U-shaped relationship. To confirm the hypothesis, we also rely on the Lind and Mehlum (2010) test that rejects the assumption of non inverted U-shaped pattern, confirming our hypothesis (Table A.5).

Fig. 1 shows a graphical representation of this relationship, based on the parameters estimated. The value of tourism intensity corresponding to the parabola vertex can be interpreted as the threshold value of social carrying capacity, that is, the maximum value of tourism intensity before residents perceive a decline in their satisfaction with life.

Accordingly, the social carrying capacity in Berlin is estimated at 27.64 tourist nights per resident on average for the period analyzed (Eq. (2)). Values of tourism intensity in Berlin in the study period ranged from as low as 0.26 tourist nights per resident (district Marzahn-Hellersdorf in 2008) to as high as 35.24 tourist nights per resident (district Mitte in 2015). The estimations show that only district Mitte exceeded the critical value of tourism intensity, and only from 2012 onwards (Table A.1).

[2] See Table A.2.

[3] Table A.3 reports the descriptive statistics about variables used in the study. Table A.4 provides correlation table of the variables included in the estimation of the model (1).

[4] See Hansen Sargen test in Table A.5.

Conclusion

This research note proposes a method for estimating social carrying capacity from the supply side, using a mix of primary and secondary data.

As demonstrated, indicators of satisfaction with life allow for the precise estimation of social carrying capacity. It provides policy makers with a tool for the early identification of overtourism. For instance, our results reveal that district Mitte, where most of the tourist accommodation is concentrated in Berlin, had already reached its carrying capacity in 2012. This finding is supported by the fact that resident protests surged in 2011 and have continued since. Informed policy intervention, in the form of directing tourist flows to areas of the city that are far from reaching the carrying capacity threshold, would allow those areas to benefit from an increase in tourist numbers while reducing the tension in central districts.

The most important aspect of the present methodology is that it avoids costly data collection on residents' sentiments towards tourism, as generally performed in studies on the impact of tourism. It uses large datasets already collected by many governments. Hence, it is possible to estimate the carrying capacity for many cities by utilizing already existing data.

The analysis presented includes only data on tourists in registered accommodation in Berlin. Investigation of the effect of home sharing on the satisfaction with life of residents needs to be conducted. Future investigations should compare destinations to explore the determinants of the impacts, positive and negative, of tourism on residents' lives in different conditions. Meanwhile, longitudinal studies will permit identification of the dynamics of the benefits of tourism growth for a local community.

Acknowledgment

This research was supported by the Free University of Bolzano project WW200F "Tourism and wellbeing of residents".

Appendix A

Table A.1
Nights per resident by district and years. Distribution of post codes in the districts.

District:	Number of Post codes contained in the District	Nights per resident									
		Year									
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1 "Mitte"	20	17.59	19.48	22.16	25.36	28.89	31.75	33.11	35.24	35.06	34.86
2 "Friedrichshain-Kreuzberg"	10	8.05	8.81	9.65	10.39	11.65	13.17	14.12	14.27	11.72	14.52
3 "Pankow"	18	2.61	3.04	3.30	3.25	3.41	3.40	3.60	3.54	4.77	3.49
4 "Charlottenburg-Wilmersdorf"	22	13.90	13.47	14.67	15.29	16.71	18.98	19.81	20.45	22.66	20.40
5 "Spandau"	13	2.06	1.96	1.95	1.78	2.08	2.32	2.31	2.52	2.22	2.47
6 "Steglitz-Zehlendorf"	15	1.49	1.55	1.54	1.56	1.74	1.62	1.67	1.72	1.48	1.65
7 "Tempelhof-Schöneberg"	22	3.36	3.50	3.90	3.99	4.56	5.01	5.34	5.33	4.87	5.65
8 "Neukölln"	16	1.95	1.79	1.73	1.78	2.02	2.28	2.41	2.62	3.29	2.68
9 "Treptow-Köpenick"	14	2.21	2.13	2.23	2.03	2.30	2.52	2.50	2.56	2.70	2.66
10 "Marzahn-Hellersdorf"	11	0.46	0.63	0.67	0.65	0.68	0.91	0.87	0.89	0.74	0.91
11 "Lichtenberg"	12	2.43	3.01	3.30	3.17	3.23	3.68	3.84	3.90	3.07	4.04
12 "Reinickendorf"	13	2.18	2.34	2.55	2.57	2.60	2.55	2.57	2.38	2.12	2.02
Total Postal codes:	186										

Table A.2
Variables included in the regression analysis, classified according to the bottom-up spillover theory.

Life domain:	Variables included in the study	Variable name in the model	Unit of measurement
	Tourism intensity in the district	NightXres	Number
Community life	Living in old residential area	Neigh	Percentage
Health	Average satisfaction with health	SatHealth	Likert scale (1–10)
	Average satisfaction with work	SatWork	Likert scale (1–10)
Work and Productivity	Average weekly work time	WorkTime	hours
	Average individual net labor income	NetLAbInc	Euros
Material well-being	Percentage of residents who own their home	Homeowner	Percentage
	Average score for being worried about presence of immigrants	WorriedImmi	Likert scale (1–3)
Personal safety	Average score for being worried about crime	WorriedCrime	Likert scale (1–3)
Quality of environment	Average score for being worried about environment	WorriedEnvir	Likert scale (1–3)

(continued on next page)

Table A.2 (*continued*)

Life domain:	Variables included in the study	Variable name in the model	Unit of measurement
Emotional well-being	Frequency of being happy in the last 4 weeks	BeHappy	Likert scale (1–5)
Relationship with family	Satisfaction with family life	SatFamLife	Likert scale (1–10)

Table A.3
Descriptive statistics.

Variable:	Var Type:	N	mean	sd	min	max
SatLife	Continuous var.	1424	7.00	1.10	2.00	10.00
Neig	Percentage (1 = 100%)	1424	0.10	0.22	0.00	1.00
SatHeallth	Continuous var.	1424	6.56	1.26	1.00	10.00
SatWork	Continuous var.	1424	6.85	1.41	0.00	10.00
WorkTime	hours	1424	37.43	8.53	3.00	75.00
NetLAbInc	Euros	1424	1667.18	822.37	0.00	8000.00
Homeowner	Percentage (1 = 100%)	1424	0.18	0.30	0.00	1.00
WorriedCrime	Continuous var.	1424	1.87	0.48	1.00	3.00
WorriedImmi	Continuous var.	1424	2.11	0.53	1.00	3.00
WorriedEnvir	Continuous var.	1424	1.77	0.39	1.00	3.00
SatLeis	Continuous var.	1424	6.90	1.31	0.00	10.00
BeHappy	Continuous var.	1424	3.50	0.60	1.00	5.00
SatFamLife	Continuous var.	1424	7.46	1.35	0.00	10.00

Table A.4
Correlation matrix of variables included in the regressions in Table 1.

	Nights~s	Neig	SatHea	SatWork	WorkTime	NetLAb~c	Homeow~r	Worrie~e	Worrie~i	Worrie~r	BeHappy	SatFamLife
NightsXres	1											
Neig	−0.0093	1										
SatHeallth	0.083	0.0466	1									
SatWork	−0.0224	−0.011	0.3234	1								
WorkTime	−0.0502	0.0042	−0.0058	0.0861	1							
NetLAbInc	0.0267	0.0192	0.0972	0.1074	0.4151	1						
Homeowner	−0.1946	0.0054	0.0428	0.0351	−0.0037	0.2518	1					
WorriedCrime	0.211	0.0767	0.1811	0.0263	−0.0177	0.1319	−0.136	1				
WorriedImmi	0.1411	0.1054	0.1738	0.0626	0.0056	0.1234	−0.0834	0.6543	1			
WorriedEnvir	0.0444	0.0216	0.0145	−0.0672	−0.0516	0.0263	−0.0516	0.1073	−0.0219	1		
BeHappy	0.002	0.0204	0.3775	0.2503	−0.0293	0.0956	0.0757	0.1276	0.1207	0.0646	1	
SatFamLife	−0.0404	0.0055	0.3144	0.3168	−0.0515	0.08	0.1763	−0.0526	0.0045	−0.0035	0.4283	1

Table A.5
Robustness checks. Dependent variable: Satisfaction with life.

Independent variables:	Fixed-effect model with clustered standard errors	Fixed-effect model without clustered standard errors	Random-effect model with clustered standard errors
	(1)	(2)	(3)
NightsXres	0.1246***	0.1246***	0.0082
	(0.032)	(0.034)	(0.008)
$NightsXres^2$	−0.0023***	−0.0023***	−0.0001
	(0.001)	(0.001)	(0.000)
Neig	−0.2036**	−0.2036**	−0.2001***
	(0.081)	(0.075)	(0.073)
SatHeallth	0.1983***	0.1983***	0.2258***
	(0.020)	(0.034)	(0.036)
SatWork	0.0801***	0.0801***	0.1010***
	(0.015)	(0.026)	(0.029)
WorkTime	−0.0070**	−0.0070	−0.0069
	(0.003)	(0.005)	(0.004)
NetLAbInc	0.0001***	0.0001**	0.0001***
	(0.000)	(0.000)	(0.000)
Homeowner	0.3361**	0.3361**	0.1326
	(0.147)	(0.150)	(0.092)
WorriedImmi	0.2152***	0.2152***	0.2316***
	(0.052)	(0.054)	(0.055)
WorriedCrime	−0.1050*	−0.1050	−0.1331**
	(0.059)	(0.068)	(0.056)

(*continued on next page*)

Table A.5 (*continued*)

Independent variables:	Fixed-effect model with clustered standard errors	Fixed-effect model without clustered standard errors	Random-effect model with clustered standard errors
	(1)	(2)	(3)
WorriedEnvir	−0.0900	−0.0900	−0.0704
	(0.060)	(0.055)	(0.047)
BeHappy	0.4093***	0.4093***	0.4769***
	(0.040)	(0.081)	(0.069)
SatFamLife	0.2389***	0.2389***	0.2420***
	(0.018)	(0.032)	(0.027)
Constant	1.2512***	1.2512**	1.2216***
	(0.285)	(0.441)	(0.403)
Observations	1424	1424	1424
R2 overall	0.424	0.424	0.440
Cluster standard errors at District level	Yes	No	Yes
Rho	0.537	0.537	0.209
Sigma_e	0.627	0.627	0.627
Sigma_u	0.921	0.921	0.705
Fixed-vs-random effects test	Sargan-Hansen statistic:		1205.761 (0.000)
Inverted U-shape hypothesis	Lind and Melhun		3.01(0.006)

The t-test value rejects the null hypothesis of no inverted U-shape at 0.01. The slopes in the extreme values of the sample are, respectively, 0.11 (t = 3.62, p = .002) and − 0.04 ($t = -3.01$, p = .006) for the minimum value of Nightxres in the sample and for the maximum value of Nightxres in the sample. The fixed-effect model is to be preferred over the random-effect model on the basis of a Sargan-Hansen test of overidentifying restrictions. This test was preferred over the Hausman test, which performs poorly under the assumption of clustered standard errors (Hansen, 1982). For completeness, the results of a fixed-effect estimation without clustered standard errors are also reported.

*** $p < .01$.

** $p < .05$.

* $p < .1$.

References

Andereck, K. L., & Nyaupane, G. P. (2011). Exploring the nature of tourism and quality of life perceptions among residents. *Journal of Travel Research, 50*(3), 248–260.
Canestrelli, E., & Costa, P. (1991). Tourist carrying capacity: A fuzzy approach. *Annals of Tourism Research, 18*(2), 295–311.
Diener, E., Oishi, S., & Tay, L. (2018). Advances in subjective well-being research. *Nature Human Behaviour, 2*(4), 253.
Füller, H., & Michel, B. (2014). "Stop being a tourist!" New dynamics of urban tourism in Berlin-Kreuzberg. *International Journal of Urban and Regional Research, 38*(4), 1304–1318.
Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica, 50*(4), 1029–1054.
Lind, J. T., & Mehlum, H. (2010). With or without U? The appropriate test for a U-shaped relationship. *Oxford Bulletin of Economics and Statistics, 72*(1), 109–118.
Moulton, B. R. (1990). An illustration of a pitfall in estimating the effects of aggregate variables on micro units. *The Review of Economics and Statistics, 72*(2), 334–338.
Nawijn, J., & Mitas, O. (2012). Resident attitudes to tourism and their effect on subjective well-being the case of Palma de Mallorca. *Journal of Travel Research, 51*(5), 531–541.
Peeters, P., Gössling, S., Klijs, J., Milano, C., Novelli, M., Dijkmans, C., … Postma, A. (2018). *Research for TRAN committee - Overtourism: Impact and possible policy responses*. Brussels: European Parliament, Policy Department for Structural and Cohesion Policies.
Saveriades, A. (2000). Establishing the social tourism carrying capacity for the tourist resorts of the east coast of the Republic of Cyprus. *Tourism Management, 21*(2), 147–156.
Socio-Economic Panel (SOEP). (2019). *Data for years 1984–2017, version 34*.
Statistical Office Berlin-Brandenburg. (2019). Tourismus Berlin-Brandenburg. Retrieved from https://www.statistik-berlin-brandenburg.de/datenbank/Inhalt-Datenbank.asp.
Tokarchuk, O., Gabriele, R., & Maurer, O. (2017). Development of city tourism and well-being of urban residents: A case of German Magic Cities. *Tourism Economics, 23*(2), 343–359.
Uysal, M., & Sirgy, M. J. (2019). Quality-of-life indicators as performance measures. *Annals of Tourism Research, 76*, 291–300.
Uysal, M., Sirgy, M. J., Woo, E., & Kim, H. L. (2016). Quality of life (QOL) and well-being research in tourism. *Tourism Management, 53*, 244–261.
Woo, E., Kim, H., & Uysal, M. (2015). Life satisfaction and support for tourism development. *Annals of Tourism Research, 50*, 84–97.
World Tourism Organization (UNWTO), Centre of Expertise Leisure, Tourism & Hospitality, NHTV Breda University of Applied Sciences, & NHL Stenden University of Applied Sciences. (2018). *"Overtourism"? – Understanding and managing urban tourism growth beyond perceptions*. Madrid: UNWTO. https://doi.org/10.18111/9789284419999.

Oksana Tokarchuk is Assistant Professor of Management and Marketing at the Competence Centre in Tourism Management and Tourism Economics (TOMTE) of the School of Economics and Management of the Free University of Bolzano, she holds a PhD in Economics and Management. Her main research interests include behavioural economics, consumer behaviour, quality of life and applied statistics/econometrics.

Roberto Gabriele is Full Professor of Applied Economics at the Department of Economics and Management of the University of Trento. Graduated in statistics at "La Sapienza" in Rome He took a PhD in Economics and Management At Sant'Anna School of Advanced Studies in Pisa. He works in policy evaluation, tourism, sectors and industry dynamics using econometric models and agent based models.

Oswin Maurer is Full Professor of Marketing and Dean, Faculty of Economics and Management at the Free University of Bozen-Bolzano. He is the founder of the Competence Centre in Tourism Marketing and Tourism Management (TOMTE) and has research experience in Tourism Marketing, and Tourism and Food. Current research revolves around perception and consumption of touristic products, Quality of Life of tourists and residents, regional product as value-generating components of regions and of touristic experiences.