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Research paper

Modeling residents' perceptions of tourism development: Linear versus non-linear models

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ABSTRACT

This paper aims to investigate the linearity of the relationship between residents' perceptions of and support for the development of tourism. The links between residents' support for the development of tourism and their perceptions have been investigated across a large number of studies, most of which assume a linear path. The current study found that a non-linear algorithm exists between residents' negative perceptions and their support for tourism development, which in some cases could increase the effectiveness of the existing model. This finding marks a significant and unique theoretical contribution of current study. Additionally, by identifying a non-linear pattern of relationships akin to that seen in vivo, these findings can assist local authorities in managing the support of residents and in promoting the sustainability of tourism development.

1. Introduction

Residents' support for and willingness to sustain tourism development activities is conditional upon how they perceive such developments impacting the communities where they reside (Andereck, Valentine, Knopf, & Vogt, 2005; Nicholas, Thapa, & Ko, 2009). Early research on perceptions of residents towards development of tourism suggest the impacts of tourism development are perceived both positively and negatively (Rasoolimanesh, Roldan, Jaafar & Ramayah, 2017). In the event of residents having a positive perceptions of tourism, they will be encouraged to support such developments and to look for opportunities to benefit by offering tourism-related services and products; the perception of negative impacts, however, has the opposite effect of discouraging residents from supporting such developments (Sharpley, 2014). Consequently, most resident-perception research assumes a linear association between the perceptions of residents and their support for the development of tourism (Choi & Sirakaya, 2006; Gursoy, Jurowski, & Uysal, 2002; Jaafar, Noor, & Rasoolimanesh, 2015; Ko & Stewart, 2002; Nicholas et al., 2009). However, studies from the field of tourism pertaining to residents' perceptions suggest the presence of more complex and non-linear relationships between constructs (Allen, Long, Perdue, & Kieselbach, 1988; Bowen & Chen, 2001). These non-linear relationships suggest that how residents behave when they are supportive for tourism development in their communities might be more heterogeneous than previously thought. The assumption of linear relationships between constructs in a model can lead to the results of a study being misunderstood. Therefore, not only is the actual relationship between variables non-linear; but if the relationship is erroneously assumed to be linear then not only will the true relationship will be underestimated, but the effects of this relationship might register as weak or non-significant.

The objective of the current study is thus to examine the effects of residents' positive and negative perceptions toward tourism development in relation to their support for such development, assuming linear and non-linear relationships in three Malaysian destinations and to compare the results of each set of analysis. Data were collected from residents of Lenggong Valley, Bujang Valley and George Town heritage sites, and subject to analysis by way of partial least squares–structural equation modeling (PLS-SEM), with WarpPLS 5.0 software used to analyse the relationships and to compare the results. WarpPLS 5.0 allows linear and non-linear algorithms to be assessed simultaneously in order to gain a better understanding of the relationships between these constructs.

2. Residents' perceptions toward tourism development

Many studies have been conducted to investigate how residents perceive the impacts of tourism development at various tourism destinations (Kim, Uysal, & Sirgy, 2013; Látková & Vogt, 2012; Nunkoo &

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Ramkissoon, 2010, 2011; Nunkoo, Smith, & Ramkissoon, 2013; Rasoolimanesh, Jaafar, Kock, & Ramayah, 2015; Vareiro, Remoaldo, & Cadima Ribeiro, 2013; Wang & Pfister, 2008). These impacts can be perceived positively or negatively (Jaafar et al., 2015). The tourism development can result in an increase in a family's income, increased employment opportunities, improved living standards and can significantly boost a destination's tax revenues from the positive side (Ko & Stewart, 2002; Nunkoo & Ramkissoon, 2011). Similarly, availability of recreational and entertainment facilities often increases in line with the development of tourism (Rasoolimanesh et al., 2015). The growth of indigenous tourism can help to elucidate residents' cultural identity and can contribute to the preservation and revival of their traditional arts, crafts and culture (Jaafar, Rasoolimanesh, & Ismail, 2017; Kim, 2002). On the downside, the development of local tourism can also result in an increase in the cost of living (Rasoolimanesh, Roldán, Jaafar, & Ramayah, 2017), raising the price of property, products and goods (Andereck et al., 2005). Local tourism development can also affect the value systems that underpin many families and the relationships between family members (Jaafar et al., 2017). Previous studies have also identified that the tourism developments can contribute to the overcrowding of local businesses and worsening traffic congestion (Ko & Stewart, 2002), can be associated with an increase in the rate of crime and drug use (Deery, Jago, & Fredline, 2012), and can increase the amount of visible litter and public alcohol consumption (Látková & Vogt, 2012).

Ultimately, predicting residents' support for tourism development is a function of they perceive tourism affecting them and their community (Telfer & Sharpley, 2008). In the event of having positive perceived impacts of tourism development, there is a higher chance of residents to support it. Conversely, should residents perceive an abundance of negative impacts, they risk withdrawing their backing from development of tourism (Kim et al., 2013).

Several studies that have tried to understand whether residents' support for tourism is influenced by their perceptions. These studies have mainly relied upon the Social Exchange Theory (SET) as a theoretical base (Látková & Vogt, 2012; Rasoolimanesh et al., 2015). As per the SET, if residents' perceived tourism development benefits outweigh its costs, they will interact with tourists and be supportive of tourism development (Telfer & Sharpley, 2008). Conversely, should their perception of tourism development's negative impacts offset positive impacts, they risk becoming disenchanted with the idea of tourism development and may refuse to support any such development (Nunkoo & Ramkissoon, 2011).

Previous SET studies have reported that residents' support for tourism development (SUP) is positively impacted by their positive perceptions (PP) (Gursoy et al., 2002; Nunkoo & Ramkissoon, 2010). Notwithstanding, regarding the effect of residents' negative perceptions (NP), previous studies have reported inconsistent findings. Some studies, consistent with SET, have confirmed a negative relationship between negative perceptions of residents about tourism development and their support for it (Rasoolimanesh et al., 2015; Wang & Pfister, 2008), while other studies have identified not significant impacts (Nunkoo & So, 2015).

3. Linear and non-linear relationship

Most studies of residents' attitudes and perceptions assume a linear relationship between variables in the model and have used a range of approaches to statistically examine these relationships (Gursoy et al., 2002; Jaafar et al., 2015). Multiple regression analysis (Látková & Vogt, 2012), covariance-based SEM (Gursoy et al., 2002; Nicholas et al., 2009) and PLS-SEM (Jaafar et al., 2015; Rasoolimanesh et al., 2015) have been used to assess linear relationships between residents' perceptions and other variables, such as community participation (Jaafar et al., 2017), support for tourism development (Gursoy et al., 2002; Nicholas et al., 2009) and quality of life (Ko & Stewart, 2002). However, several studies have suggested the possibility of non-linear relationships between the variables mediating residents' perceptions (Allen et al., 1988; Gursoy et al., 2002; Nepal, 2008). For instance, Allen et al. (1988) found a negative quadratic relationship between tourism development and residents' perceptions toward community services and opportunities. This would suggest that increasing the number of tourists in the community in the early stages of tourism development can lead to improved community services and economic opportunities for residents. However, as the number of tourists continues to rise, the local community will eventually grow to become concerned about availability of services and lack of opportunities in their community, as well as damage to the surrounding environment. Therefore, according to Allen et al. (1988), the relationship between tourism development and residents' perceptions of the impacts of tourism follows a non-linear or quadratic relationship. Moreover, Gursoy, Chi, Ai, and Chen (2011) and Nepal (2008) propose that support for tourism among community members might be heterogeneous, based on their perceptions and attitudes toward the impacts of tourism and the likelihood of non-linear and quadratic relationships.

Consequently, the possibility of non-linearity should be examined. If the relationship between variables is assumed to be linear, while in all actuality these relationships are non-linear, the true nature of these relationships will be underestimated and the effect size may be weak or non-significant (Osborne & Waters, 2002). Several approaches to the detection of non-linearity have suggested in the literature, including: (a) analysis of previous studies, (b) examination of residual plots, and (c) analysing for both linear and non-linear relationships and comparing the results and relationship plots (Berry & Feldman, 1985; Cohen & Cohen, 1983; Osborne & Waters, 2002; Pedhazur & Kerlinger, 1997). The current study focuses on the third method of analysis; consequently, this paper analyzes the relationship between residents' positive and negative perceptions of tourism development and their level of support for such development using linear and non-linear functions in three case studies. The results and models are then compared.

4. Research method

4.1. Instrument and data collection

Data pertaining to residents' positive and negative perceptions, as well as their level of support for tourism development, were collected using a self-administered questionnaire. Items for the questionnaire were taken from the literature (Látková & Vogt, 2012; Wang & Pfister, 2008). Respondents answered these questions on a five-point Likert scale where 1 was anchored at *strongly disagree* and 5 was anchored at *strongly agree*. Systematic sampling was used to identify potential respondents from the residents of three destinations in Malaysia, i.e. George Town, Lenggong and Bujang Valley. A number of students from the Universiti Sains Malaysia were hired to distribute and collect the questionnaires. Data collection was performed according to the following schedule: January–February 2015 (George Town), May 2014 (Lenggong) and March–June 2014 (Bujang). The surveyors approached residents' houses systematically, asking whether the occupant was a resident and, if so, if they were willing to complete the questionnaires. If a resident declined to participate, the adjacent house was selected. In total, 410, 221 and 141 questionnaires were returned from the respondents residing in George Town, Lenggong and Bujang, respectively. Different sample sizes reflect the size and the density of the population in each location. The George Town historical site contains 2500 households and 9425 residents; the population of villages near Lenggong totalled 3826, living among 775 households; and in Bujang, approximately 1400 villagers live within the vicinity of the archaeological site, spread over 320 households.

Having sample sizes of 141, 221 and 410 for three cases was considered suitable for performing PLS based SEM analysis, which requires a cut-off sample of 100 (Reinartz, Haenlein, & Henseler, 2009). In

addition, calculating the minimum sample size using G*Power, which is based on statistical power (Faul, Erdfelder, Buchner, & Lang, 2009), suggested a minimum sample of 107 to gain power in the order of 0.95, which is more than adequate for the social sciences.

4.2. Study Areas

The three heritage sites involved were George Town, Lenggong and Bujang. George Town is an urban heritage destination, situated in the northeast of Malaysian Island of Penang and was declared by United Nations Educational, Scientific, and Cultural Organization (UNESCO) as a world heritage site in July 2008. George Town is a mature urban tourism destination, home to almost 1900 historic buildings, numerous religious festivals, as well as music, food and lifestyles from various world cultures (State Government of Penang SGP, 2013). Lenggong Valley, on the other hand, situated in Perak State, is a rural destination and was not inscribed as a world heritage site until 2012. Lenggong Valley owed its World Heritage status to the discovery of an undisturbed Palaeolithic stone tool workshop and the australomelanesoid 'Perak Man' in 1991. In addition, Lenggong Valley is home to a diversity of flora and fauna, as well as an equatorial rainforest ecosystem, thus making the Lenggong Valley a unique natural destination (Hassan, 2012). While the number of tourists subsequent to Lenggong Valley's inscription as a WHS has grown steadily, the site remains very much in the early stages of tourism development. Among the three destinations in this study, Bujang Valley, located in the state of Kedah, has lowest level of tourism development. Bujang Valley is a rural heritage destination with an archaeological site dating back at least to the 12th century, although possibly earlier (Ramli, 2014), and is home to at least 50 known ancient Hindu and/or Buddhist temples (Sudipta, Sarat, & Babu, 2010). Moreover, archaeological evidence suggests that the Bujang Valley may have been a part of an ancient international iron trade (Ramli, 2014). Therefore, George Town is a mature urban tourism destination with the highest number of tourists, followed by the Lenggong and Bujang Valleys, respectively, as the least developed tourism destinations.

4.3. Data analysis

PLS-SEM was used to test the model, assuming linear and non-linear relationships between the constructs. PLS-SEM is a form of multivariate statistical analytical tools to simultaneously evaluate all the structural paths among the variables in a conceptual model. Another reason for using PLS-SEM was that this approach maximizes the variance of endogenous constructs (Hair, Hult, Ringle, & Sarstedt, 2017), which is important in terms of comparing the R^2 between each dataset with regard to the application of linear and non-linear algorithms. The PLS-SEM analysis was performed using WarpPLS, version 5.0 (Kock, 2015), as this software allows for linear and various non-linear algorithms to be performed.

This study used the PLS regression outer model algorithm to estimate the parameters of the measurement (i.e. outer) model and latent variable (LV) scores (Kock, 2015). WarpPLS offers various options for analysing the parameters of an outer model and for the calculation of LV scores. The PLS regression algorithm is the most frequently used method of non-linear SEM analysis (Guo, Yuan, Archer, & Connelly, 2011; Kock & Mayfield, 2015), and can minimise collinearity better as compared to other outer model algorithms, such a Mode A or Mode B (Kock & Mayfield, 2015).

PLS-SEM follows a two-stage process (Hair et al., 2017). In first stage, the LV scores, as well as the outer loadings and outer weights for the reflective and formative constructs, are estimated through a series of iterative steps (Hair et al., 2017). In the second stage, structural model criteria (e.g. path coefficients) are estimated based on LV scores using ordinary least squares (OLS) to maximise the variance that is shared among the predictors for a criterion (R^2) (Lohmöller, 1989). Maximising the shared variance of these predictors is the primary aim of PLS-SEM and other regression-based methods of analysis (Hair et al., 2017). The current study aims to compare linear and non-linear algorithms for the inner model. An assessment of the value of R^2 can elucidate upon whether linear or non-linear algorithms are best suited for the context of resident perception studies. Eqs. (1) and (2) show the linear and non-linear algorithms employed in this study, respectively (Kock, 2010).

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon_1 \quad (1)$$

$$Y = \alpha_0 + \alpha_1 F(X_1) + \alpha_2 G(X_2) + \varepsilon_2 \quad (2)$$

(Note: $F(X_1)$ and $G(X_2)$ are the non-linear functions of X_1 and X_2, which can be quadratic, logarithmic functions, etc.)

In addition, the study compared the value of path coefficients and the effect size of the relationships between PP, NP and SUP, as well as the relationship plots for linear and non-linear algorithms for each of the three research settings to gain an improved understanding and interpretation of the effects of residents' perceptions (positive and negative) of and their support for the development of tourism.

Effect size (f^2) is important for understanding whether the path coefficients, which are indicative of effect size, are high, moderate or low; as indicated by f^2 values in the order of 0.02, 0.15 and 0.35, respectively (Cohen, 1988). These effect sizes allude to the impact of a specific independent LV on a dependent LV and are calculated based on changes in the R^2 of the dependent LV (Chin, 2010). Therefore, effect size refers to the degree of R^2 derived from a specific independent LV.

5. Analysis and findings

As a rule of thumb, any model's assessment in PLS-SEM involves two steps comprising evaluation of outer (measurement) and inner (structural) models (Ali, Rasoolimanesh, Sarstedt, Ringle, & Ryu, 2018; Hair et al., 2017). Assessment of the measurement model entails establishing the validity and reliability of latent variables. This includes assessing the relationships between the LVs and their associated items. How the LVs themselves relate to one another, however, is something that is explored in the structural model assessment (Ali et al., 2018; Hair et al., 2017).

5.1. Assessment of the measurement model

Three reflective constructs were involved in the model in this study, namely PP and NP of residents toward and support for tourism development. These measurement models were assessed in three contexts using data collected from residents of three heritage sites. Assessing the measurement model includes an evaluation of reliability, as well as both convergent and discriminant validity.

In order to assess the reliability of reflective measurement model, the loading of each indicator must be greater than 0.7 for reliability to be considered acceptable (Ali et al., 2018; Hair et al., 2017). Items loading less than 0.5 should be considered for removal, while those loading of 0.5–0.7 can only be removed if their exclusion increases the Composite Reliability (CR) and Average Variance Extracted (AVE) above the threshold (Hair et al., 2017). Moreover, the CR is also used to determine construct reliability, with values greater than 0.7 thought to be acceptable (Ali et al., 2018; Hair et al., 2017). Table 1 indicates that the CR for all of the LVs in the model in each context exceeded 0.7 and the outer loading higher than 0.5. Therefore, the results indicate the acceptable reliability of measurement model.

To establish the convergent validity, AVE values of the latent constructs should be higher than the cut-off value of 0.5 (Ali et al., 2018; Hair et al., 2017). As seen in Table 1, the constructs in this study had an AVE in excess of 0.5. Therefore, the measurement model for each research settings possessed acceptable convergent validity: George Town, Lenggong and Bujang.

Table 1
The results of assessment of the measurement model.

Construct / Items	Loading George Town	CR	AVE	Loading Lenggong	CR	AVE	Loading Bujang	CR	AVE
Positive Perception (PP)		**0.919**	**0.696**		**0.881**	**0.599**		**0.874**	**0.586**
1. Tourism would create more jobs for my community.	0.832			0.781			0.830		
2. Tourism would attract more investment to my community.	0.874			0.794			0.797		
3. Our standard of living would increase considerably because of tourism.	0.875			0.672			0.799		
4. Tourism provides more infrastructure and public facilities, like roads, shopping, etc.	0.854			0.792			0.812		
5. Tourism enhances the image of our local culture and residents take pride in their culture.	0.729			0.822			0.555		
Negative Perception (NP)		**0.899**	**0.640**		**0.889**	**0.617**		**0.871**	**0.576**
1. Local residents would suffer from living in a tourism destination area.	0.778			0.801			0.733		
2. Tourism would result in traffic congestion, noise and pollution.	0.737			0.854			0.823		
3. The construction of hotels and other tourist facilities would destroy the natural environment.	0.852			0.820			0.774		
4. The development of tourism would increase the cost of living.	0.818			0.657			0.801		
5. Tourism would increase the rate of crime.	0.812			0.784			0.651		
Support For Tourism Development (SUP)		**0.933**	**0.699**		**0.870**	**0.531**		**0.882**	**0.556**
1. I believe that tourism should be actively encouraged in my community.	0.811			0.582			0.770		
2. I support tourism and would like to see it become an important part of my community.	0.848			0.634			0.785		
3. The city government was correct in supporting the promotion of tourism.	0.852			0.830			0.794		
4. It is important to develop plans to manage of the growth of tourism.	0.869			0.823			0.737		
5. I will contribute to those activities that are relevant to the promotion of this destination.	0.874			0.772			0.717		
6. Long-term planning by city officials can control the negative impact of tourism.	0.754			0.698			0.664		

Table 2
Discriminant validity assessment.

	PP George Town	NP	SUP	PP Lenggong	NP	SUP	PP Bujang	NP	SUP
PP	**0.834**			**0.744**			**0.766**		
NP	0.093	**0.800**		0.140	**0.786**		0.121	**0.759**	
SUP	0.560	0.195	**0.836**	0.271	− 0.103	**0.729**	0.415	− 0.164	**0.746**

Note: The square root of AVEs shown diagonally in bold.

How distinct each LV is from other LV in the model is a function of its discriminant validity (Chin, 2010). The square root of the AVE for each LV should be higher than the correlation with all other LVs in the model (Fornell & Larcker, 1981; Hair et al., 2017). Table 2 reports the square root of each constructs' AVE value (in a bold diagonal), which is higher than the correlations among all the constructs. This implies that the proposed measurement model has established discriminant validity.

5.2. Assessment of the structural model and comparison between linear and non-linear functions

To assess the structural model, the sign, size, and significance of path coefficients should be evaluated (Ali et al., 2018). In this study, the coefficients (betas) were estimated for all the structural paths in the model using linear and non-linear functions to describe the relationships between the constructs for each case study. Additionally, to indicate the explanatory power of the model, R^2 values were calculated for all the endogenous (dependent) constructs. Table 3 and Fig. 1 depict the outcomes of the structural model assessment, including path coefficients and R^2 in each research setting using linear and non-linear algorithms.

The results of the structural model assessment using non-linear algorithms indicates improvement across all three research settings. Compared to the linear algorithm, the value of R^2, path coefficients and the effect size of the relationships were much higher for the Lenggong setting after using the non-linear algorithm for the inner model assessment. The value of R^2 and adjusted R^2 was 0.21 and 0.20, respectively, for the non-linear algorithm compared to 0.09 and 0.08 for the linear model. In addition, the path coefficients and f^2 of the effect of PP and NP on SUP were higher with non-linear functions. However, the values of R^2 and adjusted R^2 were very close for the George Town and Bujang case studies. Additionally, the value of the path coefficients and the effect sizes were similar to one another in the case of the Bujang research setting. The George Town structural model assessment revealed some disparity between the path coefficients and the effect size of the relationships despite similarities in R^2. The path coefficient value and f^2 of the effect of PP on SUP were slightly higher where linear functions were used, but NP had a higher effect on SUP in the case of

Table 3
Results of assessment of the structural model.

Path Coefficients / R^2		Linear George Town	Non-Linear	Linear Lenggong	Non-Linear	Linear Bujang	Non-Linear
PP → SUP	Path Coefficient	0.55	0.48	0.29	0.33	0.44	0.44
	P value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
	Effect size (f^2)	0.306	0.269	0.08	0.129	0.184	0.184
NP → SUP	Path Coefficient	0.14	0.19	− 0.14	− 0.25	− 0.22	− 0.21
	P value	< 0.01	< 0.001	< 0.05	< 0.001	< 0.01	< 0.01
	Effect size (f^2)	0.028	0.079	0.015	0.081	0.036	0.037
R^2		0.33	0.35	0.09	0.21	0.22	0.22
Adjusted R^2		0.33	0.35	0.08	0.20	0.21	0.21

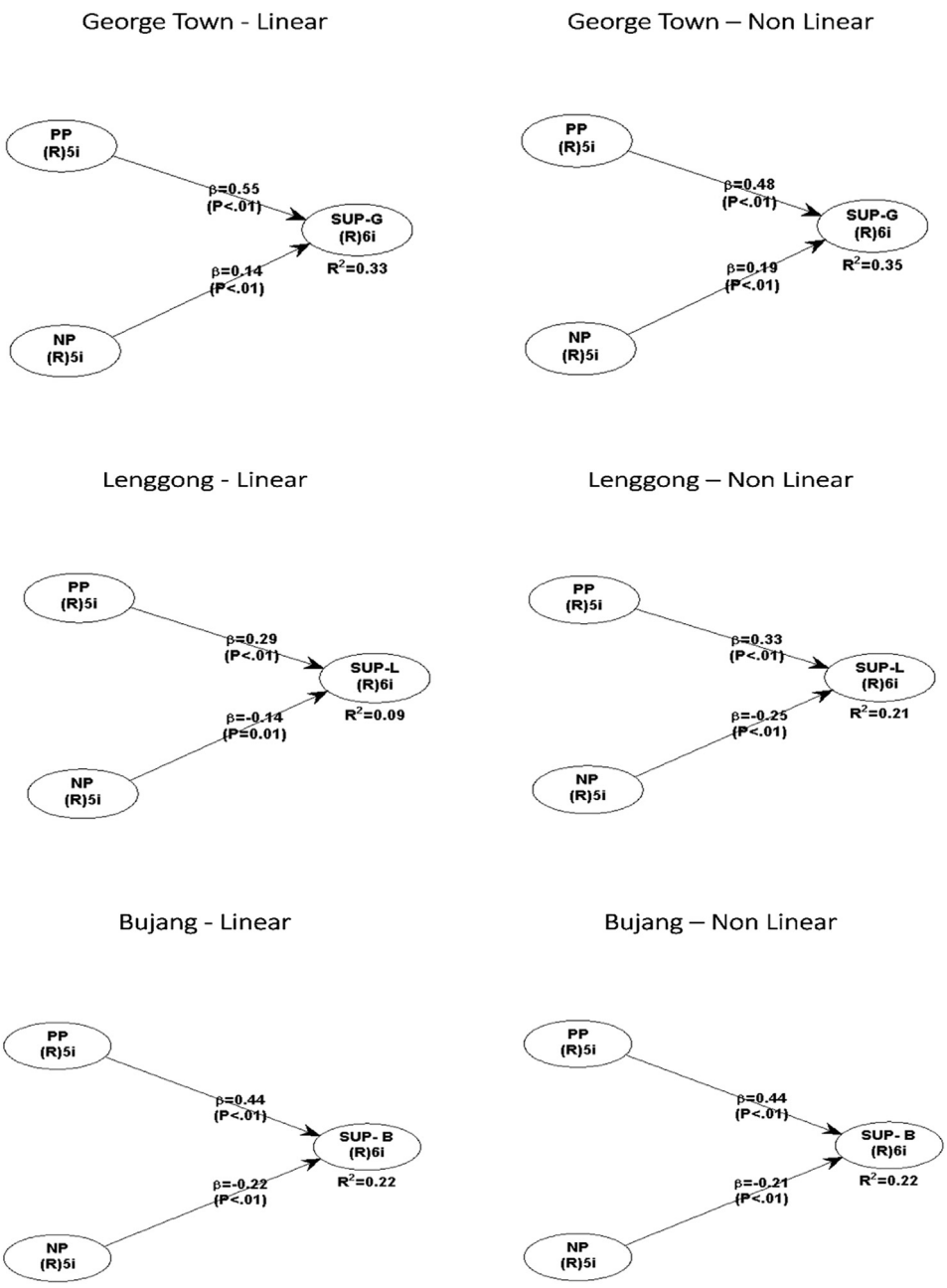


Fig. 1. The results of structural model assessment using linear and non-linear algorithms.

non-linear functions. Therefore, in both Bujang and George Town case studies, the findings revealed that the non-linear function worked very much like the linear algorithm.

The pattern of the relationships between PP, NP and SUP has been plotted in Figs. 2 and 3. For the most part, these plots indicate non-linear pattern of relationships, especially between NP and SUP. In the case of Bujang, the plots for linear and non-linear functions are similar; however, Lenggong exhibits a non-linear pattern of relationships.

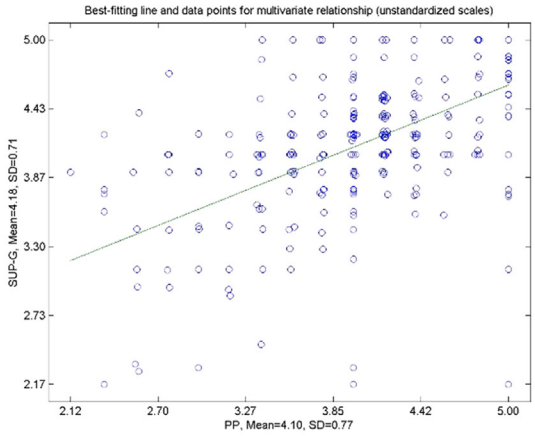
6. Discussion

The current study aimed to investigate the relationships between how residents perceive tourism development and their level of support for such development. Previous studies have examined whether residents' support for tourism development is influenced by their perceptions (positive and negative) of a tourism destination (Gursoy et al., 2002; Nicholas et al., 2009). These relationships have been conceptualized based on various theories, with SET being the most prominent (Nunkoo et al., 2013). SET suggests that the effect of PP on SUP should be positive and the effect of NP on SUP should be negative (Rasoolimanesh et al., 2015). The present study, however, is likely the first to examine the pattern of these relationships without the assumption of a linear relationship between variables. By investigating the pattern of relationships in three case studies and comparing the results of an assessment of structural models assuming linear and non-linear functions, the present study provides a new perspective on these relationships and paves the way for future studies in this area.

The findings of this study revealed a non-linear pattern of relationships between residents' perceptions and their support for the development of tourism; in particular, for the relationship between negative perceptions and support. The results identified higher R^2 or at least similar for the non-linear model compared to the linear model. Therefore, assuming a non-linear function for the relationship between residents' perceptions and their support for the development of tourism

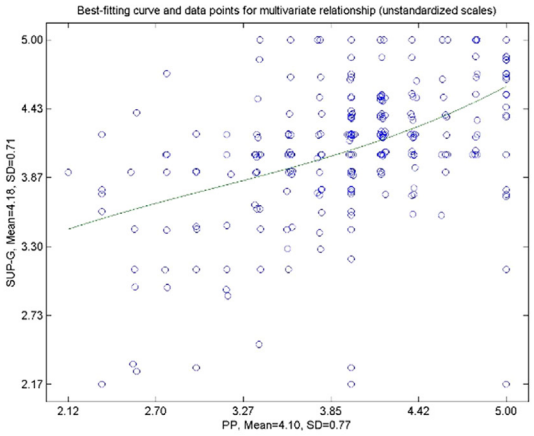
George Town – Linear

PP → SUP



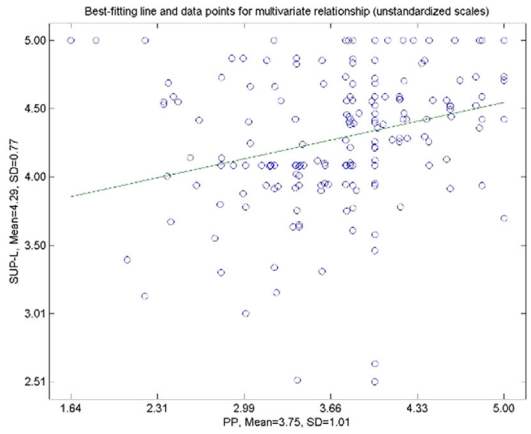
George Town – Non Linear

PP → SUP



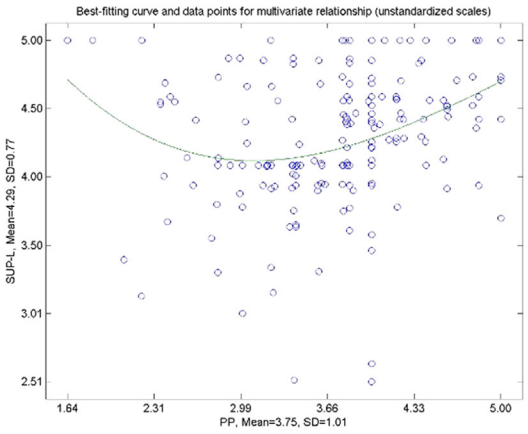
Lenggong – Linear

PP → SUP



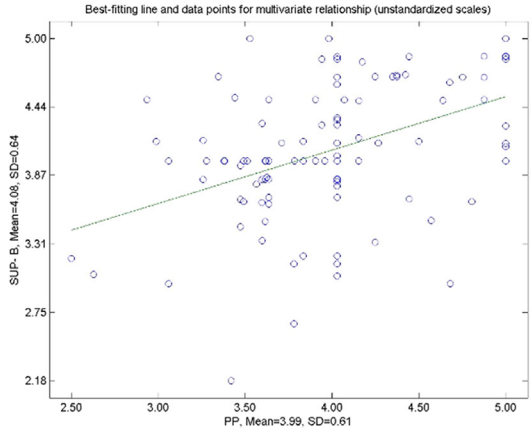
Lenggong – Non Linear

PP → SUP



Bujang – Linear

PP → SUP



Bujang – Non Linear

PP → SUP

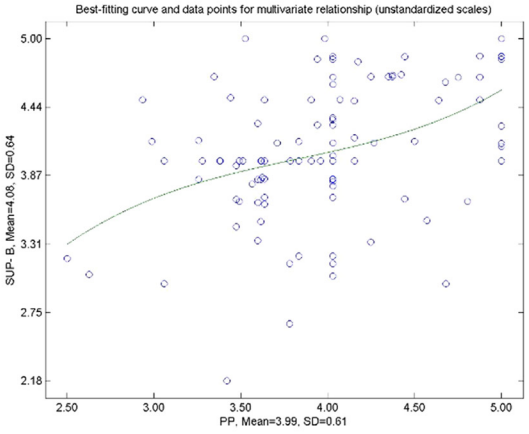
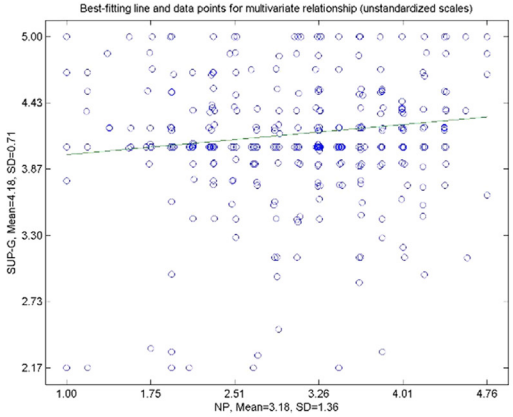


Fig. 2. Effects of residents' positive perceptions on their support for tourism development.

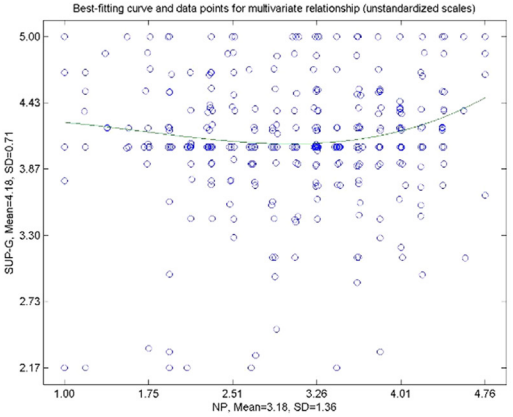
George Town – Linear

NP → SUP



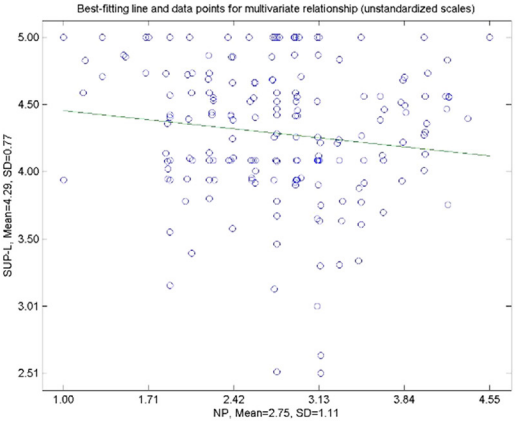
George Town – Non Linear

NP → SUP



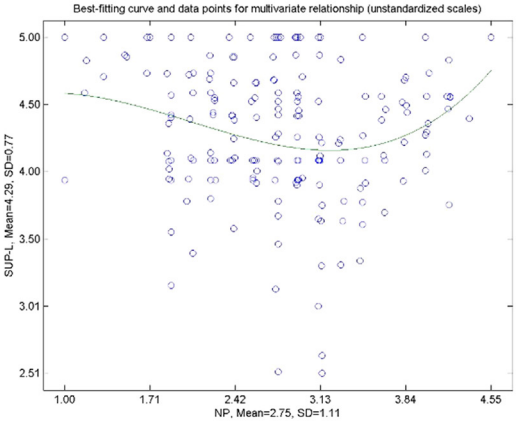
Lenggong – Linear

NP → SUP



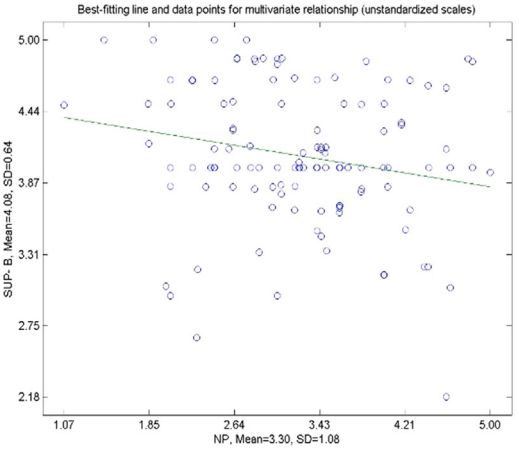
Lenggong – Non Linear

NP → SUP



Bujang – Linear

NP → SUP



Bujang – Non Linear

NP → SUP

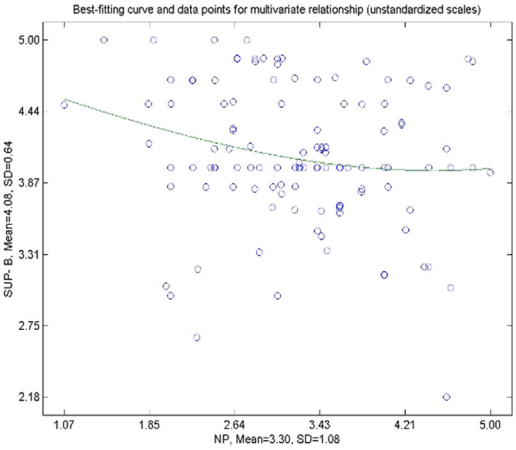


Fig. 3. Effects of residents' negative perceptions on their support for tourism development.

improves the quality of the model and the relationships. The findings showed similarities in the behaviour of linear and non-linear functions for the effect of positive perceptions on residents' support for the development of tourism. Previous SET studies suggest that residents' positive perceptions of the impacts of tourism development have a positive effect on their support for such development (Gursoy et al., 2002; Ko & Stewart, 2002; Nicholas et al., 2009). The findings of the current study indicate a positive effect of PP on SUP consistent with these previous studies and confirmed similarities between linear and non-linear algorithms for the inner model. However, the relationship between residents' negative perceptions of the impacts of tourism development and their support for such development was found to follow a non-linear path.

These results indicate the presence of heterogeneity among residents concerning how residents' support for tourism development is influenced by their negative perceptions of tourism development's impacts. In other words, the pattern of the relationship between residents' negative perceptions and support is non-linear. Among residents with low negative perceptions, the effect of NP on SUP is negative; however, this relationship is positive among residents with overwhelmingly negative perceptions (See Fig. 3, non-linear plots). Therefore, there are differences in the behaviour of residents who support tourism development, between those with low negative perceptions and those with high negative perceptions. However, if this heterogeneity was not considered and a linear relationship for the impact of NP on SUP was assumed, these results would invariably be misunderstood. For example, in the current study, the influence of NP on SUP in linear model was not positive for Bujang, but positive for George Town. For Lenggong, this effect was also negative, although with an effect size (f^2) lower than 0.02, which is considered non-significant. However, the application of non-linear functions elucidated a similar pattern of quadratic relationships in each of the three case studies and the strength of these relationships was significant. This finding is consistent with those of earlier studies, revealing various negative, positive and non-significant effects for the relationships between NP and SUP (Andereck et al., 2005; Nunkoo & Gursoy, 2012; Nunkoo & So, 2015). Therefore, if a linear function is assumed for the relationship between residents' perceptions toward tourism development impacts and their support for such development, and the results interpreted on the basis of this assumption, questionable findings are likely to be arrived at and an erroneous interpretation made. In order to improve the understanding and interpretation of residents' perceptions, it is preferable to assume a non-linear algorithm for the structural model. However, the greatest degree of heterogeneity and variance amid linear and non-linear algorithms for the impact of NP on SUP was observed in relation to Lenggong Valley. Compared to George Town, which is a mature destination, Lenggong Valley is in the middle stages of tourism development, while Bujang Valley is in the very early stages of tourism development. Unsurprisingly, heterogeneity and likelihood of non-linear relationships is greater among the residents of Lenggong Valley. Therefore, assuming a non-linear algorithm for the inner model is more important and preferable for destinations in the middle stages of tourism development as the likelihood of heterogeneity is much greater in this phase.

7. Conclusion and implications of the study

The current study investigated and reported the existence of a non-linear pattern of relationships between residents' perceptions of the impacts of tourism development and their support for such development. Most previous studies that have examined the effect of residents' perceptions of the impacts of tourism development on their support for such development have assumed a linear relationship, and examined these effects and interpreted the results based on linear functions. However, the current study revealed differences in the findings, and subsequent interpretation of those findings, where linear and non-linear functions are used. This finding is a significant and unique theoretical contribution of the current study.

In addition, the results of the current study have significant implications for local authorities responsible for the management of tourism destinations in understanding the behavior of residents in support of tourism development. The findings demonstrate a non-linear pattern of resident behavior with respect to their negative perceptions. In other words, there is a critical heterogeneity among residents in terms of their negative perceptions. Up to a certain level, residents' negative perceptions will logically reduce their support for tourism development, but once these negative perceptions exceed this level or threshold, their behaviour toward tourism development will change. Residents with negative perceptions exceeding this threshold will likely adopt a paradoxical position of support for tourism development because they are worried about the negative effects of such development (while being simultaneously aware of the positive impacts) and hope to negate these negative effects through their involvement and support of the tourism development process. Armed with an understanding of these patterns of resident behavior, local authorities should plan to increase awareness of residents about the impacts, positive as well as negative, of tourism and tourism development in their community. The non-linear pattern shows that the more residents understand tourism development's negative impacts, the more they tend to support and express an interesting in becoming involved with the tourism development. This non-linear pattern is more effective in destinations in middle stages of tourism development, such as Lenggong Valley.

8. Limitations and suggestions for future research

This study is not, however, free from limitations. One limitation is that we only examined how residents' support for tourism development is influenced by residents' perceptions (positive and negative). Further studies should be conducted to investigate the pattern (e.g. linear or non-linear) of the relationships between other factors potentially influencing residents' perceptions in this area. Moreover, this study has been conducted on three destinations in Malaysia and this can be considered as another limitation of this study. More studies in other destinations in both developing and developed countries are needed to get more reliable results and generalize the findings of current study.

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