

Innovation, uncertainty, and inter-firm shortcut ties in a tourism context

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Abstract

Efficient inter-firm coproduction in the tourism industry can bear a resemblance to the concept of small-worlds, typically characterized by pockets of local clusters and shortcut ties that connect and decrease path-length between clustered network members. In this paper we analyze survey and inter-firm network data across several winter destinations, finding that innovating firms can reduce path-length, but uncertainty is a necessary catalyst for this process to take place.

Keywords: coproduction; innovation; inter-firm networks; path-length; shortcut ties; uncertainty

1. Introduction

Tourism destinations can be viewed as complex inter-firm networks involving coproducing actors (Haugland, Ness, Grønseth, & Aarstad, 2011). A key characteristic is the need for close coordination and integration of specialized resources and activities provided by interdependent, yet autonomous actors, in order to deliver the destination product.

Coproduction requires that actors can easily reach each other to integrate specialized resources and activities across firm boundaries. Thus, in network terms, local clustering, or “pockets” of linked firms, is important for efficient coproduction. However, an overembedded, closed local cluster may insulate actors from new external information that enhances innovation and renewal (Uzzi, 1997). Consequently, accessing information beyond the local pocket by forming shortcut ties to wider networks is crucial. Efficient coproduction may accordingly bear a resemblance to the concept of small-worlds, which is typically characterized by pockets of local clusters *and* shortcut ties that connect and decrease the path-length between clustered network members (Watts & Strogatz, 1998). Shortcut ties provide access to novel, non-redundant information (Burt, 1992). Research also suggests that shortcut ties that decrease the path-length between local clusters and network members can have favorable performance implications (Aarstad, 2014; Chen & Guan, 2010; Fleming, King, & Juda, 2007; Mason & Watts, 2012; Singh, 2010).

To our knowledge, scholarly works on inter-firm shortcut ties in a tourism destination context are virtually non-existent. In this paper, we start to address this void. Specifically, we explore to what extent individual firm characteristics are related to their tendency to form shortcut ties that reduce the average path-length in a network. The level of analysis is thus individual firms’ marginal contribution to average path-length. In studying firm characteristics, we will pay special attention to two factors: innovation strategy and uncertainty assessment. We have noted that shortcut ties can provide access to new and

important information. We will argue that such information is necessary for firms pursuing innovation strategies and for managing uncertainty. One way of acquiring novel, non-redundant information is by actively impacting the network structure in such a way that the firm can easily access other firms in the network.

The present study contributes to the tourism literature in several ways. First, we respond to the need for quantitative research on structural aspects of complex tourism networks (Baggio, Scott, & Cooper, 2010). Second, we investigate firm-level factors that may increase network connectivity in destination networks. Although we do not directly study coproduction, connectivity between tourism firms is necessary for realizing integration and coordination, and path-length is in this respect a key structural feature. Third, the present study also contributes to the network literature by examining how individual firm behavior may impact the overall network structure. This action-structure duality is a largely unexplored area within network research (Dhanaraj & Parkhe, 2006). Furthermore, we contribute to a focus on the importance of individual firms' collaborative actions in forming networks to create opportunity and novelty (Pavlovich, 2014). Finally, the study makes a methodological contribution by combining survey data and inter-firm network data from both within and across several tourism destinations. Inter-firm network studies have been conducted within tourism destinations (e.g. Scott, Cooper, & Baggio, 2008), but few studies focus on networks spanning numerous local destinations. In addition to network data, we combine this methodology with survey data. Survey and network data are collected independently through different procedures. This combination of methodology is unique and strengthens the study's validity by reducing problems related to common method variance (Malhotra, Kim, & Patil, 2006).

The outline of the paper is as follows: First, we discuss how innovation and uncertainty can be related to the formation of shortcut ties that reduce the path-length

between actors and clusters in a network. Thereafter, we describe the procedures for collection of survey and network data and present the results of our hypothesis-testing. Finally, we discuss theoretical and practical implications, address limitations, and suggest avenues for future research.

2. Theory and Hypotheses

As pointed out above, the average path-length in a network represents an overall indication of how close all firms in a network are to each other, or in other words, how easy it is for a firm to reach any other firm in the network. The longer the average path-length, the more distant the firms are on average from each other; the shorter the average path-length, the closer the firms will be to each other on average. A firm's marginal contribution to average path-length indicates the impact of each single firm's network structure on average path-length. Some firms may contribute substantially to reducing the average path-length while other firms may make only minor contributions to this reduction. We do not have much knowledge concerning how individual firms and their behavior may impact average path-length. The literature therefore provides no guidance as to which factors might be of particular importance. In studying how firm-level factors may impact average path-length, we thus take an explorative view and consider two potential drivers: innovation strategy and uncertainty. We first discuss how innovation strategy may impact average path-length, and then address the potential impact of uncertainty. Finally, we discuss a potential interaction effect between innovation and uncertainty.

2.1 Innovation

Innovation is defined as novel and useful products or methods of production for firms "to gain a competitive edge in order to survive and grow" (Grønhaug & Kaufmann, 1988, p.

3). Although innovations might occur for a range of different reasons, such as luck and coincidence, or intra-organizational idea-generation and implementation, we focus here on the impact of new external information in generating innovations. A firm's ability to innovate has been argued to depend on sourcing new external information that is assimilated and used for commercial ends, referred to as absorptive capacity (Cohen & Levinthal, 1990). In particular, it has been argued that information-seeking that is intentional, directed, persistent, and related to current capabilities and operations is likely to increase the realization of innovations (Cohen & Levinthal, 1990; Zahra & George, 2002). Access to diverse, non-redundant information beyond a firm's local relationships can thus be crucial for firms to realize innovative strategies (Baum, Calabrese, & Silverman, 2000; Nieto & Santamaria, 2007; Ruef, 2002). Schilling and Phelps (2007, p. 1113) argue that "[n]onredundant connections contract the distance between firms and give the network greater reach by tapping a wider range of knowledge resources". Non-redundant ties reaching disparate parts of a network furthermore bridge otherwise disconnected cliques, which gives "...access to distinct information, technologies, and markets, openings to broker the flow of information and resources, and chances to control projects involving participants from different cliques" (Baum, Cowan, & Jonard, 2010, p. 2095).

Powell, Koput, and Smith-Doerr (1996) find in a study of biotechnology firms that collaborative R&D experience increases a firm's global inter-firm network position, i.e. the extent to which a firm is connected to otherwise distant firms in the network space (cf. Freeman, 1979). Furthermore, simulations show that disruptive innovations increase connectivity in the inter-firm network (Baum et al., 2010).

Taken together, the ability to innovate depends on sourcing new, external, diverse, and non-redundant information (Baum et al., 2000), and collaborative R&D experience increases a firm's connections to otherwise distant firms in the network (Powell et al., 1996).

Since innovative firms are likely to collaborate with otherwise disconnected firms beyond a local cluster, this will tend to reduce the average path-length in the network. As noted, the level of analysis in this study is the individual firm's marginal contribution to average path-length, and we hypothesize:

H1: An innovating firm reduces the average path-length in the network.

2.2 Uncertainty

Research on destination evolution has documented that travel behavior, tourism firms' product offerings, and technology have changed over recent decades and years (Formica & Kothari, 2008; Ma & Hassink, 2013; Pavlovich, 2014). This indicates market uncertainty in the industry, which is typically shared across a set of firms (Beckman, Haunschild, & Phillips, 2004). Beckman et al. (2004) find that market uncertainty tends to reinforce existing relationships as actors seek stability and trust to exploit the current situation. But actors might also perceive what they describe as firm-specific uncertainty, which is not shared across firms. This unique uncertainty might arise from internal idiosyncrasies related to the resource situation, capabilities, managerial changes, and inter-firm relationships. Firms' demand for products, or customer needs and preferences may furthermore be volatile and idiosyncratic, depending on, for instance, the market segments the firm serves or the availability of long-term contracting versus reliance on spot contracts.

We argue that in the context of tourism, market uncertainty and firm-specific uncertainty are more intertwined than in many other industries, due to tourism's cross-sectorial and coproducing characteristics. Furthermore, coproduction requires firms to improve their management and coordination skills and define their role(s) in the destination network (Haugland et al., 2011). Thus, firms are exposed to uncertainties that increase their

propensity to search for knowledge about efficient working practices that can be transferred and adapted locally (Shaw & Williams, 2009). Such searching often involves bridge ties that span local clusters and connect firms at different destinations (Ness, Aarstad, Haugland, & Grønseth, 2014).

In a recent review, Song, Liu, and Chen (2013) argue that the role of intermediaries (i.e. tour operators, travel agencies, etc.) is very important in bridging product and service providers (i.e. destination firms) and tourists (i.e. the market). Thus, destination firms' market orientation through downstream connections might serve to reduce uncertainty (Kohli & Jaworski, 1990). To cope with the dynamics causing uncertainty, firms can form ties to generate intelligence (e.g. information searches) to understand and predict changing market conditions and consumer needs and preferences. In turn, firms become better informed and develop an appropriate response, including developing strategic flexibility to cope with uncertainty (Zahra & George, 2002). Rosenkopf and Schilling (2007, p. 199) argue that firms facing uncertainty can respond by forming alliances: "Through an alliance, a firm can establish a limited stake in a venture while maintaining the flexibility to either increase the commitment at a later date or shift these resources to another opportunity." Anand, Oriani, and Vassolo (2010) also suggest that firms can mitigate uncertainty by forming alliances. Furthermore, technological shifts induce firms to engage in exploratory searches involving shortcut ties that span local clusters (Rosenkopf & Padula, 2008). All in all, searching for new and diverse information to cope with perceived uncertainty is likely to reduce the average path-length in the network.

H2: A firm perceiving uncertainty reduces the average path-length in the network.

2.3 Interaction between Innovation and Uncertainty

We argue that access to diverse, non-redundant information is crucial to the successful pursuit of innovative strategies (Baum et al., 2000; Nieto & Santamaria, 2007; Ruef, 2002). If a firm in addition operates in high uncertainty environments, diverse, non-redundant information may play an even more crucial role in pursuing such a strategy. High levels of uncertainty may indicate that a successful outcome of an innovative strategy is less evident as compared to realizing a successful outcome in a less uncertain environment. Thus, diverse, non-redundant relations may be even more crucial in order to access rich, heterogeneous information. Hence, firms should be expected to maneuver proactively to access information from disparate parts of the network when facing high levels of uncertainty, which will further spur an innovating firm to collaborate with otherwise disconnected firms. We therefore hypothesize:

H3: An innovating firm perceiving uncertainty contributes more to reducing the average path-length in the network compared to an innovating firm perceiving less uncertainty.

3. Methods

3.1 Research Context

Tourism destinations were chosen as the empirical context. Destinations are complex networks where a large number of coproducing firms provide a variety of products and services (Haugland et al., 2011). Innovation within individual firms and uncertainty management are likely to be related to efficient sourcing of diverse and new information. These characteristics should make tourism destinations a suitable context for testing the hypotheses.

We chose nine winter sports destinations in southern and eastern Norway. These are: Beitostølen, Geilo, Gol, Hemsedal, Hovden, Rauland, Rjukan, Trysil, and Vrådal. Tourism destinations normally pass through different lifecycle stages (Hovinen, 2002; Moore & Whitehall, 2005; Russell & Faulkner, 2004), and local resources, contexts, and organizing principles might differ (Prideaux, 2000; Scott et al., 2008). Some of the destinations in our study are considered mature and highly professionalized (e.g. Hemsedal and Trysil), whereas others are less developed and rather small (e.g. Hovden and Vrådal).

We first identified all firms that were registered at the Brønnøysund Register Centre – a government body under the Norwegian Ministry of Trade and Industry – at each destination. From these lists we deleted firms that were irrelevant for the study (e.g. firms that had ceased operations). We also crosschecked the identified firms with the websites of the nine destinations, and finally, we asked well-informed local representatives to review our lists. In total, we identified 568 firms. The firms represent different types of actors operating at winter sports destinations, such as: hotels, ski lift operators, restaurants, museums, destination marketing organizations, stores and malls, local sports organizations, municipalities, activity providers, etc.

Data collection took place in two phases. First, we collected data on inter-firm relations within each destination and across destinations, in order to model the intra- and inter-destination network. Second, we performed a survey to collect data on the independent variables. The fact that we collected data to measure the independent and dependent variables through different data collection procedures strengthens the validity of the study by avoiding problems related to common method (Lindell & Whitney, 2001; Malhotra et al., 2006). Furthermore, access to data from different tourism destinations is unique and enables us to study inter-firm networks both within and across destinations.

3.2 Inter-Firm Network Data

We first sent information about the study to the general managers of the 568 firms. Second, we collected data via telephone interviews. The managers were requested to identify firms they were currently cooperating with or had previously cooperated with. This procedure involved a complete list of all destination firms. The total number of interviewed respondents is 202, and the overall response rate 35.6%.

In addition to intra-destination network ties, we also requested information about collaboration with other firms beyond the firm's local destination. Inter-destination ties can be classified into two separate groups: (1) direct ties between firms located at different destinations, and (2) ties between a destination firm and regional, national, or international organizations that are not localized at a specific destination (e.g. academic and research institutions, regional and national governmental bodies, airlines, ferry-lines, etc.). Thus, destinations are likely to be directly connected through type-1 ties, and indirectly connected through type-2 ties.

We model a structural relation between two firms if one or both report that collaboration exists. This enables us to model network data for firms that were not sampled (i.e. type-2 inter-destination ties) and for non-respondent firms in the network sample. Non-respondent actors can reduce the validity of social network data (Barnes, 1979), and our approach reduces this limitation. By this procedure, we are able to include 434 of the 568 targeted firms in our network analysis. Our network includes 202 responding firms, 232 non-responding firms, and 111 "other" organizations, e.g., organizations not located at a particular destination (cf. type-2 ties), or organizations not included in the original list. Relations reported as terminated were omitted from the network. In total, the network consists of 545 firms (nodes) connected by 2616 inter-firm ties. Figure 1 illustrates graphically the

aggregated inter-firm network. All network analyses are performed in the social network program Ucinet 6.135 (Borgatti, Everett, & Freeman, 2002).

<<< Insert Figure 1 about here >>>

3.3 Survey Data

We collected survey data via an electronic questionnaire about one year after collecting the network data. To ensure the questionnaire's face validity we first presented an early version to well-informed local representatives at different destinations. Next, we targeted the same 568 firms as those approached for collection of network data. Initially, we made phone calls to all sampled firms and asked for their participation in the survey. Of these, 325 firms were willing to participate and these received an e-mail with a link to the electronic questionnaire. After a couple of reminders we received a total of 72 usable responses. We merged the survey data with the nodes (firms) of the network data, resulting in complete data from 63 firms. Firms at eight out of the nine destinations are represented in the sample.

3.4 Measures

The dependent variable, measured by network data, is a firm's marginal contribution to average path-length (i.e. the extent to which the presence of a firm and its inter-firm relationships to other network members alters the average path-length). We model this variable by first measuring the aggregated network's average path-length (PL) relative to a random network of the same size as follows (cf. Watts, 1999):

$$PL = \frac{\text{Average path length (real network)}}{\ln(\text{number of nodes}) / \ln(\text{Average degree})}$$

Next, we exclude the focal firm (along with its inter-firm relations) from the network and re-estimate PL'. We repeat this procedure for all 63 firms. Finally, we model the operational definition of each firm's marginal contribution to average path-length as follows: $\Delta PL = (PL - PL') / PL'$.

Innovation as an independent variable is measured by two items from the survey data. One item was developed for this study and reflects a firm's ability, as compared to its competitors, to produce and supply products and services in better and more efficient ways. The other item reflects a firm's ability, as compared to its competitors, to be first to the market with new products and services, and is based on Deshpande, Farley, and Webster (1993) and Sandvik and Sandvik (2003).

Uncertainty as an independent variable is also measured by two items from the survey data. One reflects demand volatility for the firm's products, and is based on Buvik and John (2000), Ganesan (1994), and Heide and John (1990). The other item reflects rapid changes in end users' needs and preferences and is based on Jaworski and Kohli (1993) and Selnes and Sallis (2003).

We include the following control variables: Imitation, degree centrality, and firm size. Imitation is measured by two survey items reflecting the firm's use of other firms as role models in developing high quality products and services, and copying other firms' efficient work practices. These items are developed for this study with reference to Haunschild and Miner's (1997) concept of outcome-based imitation. Degree centrality measures a firm's number of ties to other firms and was collected by the network data. It describes involvement or activity in a social network (Freeman, 1979). The variable thus represents a proxy for firm and structural heterogeneity. Moreover, Watts (1999) shows that a very limited number of network ties can dramatically reduce the average path-length in a network. A network

member's degree centrality and its marginal contribution to average path-length may accordingly be correlated (i.e. firms spanning a limited number of ties will tend to reduce the path-length more than firms spanning numerous ties). Firm size is measured as the number of employees and collected by the survey data. Imitation and firm size are included in order to account for firm heterogeneity.

Forty-five of the 63 firms used in the analyses are respondents in both the survey- and the network data, while 18 (of 63) actors in the network data are referred to by other respondents. These 18 actors are not themselves respondents in the network data, but respondents in the survey data. This may represent bias in the network data as the latter group of actors may be underreported in terms of relationships as compared to those who responded themselves in the network data. To account for this potential bias, we include a dummy variable to distinguish between respondents in the network data (coded as 0) and actors referred to by the respondents (coded as 1).

The items representing innovation, uncertainty, and imitation are all measured by seven-point Likert-type rating scales anchored by "strongly disagree" (1) and "strongly agree" (7). The items, along with factor loadings and Cronbach's (1951) alpha coefficients, are presented in Table 1. All three variables receive satisfactory construct validity and reliability. We model these three variables by using average scores for the items reflecting each variable.

<<< Insert Table 1 about here >>>

4. Results

4.1 Descriptive Statistics

The firms' marginal contributions to average path-length (ΔPL), degree centrality, and firm size deviate from normal distributions. We correct for this and transform the three variables by applying Van der Waerden's (1953) method of generating normal quantile values (for further details, see Conover, 1999). Skewness, kurtosis, and other descriptive statistics are reported in Table 2. We observe in Table 2 that a firm's marginal contribution to average path-length (ΔPL) correlates with degree centrality, which is in accord with our arguments above. In addition, the dummy correlates with degree centrality, indicating that non-responding network members tend to be discriminated in terms of degree centrality, supporting our previous argument. We also observe that ΔPL correlates with the dummy, and this may be a reflection of the strong correlation between degree centrality and the dummy (the correlation between ΔPL and the dummy is reduced to .112 if we partial out the effect of degree centrality). Imitation also correlates with degree centrality. The reason may be that imitating firms collaborate with numerous other firms to pursue an imitation strategy, or a large number of collaborative ties may in fact induce firms to pursue imitative strategies. Moreover, we find that imitation and uncertainty are correlated, indicating that firms tend to mitigate uncertainty by imitating other firms (cf. Haunschild & Miner, 1997). Imitating firms also tend to be innovative. These strategies accordingly seem to complement each other. Finally, there is a positive correlation between firm size and degree centrality, which is expected since large firms are both more well-known and have better capabilities to build collaborative ties to numerous actors.

<<< Insert Table 2 about here >>>

4.2 Testing the Hypotheses

Table 3 presents the results of the hypothesis-testing carried out in Stata 13.1. We have noted that the response rate for the network data may potentially hamper the validity of the dependent variable. If the response rate represents a validity concern, one may assume that variations in response rates between the destinations represent a destination effect. In the current study response rates vary between local destinations from 22.1% to 55.6%. To account for a potential destination effect, we therefore conduct multilevel estimates (with the exception of Model 6).

Model 1 tests whether firms' localization at a particular destination is associated with ΔPL , but the destination effect is absent and insignificant (likelihood ratio $\chi^2 = .00$, n.s.). Model 2 includes the control variables and reports a strong association between degree centrality and the dependent variable, but the other control variables are not significantly associated with ΔPL . Model 3 tests H1 and Model 4 tests H2, but they only receive directional, non-significant support. Model 5 tests H3 by including an interaction term between innovation and uncertainty. The interaction term is mean-centered in accordance with Cronbach's (1987) recommendation. H3 gains strong empirical support ($p=.0013$, two-sided test of significance). The strong increase in the Wald χ^2 in Model 5 (as compared to Model 4) shows that the inclusion of the interaction term increases the model fit. In other words, firms pursuing innovative strategies in high uncertainty environments seem to play a crucial role in reducing the network's average path-length. Since the destination effect is absent, we omit the parameter in Model 6 in addition to the insignificant control variables. In addition, Model 6 reports standardized beta values. H1 now gains borderline significant support ($p=.0702$) and H3 receives strong empirical support ($p=.0027$), which is in line with Model 5. The maximum variance inflation factor (VIF) for Model 6 is 1.03, which implies that multicollinearity is not a problem (for further readings, see for instance O'Brien, 2007).

We add closeness centrality as a control variable in an unreported model. Closeness centrality measures to what extent an actor is “close” in terms of geodesic path-length to all other actors (Freeman, 1979). However, H3 retains strong empirical support. Taken together, the results indicate that innovating firms perceiving uncertainty play a crucial role in reducing average path-length beyond their own position in the inter-firm network.

<<< Insert Table 3 about here >>>

5. Conclusion

5.1 Discussion and Implications

This study increases our knowledge about specific firm characteristics that can reduce average path-length in tourism networks. We find that innovating firms perceiving uncertainty can reduce network path-length. Shortcut ties that reduce path-length provide access to novel and non-redundant information (Burt, 1992), and research also suggests that they can have favorable performance implications (Aarstad, 2014; Chen & Guan, 2010; Fleming et al., 2007; Mason & Watts, 2012; Singh, 2010). Identifying factors that may lead to such favorable network characteristics is accordingly of importance.

We have noted that tourism destinations require extensive collaboration between firms in order to coproduce efficient services (Haugland et al., 2011). Firms playing an active role in reducing average path-length may thereby facilitate close ties and more collaboration. From a tourist’s point of view, the total coproduced “experience” can be viewed as an integrated product or service in spite of the fact that it is provided by a number of individual firms. Tourism firms reducing path-length may accordingly enable destinations to leverage a close-knit network that contributes to integrated, seamless product and service offerings. Since this study spans several destinations, our findings also indicate that innovating firms

that perceive uncertainty have network ties across destinations, which can contribute to increased learning and adoption of best practices beyond a local destination (Ness et al., 2014).

We have no clear understanding of why innovation and uncertainty alone do not robustly contribute to reducing average path-length. A possible explanation may be that innovating firms facing little or no uncertainty feel less inclined to access novel, non-redundant information from distant regions of the network. In other words, these firms may not be affected by the same pull factor to gain such information as firms facing less predictability in demand and customer preferences. Similarly, firms perceiving uncertainty, but not pursuing innovation strategies, may not need to access novel, non-redundant information in order to mitigate the uncertainty challenge. Instead it appears that uncertainty might lead to an imitative strategy (Table 2), which is in accordance with the finding that firms experiencing market uncertainty tend to reinforce existing relationships as they seek stability and trust to exploit the current situation (Beckman et al., 2004). It is, nevertheless, interesting to note that uncertainty, in tandem with firms pursuing innovative strategies, connects and integrates disparate parts of the destination network. To our knowledge, this is a novel finding, revealing that perceiving uncertainty in combination with innovation may facilitate efficient collaborative network structures.

From a theoretical and methodological point of view, several implications can be drawn from this study. First, coproduction is at the very core of tourism destinations (Haugland et al., 2011), and understanding how individual firms can contribute to increased coproduction should be greatly valued as many tourism destinations suffer because they are unable to reach an optimal level of coproduction. Although we have not studied coproduction directly, a high level of connectivity between firms is necessary for realizing coproduction, and we show that innovative firms experiencing uncertainty are of special importance in

reducing average path-length and thereby increasing network connectivity. From the point of view of tourism literature, we have thus revealed one type of firm behavior that seems to be important for increasing the level of coproduction.

Second, we have addressed the action-structure duality in network research that is largely unexplored (Dhanaraj & Parkhe, 2006). Our results indicate that individual firm behavior impacts and may change the network structure. We have particularly studied firm-level factors contributing to a reduced path-length in a coproduction context that will benefit from increased connectivity. However, other types of networks may benefit from other changes in the network structure, requiring other firm behaviors than those studied here. We thus contribute to an emerging understanding of the action-structure duality, and our findings are in this respect interesting and should stimulate further research.

Third, we have used a combination of network and survey data that is novel both in tourism and network research. It is challenging to collect and combine two independent and different data sources due to difficulties in obtaining large response rates with corresponding respondents across two data sets. Nevertheless, we show that this is possible, and it enables us to research new issues and topics, especially within the action-structure duality pointed out above. Further progress in exploring this duality requires combinations of network and firm-level data, and developing data collection procedures tailored to this purpose can be an advantage for future studies.

5.2 Limitations and Future Research

Potential non-respondent bias in the network data is a limitation. However, the fact that we managed to identify network ties of non-respondent firms may imply that this is not a major problem in the present study. In addition, we control for a potential bias stemming from the fact that some firms participate in the survey data, but not in the network data.

However, no significant effect was found. We also show that, despite varying response rates across destinations, there is no destination effect on the dependent variable. This may indicate that the response rate of the network data does not substantially skew the results of our analyses in any direction. The strong, robust empirical support for H3 may also indicate satisfactory validity with reference to the network data. Yet having said this, we cannot completely rule out the possibility that non-respondent bias in the network data has artificially inflated support for H3, even though we cannot find any substantial argument for such a potential bias. By the same token, we cannot rule out the possibility that the lack of robust support for H1 and H2 may stem from incomplete network data, or that it may be due to a low number of observations in our statistical analyses. We would also emphasize that, while there are potential limitations with reference to the response rate of the network data, to our knowledge ours is the only data set which aims to model network data both within and across destinations.

The response rate for the survey data is lower than that for the network data, and unreported analyses show that the average degree centrality is higher for firms participating in the survey compared to non-participating firms. This may indicate that we have data on firms playing a central role in the network. We should by the same token be cautious about generalizing the study's findings to firms with a low involvement in the network. To further validate the findings, future research should replicate the present study in other contexts and, if possible, access more complete network and survey data.

Innovation, uncertainty, and imitation were all measured by two items. Table 1 shows robust construct validity, and we also argue that the items' face validity and content validity are satisfactory. It should also be noted that, in spite of having few items, we report high reliability measures. Future research should nevertheless aim to measure these concepts using additional items.

The data analysis does not track dynamics over time. In fact, the survey data were gathered about one year after we gathered the network data. Thus, we cannot theoretically rule out the possibility that a firm's marginal contribution to average path-length might be a cause, rather than an effect of the interaction between innovation and uncertainty. If this is the case, it might indicate how a specific network structure partakes in leveraging an innovation system. Future contributions should accordingly further elaborate the issue of causality, preferably using a longitudinal research design or appropriate instrumental variables.

To gain richer knowledge of how innovation, uncertainty, and other firm characteristics are related to network structures, future research should, besides quantitative data, apply qualitative archive and interview data. Such data can provide more in-depth knowledge about individual firms' actions and network strategies.

Other sectors, such as the construction industry, the petroleum industry, and the aviation industry have similar characteristics to the tourism industry in terms of coproduction and close relationships between actors. Hence, the findings of this study may have implications beyond the tourism industry. Nevertheless, future studies should replicate this study in other contexts in order to verify whether our results are context-specific, or if similar results can be found in other contexts as well.

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Table 1. Measures and factor analysis

	Innovation	Imitation	Uncertainty
Compared to our most important competitors, our firm is often the first to produce and supply products and services in better or more efficient ways.	.952	.010	.053
Compared to our most important competitors, our firm is often first to the market with new products and services.	.931	.226	-.026
If we observe that other firms offer high quality products and services, we use these as role models to achieve the same in our firm.	.089	.941	.093
When we know that other firms have efficient routines or operating processes, we try to implement similar practices in our firm.	.266	.866	.225
In our industry, end-users' needs and preferences change rapidly.	.052	.124	.909
The demand for our products varies continually.	-.022	.149	.902
Cronbach's α	.905	.847	.808

N=63. Principal components with varimax rotation. Eigenvalue .998. Explained variance 88.19 %

Table 2. Correlation matrix

Mean	SD	Skew	Kurtosis		Δ PPL	IN	U	IM	DC	NE
.000	.951	.000	-.384	Firm's marginal contribution to path-length (Δ PPL) ¹						
3.99	1.52	.108	-.468	Innovation (IN)	-.183					
3.38	1.46	.327	-.428	Uncertainty (U)	-.085	.056				
4.30	1.52	-.341	-.557	Imitation (IM)	-.050	.347***	.309**			
.001	.948	.012	-.392	Degree centrality (DC) ¹	.492****	.005	.141	.237*		
.003	.943	.030	-.395	No. of employees (NE) ¹	.036	.181	.139	.189	.220*	
.714	.455			Dummy	.356***	-.120	.009	-.072	.560****	.082

¹ Skewness and kurtosis are measured after the transformation of the variables.

N=63

*p<.10

**p<.05

***p<.01

****p<.001

Two-tailed tests

Table 3. Multilevel linear regression analyses (except Model 6) with a firm's marginal contribution to average path-length as dependent variable (ΔPL)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Std. beta
FIXED EFFECTS							
Intercept	.000 (.119)	.311 (.420)	.543 (.460)	.478 (.448)	.690 (.453)	.761** (.334)	
Innovation (H1)			-.084 (.072)		-.081 (.066)	-.112* (.062)	-.179
Uncertainty (H2)				-.074 (.073)	-.066 (.067)	-.089 (.065)	-.137
Innovation*Uncertainty (H3)					-.120*** (.037)	-.111*** (.037)	-.298
Imitation		-.096 (.072)	-.068 (.075)	-.077 (.074)	-.048 (.072)		
Degree centrality		.503**** (.139)	.494**** (.138)	.510**** (.138)	.552**** (.128)	.544**** (.100)	.542
No. of employees (firm size)		-.052 (.112)	-.033 (.112)	-.043 (.111)	-.103 (.106)		
Dummy		.143 (.420)	.123 (.277)	.140 (.277)	.112 (.254)		
RANDOM EFFECTS							
Residual	.890 (.159)	.644 (.115)	.630 (.112)	.634 (.113)	.531 (.095)	.547 (.097)	
Destination effect	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)		
Wald χ^2		24.12****	26.02****	25.52****	42.56****	39.56****	
Log likelihood	-85.73	-75.52	-74.84	-75.02	-69.47	-70.38	
Likelihood ratio χ^2	.00 n.s.	.00 n.s.	.00 n.s.	.00 n.s.	.00 n.s.		

N=63, number of destinations = 8, *p<.10, **p<.05, ***p<.01, ****p<.001

Two-tailed tests of significance. Standard error in parentheses. P-value H3 in Model 5 is .0013 and .0027 in Model 6.

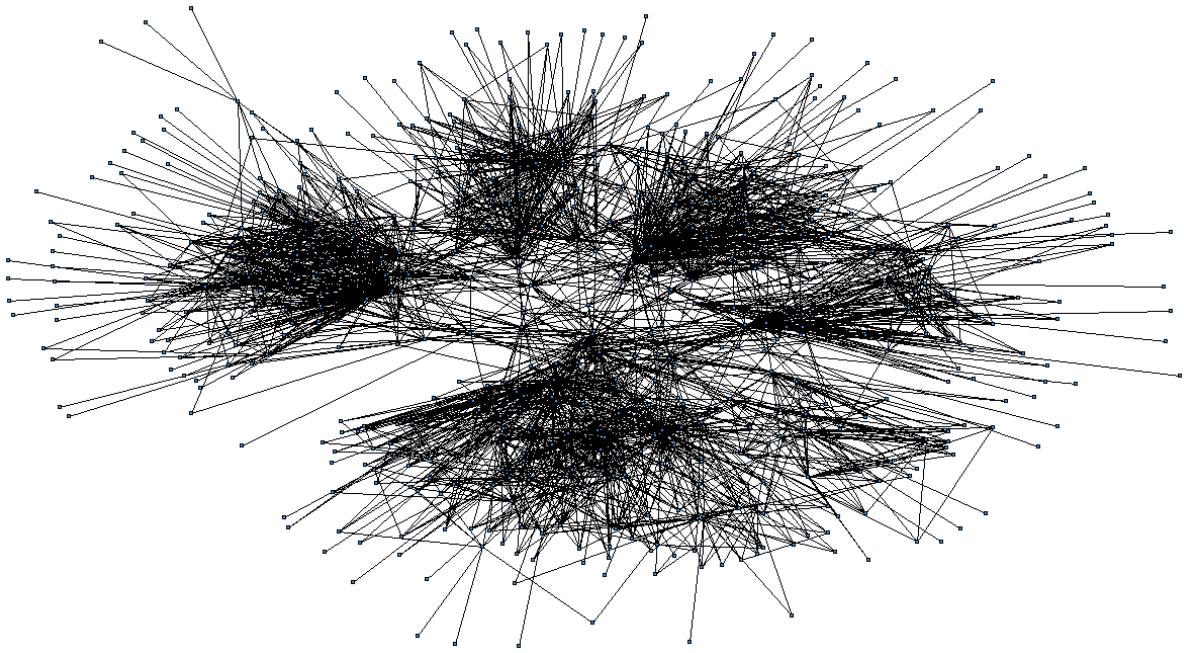


Figure 1. A graphical display of the network