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Innovation diversity and uncertainty in small and medium sized tourism firms

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ABSTRACT

In increasingly uncertain and competitive markets, small tourism firms are often pressured to innovate across a diverse range of innovation types. Innovation diversity creates synergies in that capabilities developed for one type can enhance the outcomes of other types of innovation. This paper defines and examines innovation diversity, and its relationship with small and medium enterprise (SME) performance. It then considers the role of uncertainty and dependence on tourism markets in this relationship. The paper is original in that it first finds that innovation diversity mitigates the negative effect of uncertainty on performance, and second that this relationship is especially strong in more tourism-dependent SMEs. Whereas most research on tourism innovation relies on cross-sectional data, this paper is methodologically novel in using longitudinal data collected from 358 SMEs over a period of 18 months.

1. Introduction

Innovation is one of the most deliberated of the numerous endogenous and exogenous factors that affect firm performance (Subramanian & Nilakanta, 1996). While the impact of innovation on large firm performance and growth has been substantially researched, recently attention has switched to innovation in SMEs, which have fewer slack resources to generate and commercialize innovation (Audretsch & Lehmann, 2005; Caloghirou, Protogerou, Spanos, & Papagiannakis, 2004; Van de Vrande, de Jong, Vanhaverbeke, & de Rochemont, 2009). Yet, recent research provides no clear findings about the relationship between innovation and SME performance (Love & Roper, 2015; Rosenbusch, Brinkmann, & Bausch, 2011), and this vagueness extends to research on innovation in tourism SMEs (Hjalager, 2010; Lee, Hallak, & Sardeshmukh, 2016).

We attribute the conflicting findings to the failure to investigate the relationships between a broader engagement in innovation (we term this innovation diversity in this paper) and performance, rather than focusing on the impact of particular types of innovation (Love & Roper, 2015). Because innovation types are interrelated, they exert direct, indirect and combined effects on firm performance (Gallego, Rubalcaba, & Hipp, 2012; Mattsson & Orfila-Sintes, 2014). This situation applies particularly to tourism innovation, wherein the types are often blurred (Gallouj & Savona, 2009; Hall & Williams, 2008). As well, the relationship between the innovation process and outcomes of performance is still poorly understood (Lee et al., 2016; Rodriguez-Sanchez, Williams, & Brotons, 2017). For instance, Crespi, Criscuolo, and Haskel (2007) demonstrate that, while neither information technology nor organizational innovation separately impacts firm performance, they have a significant and positive conjoint influence, indicating that the combined effects of innovation types on performance is seen as synergistic and cumulative (Damanpour, Walker, & Avellaneda, 2009).

This paper aims to make four main contributions. First, innovation research is replete with diverse proxies for measuring innovation. Innovation typologies are used to reflect and account for the multi-dimensional nature of the construct (Hipp & Grupp, 2005). Yet, there is widespread mismatching of its conceptualization and operationalization. Researchers operationalize innovation in its broadest sense, but only measure a specific dimension of it: product innovation. This practice leads to many seemingly contradictory empirical findings being reported in the literature (Audretsch & Lehmann, 2005). We echo Lee et al.'s (2016) sentiment that "the operationalization of the innovation construct in previous tourism and hospitality research has obfuscated the findings" (p. 217). This paper specifically contends that innovation as measured by applying the Oslo Manual's definition

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(OECD, 2005), and used in numerous community innovation surveys, measures innovation diversity and not 'innovation' *per se*. This provides an approach that is both replicable and that can be applied consistently in different contexts.

Second, the literature contains an implicit pro-innovation bias that stems in part from failing to account for the higher proportional risks and constraints encountered by SMEs over large firms that participate in innovation diversity. The evolutionary theory of economic growth emphasizes the importance of diversity, and Lee et al. (2016) similarly emphasize the importance of generating new ideas and products in the evolution of tourism and hospitality. However, evolutionary theory also acknowledges "that the flexibility of routinized behavior is of limited scope and that a changing environment can force firms to risk their very survival on attempts to modify routines" (Nelson & Winter 1982, p. 400). SMEs therefore face a conundrum: while they have limited resources (Rosenbusch et al., 2011) and scope to change their routines to increase innovation diversity, they also face a survival and growth imperative to craft market offerings and new routines within a number of innovation arenas. Focusing on the distinctive context of SMEs (Rodriguez-Sanchez et al., 2017) therefore provides the opportunity to broaden our understanding of how such innovation relates to performance.

Third, tourism SMEs are disproportionally affected by uncertainty as they face a number of challenges and barriers to growth. This is partly because they operate simultaneously in local and international markets, and therefore face a highly competitive and dynamic environment. Tourism SMEs are particularly exposed to a range of uncertainties originating in other parts of the supply chain or in other countries that negatively affect demand and revenue (Ritchie, 2004). While innovation can help reduce barriers to growth and uncertainty for tourism SMEs, the extent to which it reduces uncertainty and improves performance is unknown in tourism.

Fourth, most research on comparable sectors compares innovation and performance in context of the misleading dichotomy of tourism versus non-tourism firms. This needs to be problematized, because in reality the level of dependence on tourism markets is a continuum not a dichotomy. This paper therefore seeks to bring fresh conceptual perspectives to the understanding of how the relationship between innovation diversity and performance is influenced by the degree of dependence of SMEs on tourism markets.

To address these gaps in the link between innovation and SME performance within a tourism context, this paper uses longitudinal panel data to explore the relationship between innovation diversity with SME performance, acknowledging that it takes time for the performance benefit of innovation to accrue (Audretsch, Coad, & Segarra, 2014). The longitudinal perspective represents an important advance over most of the tourism innovation-performance literature, which tends to rely on cross-sectional data. The paper proceeds as follows: First, we present the theoretical foundations for innovation diversity and relate it to innovation in tourism firms. Second, we present our research model, thus addressing the proposed relationships between innovation diversity, uncertainty, tourism market dependence and SME performance. Third, we present our methods, addressing the data collection, operationalization of the main and contextual variables and our analytical approach. An overview and discussion of the findings is followed by the contribution of the paper.

2. Literature review

2.1. Innovation and innovation diversity

Innovation occurs when firms successfully exploit new ideas (Adams, Bessant, & Phelps, 2006). It can refer to a process and an outcome of that process (Crossan & Apaydin, 2010; Siguaw, Simpson, & Enz, 2006). Much research, including this paper, focuses on innovation as an outcome of different types of technical and managerial innovations (Damanpour & Evan, 1984; Salavou & Lioukas, 2003). Schumpeter (1934) reasoned that there are five innovation categories, namely product, process, market, input and organizational innovations, a view broadly followed in the Oslo Manual (OECD, 2005) and adopted in this paper. With a few exceptions, such as Love, Roper, and Bryson (2011), most scholars use this categorization to measure innovation output. However, it only indicates the different types of innovation in which a firm has engaged, rather than the number or extent of its output. Firms that simultaneously innovate across a number of different innovation types produce greater innovation diversity and capability; this is also the case for tourism innovation (Hall, 2009; Hjalager, 2010).

The diversity in operationalizing innovation also partly explains the variability of empirical findings when studying how innovation relates to organizational performance (Crossan & Apaydin, 2010). To better clarify this topic by improving the comparability of its research findings, this paper advocates to adopt 'innovation diversity', because it relates to breadth rather than depth. It is an aggregate variable representing the number of different types of innovation that a firm has implemented. Innovation diversity does not count the number of actual innovations implemented nor the amount of sales or profit generated by them. It also does not distinguish between radical and incremental innovations, but sets a minimum novelty requirement that the innovation be new or an improvement at the focal firm level.

Because innovation diversity is particularly relevant to tourism, it best represents innovation in that industry (Lee et al., 2016). Within the service sector, including tourism, firms tend to focus their innovative efforts more on non-technological organizational and marketing innovations (Camisón & Monfort-Mir, 2012). However, tourism firms can be found across diverse industries and evidence suggests (as confirmed by our data) that innovating tourism firms innovate across all types of innovation (Booyens & Rogerson, 2016). A practitioner would find it difficult to discern between types of innovations where introducing a new computer application, for example, may be considered a service, product or process, or a managerial or organizational innovation. An innovation in one area therefore normally requires or lead to an innovation in another area (Hjalager, 2010). As we discuss below, in service firms the combined effects of innovation types on performance is seen as synergistic and cumulative (Damanpour et al., 2009), suggesting that performance benefits derive from combining innovation types rather than focusing on one specifically. With novel or breakthrough innovations being scarce in tourism, a spillover from the adoption of technological innovation that has been developed by suppliers from other industries enables tourism SMEs to simultaneously innovate in non-technical areas (Camisón & Monfort-Mir, 2012).

Few studies apply innovation diversity as conceptualized in this paper. Love et al. (2011) describe implementing different types of innovation activity as "innovation diversity" (p. 1450) whereas Damanpour et al. (2009) refer to the joint adoption of all innovative types as "total innovation" (p. 662). Building on these earlier research efforts, this paper contends that not only is it necessary to conceptualize innovation variables appropriately, but also to establish their theoretical grounding.

2.2. Theoretical grounding of innovation diversity

Theoretical foundations for the use of different innovation types as the basis of a measure of innovation diversity originated from Schumpeter's (1934) clear differentiation between different types of innovation, and can be found in evolutionary growth theory (Llerena & Zuscovitch, 1996; Nelson, 2002; Nelson & Winter 1982) and resource based theory (Barney, Ketchen, & Wright, 2011; Teece, Pisano, & Shuen, 1997; Wernerfelt, 1984).

First, evolutionary growth theory, as used here, is based in the ideas of Nelson and Winter (1982) who draw on Darwinian evolutionary biology and Schumpeterian innovation-based economic theory. To them, the diversity in products and firms drives economic evolution and growth in a similar manner to biological evolution (Llerena & Zuscovitch, 1996). An essential aspect of Schumpeterian competition is “the diversity of firm characteristics and experience and the cumulative interaction of that diversity with industry structure” (Nelson & Winter 1982, p. 30). Innovation in this sense represents adaptation (Nelson & Winter 1982). We thus argue in this paper that diversity in innovative activity, and output at the firm level (as expressed by the innovation diversity proxy) result from changing, or newly combined, routines within a firm. Innovation diversity in turn impacts the firm's adaptability to its competitive environment and subsequent growth.

Second, according to resource-based theory, innovation is an important source of competitive advantage (Barney, 2002; Harmancioglu, Droge, & Calantone, 2009). Diverse capabilities and regimes, absorptive capacity, and network links are required to successfully implement different types of innovations. Resource slack (e.g., in administrative capacity of financial, human and social capital), experience, and learning also impact a firm's ability to increase the diversity of its innovative activities which can, in turn, impact firm performance. When this relationship is positive (Love et al., 2011), the importance of innovation diversity is apparent. Such diversity means that a broad application of different sets of resources is required to implement innovation activities.

2.3. Innovation diversity and performance

The link between innovation and performance is based in evolutionary economics, resource-based theory and dynamic capabilities perspectives. According to evolutionary economics (Nelson & Winter 1982), diversity in a firm's innovation activity makes the firm more flexible in dealing with market pressure (Kreiser, Marino, Kuratko, & Weaver, 2013). Resource-based theory emphasizes the importance of firm-specific capabilities or competencies and resources in strategy formulation and implementation as the fundamental determinants of firm performance (Parnell, 2007; Teece et al., 1997). Competitive advantage thus results from a firm using these rent-generating resources and matching them with the external environment to generate above-average profits (Wernerfelt, 1984). If we take the perspective of resource-based theory, we can argue that firm innovativeness and the outputs of the innovation process are valuable resources and sources of sustainable competitive advantage in the market and hence commercial success (Harmancioglu et al., 2009).

Dynamic capabilities extend resource-based theory thinking (Caloghirou et al., 2004) to explain why some firms sustain competitive advantage in rapidly changing environments (Eisenhardt & Martin, 2000). The performance strength of innovating firms is related to the innovation capabilities to access and integrate a variety of knowledge and expertise (Henderson & Clark, 1990). We thus contend that innovative SMEs will be more successful than non-innovative SMEs, both by instigating innovation activities to make them more competitive, and by ensuring that SMEs’ internal capabilities use such activities to impact performance positively. The support for this contention (see Baldwin & Gellatly, 2003; Dibrell, Craig, & Neubaum, 2014; Hoffman, Parejo, Bessant, & Perren, 1998; Klomp & van Leeuwen, 2001; Mansury & Love, 2008) leads us to hypothesize that:

H1. There is a positive association between innovation diversity and SME performance in a subsequent period.

Although this relationship is also evident in tourism research (Grissemann, Plank, & Brunner-Sperdin, 2013; Martínez-Román, Tamayo, Gamero, & Romero, 2015), it is unclear how SMEs’ level of dependence on tourism sales impact this relationship.

2.4. Tourism sales dependence, innovation diversity and performance

The majority of tourism studies concerning innovation are conceptual or uses qualitative methods (Hjalager, 2010; Peters & Pikkemaat, 2006). However, considerable research has recently sought to quantitatively confirm both the importance of different types of innovation (e.g., Martínez-Ros & Orfila-Sintes, 2009), and the relationship between different types of innovation and performance (Crespi et al., 2007; Jacob, Tintoré, Aguiló, Bravo, & Mulet, 2003; Nicolau & Santa-Maria, 2013). This research tends to dichotomize firms as either tourism or non-tourism enterprises, which is clearly inaccurate in the case of large, diverse companies, but also problematic even in the case of SMEs. The definition of tourism applies to the extent to which a sub-sector depends on tourism, rather than non-tourism markets. Whereas hotels clearly depend highly on tourism, other sectors such as catering and local transport depend varyingly on tourism markets. Moreover, there is likely to be a high degree of heterogeneity in how much different firms rely on tourism, even within some of these sub-sectors. This poses the question of whether the degree of tourism dependence of a firm moderates the relationship between innovation and performance.

In addressing this question, we can initially theorize the importance of demand to firm performance (Park, Yaduma, Lockwood, & Williams, 2016). However, also important is the contestability of markets (Baumol, Panzar, & Willig, 1982). And, in the face of competition, innovation is ‘a primary competitive weapon’. The intensity of competition is likely to increase with the lack of barriers to entry, high levels of new entry firms, and possibilities to strategically reposition a company in the market place in relation to other firms (Simmie, 2004). Globalization has played a major role in increasing competition and thereby stimulating innovation, while innovation enables firms to adapt to rapid changes in the globalized competitive landscape and technology-driven disruptions.

Tourism is essentially an export activity so that increasing reliance on tourism increases exposure to global competition, at least non-locally. However, in some tourism sub-sectors, such as local transport, restaurants, and leisure facilities, which rely on *in situ* production of services for consumers, the non-tourism market segment is likely to be localized. This variable reliance on external versus local competition conditions accords with Stabler, Papatheodorou and Sinclair's (2009) argument that tourism markets may be contestable, but heterogeneously. Additionally, Williams and Shaw (2011) explain the internationalization of innovation, particularly related to how mobility (especially labor and entrepreneurs) and knowledge resources associated with international tourism, contribute to innovation. Therefore, this paper hypothesizes that the impact of different innovation types on firm performance is positively moderated when firms depend more on tourism sales because they face greater competition.

H2. Tourism turnover moderates the positive relationship between innovation diversity and SME performance in a subsequent period.

2.5. Uncertainty, innovation diversity and performance

The firm's operating environment is shaped by the complex interactions between a number of factors including: customer needs, competitor strategies, technological change, and changes in macro-environmental conditions (Sawyerr, McGee, & Peterson, 2003). In effect, they operate under conditions of uncertainty because they lack knowledge of future changes in markets, demand, competitors, technology, and skills in or access to, finance (Freel, 2005). We use this approach to describe uncertainty for this paper, arguing that firms face uncertainty in relation to both markets and resources (McKelvie, Haynie, & Gustavsson, 2011). One of the most common reactions to uncertainty is to innovate to support performance (Freel, 2005; Morrow, Sirmon, Hitt, & Holcomb, 2007; Zahra, 1993).

These arguments are derived from theories about the configuration of internal resources and how firm structures and routines make the firm more responsive to uncertainty and unexpected changes in their operating environment by purposefully stimulating innovation activity (Harmancioglu et al., 2009; Love, Roper, & Du, 2009). The resulting innovation is a source for competitive advantage, despite firms being faced with uncertainty, which in turn leads to their above-average performance. The innovation process uses and strengthens the dynamic capabilities of a firm, making its performance more robust in a dynamic and uncertain competitive environment (Geroski & Machin, 1993).

Although the existing innovation literature suggests that uncertainty may motivate innovation, this is little discussed in the tourism literature (Hjalager, 2010). Uncertainties in the operating environment influence innovation in tourism (e.g., Hall & Williams, 2008) to the extent that competition stimulates innovation. In noting that entrepreneurial activities can shift market needs and increase competition and firm innovativeness, Hjalager (2010) concurs with this view. Further, while learning from the competition within a tourism sub-sector (i.e., accommodation, attractions and airlines) can drive innovation, firms can also learn from innovations in other tourism sectors. This leads us to hypothesize that:

H3. There is a negative direct relationship between uncertainty and SME performance in a subsequent period.

H3a. There is a positive indirect relationship between uncertainty and SME performance via innovation diversity.

Last, we combine the three hypotheses to examine how performance is influenced if they are operationalized simultaneously. In addition to the previous three hypotheses, we are also interested in understanding the conditional indirect effect (moderated mediation) of uncertainty on performance that occurs during innovation, at different levels of tourism dependence. We find support for this approach in a recent study of Australian tourism SMEs that shows that the degree of market competition, a form of uncertainty, positively relates to marketing innovation (Divisekera & Nguyen, 2018). Similarly, we argue that uncertainty motivates tourism firms to increase their innovation efforts, which in turn supports performance (Lee et al., 2016). We thus offer Hypothesis 4, and summarizes our model in Fig. 1:

H4. The positive indirect effect of uncertainty on performance in a subsequent period via innovation diversity depends on the proportion of tourism turnover.

3. Methods

3.1. Data collection

This paper uses data from an Australian innovation and growth survey conducted during two periods, approximately 18 months apart. During 2010–2011, Wave 1 surveys were mailed to 28,300 Australian firms of all sizes. One owner/senior executive from each firm was asked to complete and return the questionnaire, either by mail, or by completing it online. A random stratified sampling strategy was used to ensure that firm sizes, industries and states were represented. Reminders were sent by fax to all non-responding firms and a second reminder by phone to firms in strata that were under-represented. The unusually long data collection period was a response to data collection being suspended following a number of natural disasters in Australia during this period. In addition to major floods in Queensland and Victoria, the region was also plagued by storms and droughts. The natural disasters cost Queensland AUD$5 billion including an AUD$590 million loss for the tourism industry (Walters, Mair, & Ritchie, 2014). Accordingly, we may expect that certain aspects of innovation would have been constrained. Nevertheless, comparison of the responses received before and after floods, for example, found no meaningful differences (Armstrong & Overton, 1977).

The overall response rate from managers and business owners was 7.5 percent yielding a total of 2107 responses. This agrees with similar studies conducted elsewhere (e.g., 10–11.5% in Scotland [Freel, 2005] and 8.4% in South Africa [Oerlemans, Pretorius, Buys, & Rooks, 2003]) and exceeds many other recent comparable studies in Australia.

In 2012, we again distributed a detailed mail survey to 14,102 firms with the option of completing it online (Wave 2). Of them, 1710 completed the survey, for an overall response rate of 12 percent, while 413 firms responded to both waves. To focus only on SMEs, we deleted data from firms that employ more than 200 employees (ABS, 2007). This left a total of 358 firms in our database. The survey instrument included questions about the owner/manager, and organizational demographics, practices and performance. For this paper, we analyzed responses to questions about different types of innovation, firm age and size, industry classification, and self-reported performance.

3.2. Variables

Table 1 summarizes the variables used in this study, their operationalization and theoretical foundations. The dependent variable, *SME performance* was operationalized as a perceived measure that drew from 11 different types of performance, such as sales growth, productivity, and profitability (Verreynne, Meyer, & Liesch, 2016). We adapted this scale to represent a broader measurement approach (e.g. Kaplan, Norton, Dorf, & Raitanen, 1996), which included measures of customer satisfaction, market share, growth and profit (internal consistency was confirmed by our Cronbach's Alpha of 0.840 for 2012). Importantly, such self-reported measures of performance have been found to correlate strongly with objective measures of performance

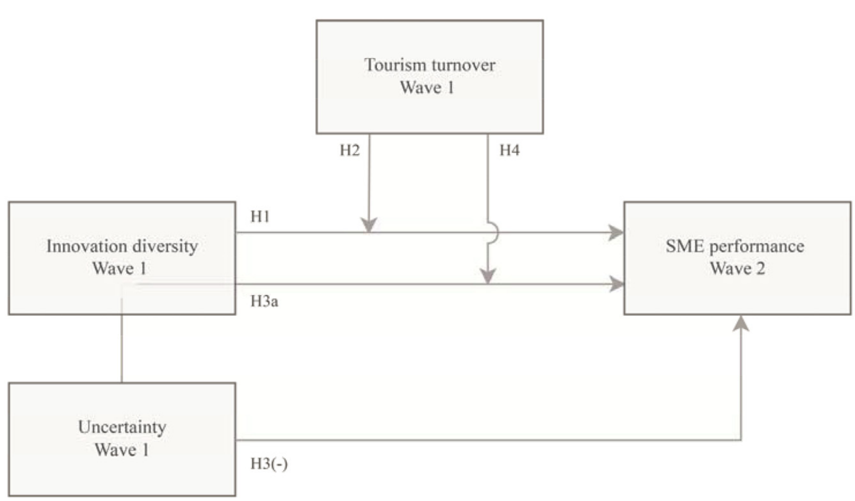

Fig. 1. Research model.

Table 1
Variables.

Dependent variables	Description	References	Cronbach Alpha
Perceived performance	The importance attached to 11 different types of performance as business objectives was multiplied with the satisfaction rating for the same measures and aggregated to provide a weighted average index of perceived performance. Importance and satisfaction were recorded on a three point Likert scale (not important, important and very important). The performance types included: Profit margin on sales; return on assets; profit per employee; growth in sales, assets, employees, and profits; maintaining and increasing market share; as well as maintaining and increasing customer satisfaction.	Brockman, Jones, & Becherer, 2012; Caloghirou et al., 2004; Kaplan et al., 1996; Li, Veliyath, & Tan, 2013; Liao & Rice, 2010; Mansury & Love, 2008; Subramanian & Nilakanta, 1996; Verreynne et al., 2016	2011: 0.877 2012: 0.840
Independent variables			
Innovation diversity	Number of innovation types a firm has introduced in the previous three years. New or significantly improved (six dichotomous, yes/no measures): products; services; operational processes for producing products; operational processes for delivering services; logistic (supply, storage or distribution) systems; and organizational, managerial processes or marketing methods.	Bhattacharya & Bloch, 2004; Geroski et al., 1993; Gronum et al., 2012; Laursen & Salter, 2006	0.831
Tourism sales	Based on self-reported proportion of revenue derived from expenditure by tourists		
Tourism firms	For robustness tests, tourism firms were categorized as either 5%, 10% or 20% sales to tourists	Authors own calculation based on TRA (2016) data	
Uncertainty	Respondents were asked to rate on a 5-point Likert scale how the following factors acted as significant limitations or barriers (insignificant, slightly significant, moderately significant, very significant and crucial limitation) on their ability to meet business objectives over the past three years. Responses to 11 factors were aggregated, namely access to overseas markets, overall growth of market demand in main product markets, increasing competition, and availability of appropriate premises or site, as well as uncertainty related to technology (acquisition of technology and difficulties in implementing new technology), skills (skilled labor, management skills, marketing and sales skills), and external resources and finance (availability and cost of finance for expansion and overdraft finance).	Freel, 2005; Sawyerr et al., 2003	0.79
Controls			
Size	Full-time equivalent employees – natural log transformed	Edwards, Delbridge, and Munday (2005)	
Age	Age of firm in years – natural log transformed	Hannan and Freeman (1983)	
Industry	Firms were divided into four industry categories, namely: Manufacturing Services Retail/wholesale Other Dummy variables were created for each and therefore the latter category was used as reference category in regression analyses.	Hawawini et al. (2003)	

(Dess & Robinson, 1984).

The main independent variable, *innovation diversity* (α = 0.831), was calculated as the sum of six groups of innovation types (Bhattacharya & Bloch, 2004; Laursen & Salter, 2006), regardless of whether it occurred at the firm or industry level (Geroski, Machin, & Van Reenen, 1993; Gronum, Verreynne, & Kastelle, 2012). Its Cronbach's Alpha value of 0.831 is well above accepted levels for scale reliability. The descriptive statistics for the different years under review (Table 2) indicate relatively low levels of innovation diversity among SMEs within the sample with mean = 1.95 and S.D. = 1.91, given a maximum potential value of six. Similarly, descriptive analysis of innovation propensity reveals that 34.9 percent of the firms in the full sample are non-innovators. These figures agree with Australian Bureau of Statistics data (ABS, 2010).

Firms were asked to identify the percentage of their total revenue that was derived from expenditure by tourists. We named this variable *tourism turnover*. We measured six arenas in which firms may perceive *uncertainty*, namely 'availability of finance', 'access to labor', 'technology', 'access to overseas markets', 'market demand' and 'competition'. These have a good fit to the definitions used by authors such as Sawyerr et al. (2003), and are similar to Freel's (2005) categories of competitors, uncertain markets, technical index, skills index and finance index. Firms were asked to rate these barriers to realizing their business objectives on a scale of one to five, and they were summed to create the uncertainty variable (alpha = 0.79).

We controlled for *firm age* and *size*, and *industry sector* to account for the liabilities of newness and smallness (Klomp & van Leeuwen, 2001; Lööf & Heshmati, 2006; Stinchcombe, 1965), and for the industry differences observed in our variables (Hawawini, Subramanian, & Verdin, 2003). Both the size and age variables were skewed, and therefore log-transformed to be included in regression models. The industry sector has been shown to influence the innovation diversity–performance relationship (Deschryvere, 2014; Uhlaner, van Stel, Duplat, & Zhou, 2013). Therefore, industry membership was recoded into four categories, based on data provided by respondents: retail/wholesale (also including cafés and accommodation), manufacturing, services, and 'other' industries. The manufacturing industry was omitted from regression models as a reference category. As a robustness test (see Table 10), we also controlled for past firm performance, by including the self-reported performance of respondents since 2010, to account for

Table 2
Correlation matrix of study variables.

		1	2	3	4	5	6	7	8	9	10	11
1	Performance Wave 2	1.00										
2	Innovation diversity	0.22*	1.00									
3	Tourism percentage	0.07	−0.07	1.00								
4	Uncertainty	−0.09	0.14*	−0.02	1.00							
5	Log size	0.12*	0.30*	−0.12	0.22*	1.00						
6	Log age	0.02	0.07	−0.19*	0.03	0.25*	1.00					
7	Manufacturing	0.10	0.36*	−0.44	0.28*	0.35*	0.12	1.00				
8	Service	0.01	0.00	−0.08	−0.22*	−0.03	−0.10	–	1.00			
9	Retail	−0.08	−0.11	0.31*	0.01	−0.24*	−0.15*	–	–	1.00		
10	Other	0.01	−0.11	−0.30*	0.09	0.06	0.23*	–	–	–	1.00	
11	Performance Wave 1	0.56*	0.22*	−0.04	−0.04	0.16*	−0.05	0.01	−0.03	0.00	0.04	1.00

Note: * indicates a significant correlation at $p < 0.05$. Industry types were mutually exclusive categories and thus correlations among them were not calculated.

the effect of resources slack (Bourgeois, 1981).

3.3. Data analysis and robustness tests

We first assessed Hypothesis 1 by using linear regression to test the univariable association between innovation diversity at Wave 1 with performance at Wave 2. In addition, we tested the univariable associations between the other explanatory variables and covariates at Wave 1 with performance at Wave 2, and between innovation diversity and the remaining explanatory variables and covariates. Next, moderation analysis was used to test Hypothesis 2, with further multivariable moderation analyses undertaken to test the robustness of significant interactions. We then conducted mediation analysis to assess Hypothesis 3, a negative direct effect between uncertainty and performance, and Hypothesis 3a, a positive indirect effect between uncertainty and performance via innovation. We used the product of coefficients method and bootstrapping (5000 replicates) to produce percentile estimates for the point estimate and confidence intervals of the indirect effects, to address non-normality in the product term in small and moderate sample sizes (Zhao, Lynch, & Chen, 2010), adjusting for all covariates. Last, we constructed a final model incorporating all the effects, including the conditional indirect effect and all covariates to test Hypothesis 4. Our models are summarized in Appendix 1.

We undertook a number of robustness analyses to scrutinize our findings. First, we re-ran the final model controlling for performance at Wave 1 to observe if any relationships attenuated after including baseline performance. Second, we tested the relationship between innovation with a logarithmic transformation of performance at Wave 2 adjusted for tourism, uncertainty and the covariates. This ensured that the findings were robust to minor positive skew in the untransformed outcome variable. Third, we tested for an interaction between innovation and uncertainty in the association with performance, to assess if the interaction was unique to tourism firms as we expected. Last, we tested for mediation by innovation diversity in the relationship between tourism turnover (Wave 1) and SME performance (Wave 2) to ensure that a finding of moderation in Hypothesis 3 was not spurious.

The low response rate for our data, although typical for surveys of this nature, meant that we had to assess the generalizability of our sample compared with national figures. Our sample included only slightly more retail businesses than the national average. ABS data showed four percent manufacturing, 50 percent services, 31 percent retail/wholesale, and 14 percent other, whereas the numbers (and 95% confidence limits) in our data (2011 full sample; n = 2097) were 13.6 percent (12.2%, 15.2%), 37.3 percent (35.2%, 39.4%), 35.3 percent (32.9%, 37.7%) and 14.9 percent (13.5%, 16.4%).

Further, 358 firms from our original sample completed the survey at the second follow-up, comprising the sample for our longitudinal analyses. We used multivariable logistic regression to examine if any of the baseline variables in 2011 predicted their repetition in the 2012 survey data. Although firms that repeated the survey were, on average, smaller and older, levels of innovation [odds ratio = 0.97; p = 0.423], tourism percentage [odds ratio = 1.00; p = 0.933] and uncertainty [odds ratio = 0.99; p = 0.259] did not differ by follow-up status. Thus, we would not expect our findings to be biased by follow-up attrition in the sample.

4. Findings

Descriptive analyses showed that the average firm in our database was 25.28 years old (S.D. = 22.47) and employed 147.18 people (S.D. = 2199.06). Ten percent of firms were in manufacturing, 27 percent retail and wholesale, 39 percent services, and 24 percent in other industries. As expected, while innovation diversity was positively related to performance (1.57 (0.86, 2.29), $p < 0.001$) and uncertainty (0.04 (0.01, 0.06), p = 0.007), performance and uncertainty were marginally negatively related (−0.16 (−0.35, 0.22), p = 0.084). Notably, tourism sales were not significantly related to any of these variables (See Table 3). Last, our outcome variable, performance, exhibited minor skew and kurtosis (mean = 43.95, S.D. = 13.43, skew = 0.80, kurtosis = 4.26), further justifying our robustness analysis using log transformed performance (mean = 3.78, S.D. = 0.27, skew = 0.25, kurtosis = 2.71).

4.1. Hypotheses testing

The mean for SME performance (Wave 2) in our sample was 43.08 (S.D. = 13.47), which was similar, albeit slightly lower than at Wave 1 (mean = 47.52; S.D. = 14.07). The mean score for innovation diversity was 1.95 (S.D. = 1.91) and for uncertainty was 23.27 (S.D. = 7.58). Most SMEs (70%) stated that they derived no turnover from tourism, while 13.4 percent derived at least 10 percent, and only six SMEs derived all of it, from tourism.

Tables 2 and 3 show the univariable association among the explanatory variables and covariates with innovation diversity (Wave 1) and performance (Wave 2) in separate analyses. A positive association was found between innovation diversity and performance (beta = 1.57; 95% CI = 0.86, 2.29), while tourism and uncertainty were not associated with performance. Further, innovation diversity and uncertainty were positively associated, although the estimate was weak (beta = 0.04; 95% CI = 0.01, 0.06), but tourism was not associated with innovation diversity. Among the covariates, retail, services and other SMEs all reported significantly lower innovation diversity than manufacturing SMEs. Size, but not age, was positively associated with both performance and innovation diversity. Thus, the data are consistent with Hypothesis 1.

Table 4 shows the results for the unadjusted interaction (i.e., performance = tourism × innovation diversity). The p-value for the interaction was significant (p = 0.032), and remained so after adjusting for covariates (p = 0.029, see Table 5). The interaction between

Table 3
Associations between performance and innovation diversity with explanatory variables and covariates [univariable linear regression].

	Mean	S.D.	Performance (Wave 2)		Innovation diversity	
			Beta (95% CI)	p-value	Beta (95% CI)	p-value
Performance (Wave 2)	43.88	13.47				
Innovation diversity	1.95	1.91	1.57 (0.86, 2.29)	< 0.001		
Tourism percentage	7.29	21.08	0.05 (−0.02, 0.11)	0.168	−0.01 (−0.02, 0.00)	0.219
Uncertainty	23.27	7.58	−0.16 (−0.35, 0.22)	0.084	0.04 (0.01, 0.06)	0.007
Industry						
- Manufacturing	0.10	0.30	reference		reference	
- Retail	0.27	0.44	−3.68 (−8.87, 1.50)	0.163	−1.63 (−2.30, −0.95)	< 0.001
- Service	0.39	0.48	−2.67 (−7.33, 2.59)	0.348	−1.35 (−1.99, −0.71)	< 0.001
- Other	0.24	0.43	−2.23 (−7.49, 3.03)	0.405	−1.67 (−2.35, −0.98)	< 0.001
ln(size)	1.97	1.22	1.24 (0.10, 2.38)	0.033	0.46 (0.31, 0.62)	< 0.001
ln(age)	2.86	0.84	0.32 (−1.35, 2.00)	0.704	0.16 (−0.08, 0.39)	0.198

Note: remembering that the mean of a binary variable is equal to its proportion with S.D. of sqrt[p(1-p)].

Table 4
Associations between performance with interactions of innovation by tourism [not adjusted for covariates].

	Performance (Wave 2)	
	Beta (95% CI)	p-value
Innovation diversity	1.65 (0.94, 2.36)	< 0.001
Tourism percentage	0.07 (003, 0.13)	0.039
Tourism by innovation	0.04 (0.00, 0.08)	0.032
Constant	43.98 (42.62, 45.34)	< 0.001
F-statistic	8.91 (3, 354)	< 0.001
R^2	0.070	
R^2-adjusted	0.062	

Note: Explanatory variables were centered prior to coding of the multiplicative terms.

Table 5
Association between performance with innovation by tourism [adjusted for covariates].

	Performance (Wave 2)	
	Beta (95% CI)	p-value
Innovation diversity	1.71 (0.96, 2.47)	< 0.001
Tourism percentage	0.09 (0.02, 0.17)	0.009
Tourism by innovation	0.05 (0.00, 0.08)	0.029
Uncertainty	−0.28 (−0.47, −0.09)	0.003
Industry		
- Manufacturing	reference	
- Retail	−2.72 (−7.96, 2.52)	0.309
- Service	−2.04 (−6.95, 2.87)	0.414
- Other	0.50 (−4.65, 5.65)	0.848
ln(size)	0.92 (−0.31, 2.15)	0.143
ln(age)	−0.32 (−2.01, 1.38)	0.713
Constant	51.00 (42.74, 59.25)	< 0.001
F-statistic	4.57 (9, 346)	< 0.001
R^2	0.109	
R^2-adjusted	0.085	

Note: Explanatory variables were centered prior to coding of the multiplicative terms.

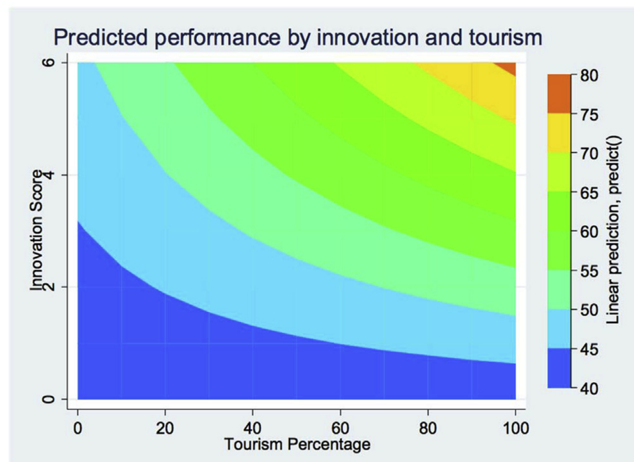

Fig. 2. Graphical display of the interaction (performance = innovation × tourism + covariates) showing little or no change in the predicted value of performance with increasing values of innovation and tourism respectively when the other is set to 0, but large increases in performance as innovation and tourism increase in tandem.

Table 6
Direct and indirect (via innovation) effects of uncertainty with performance [separate models, not adjusted for covariates].

	Performance (Wave 2)	
	Beta (95% CI)	p-value
Innovation diversity	1.70 (0.99, 2.41)	< 0.001
Uncertainty percentage	−0.22 (−0.40, −0.04)	0.016
Uncertainty via innovation	0.06 (0.01, 0.13)	–
Constant	45.77 (41.30, 50.23)	< 0.001
F-statistic	12.50 (2, 355)	< 0.001
R^2	0.066	
R^2-adjusted	0.061	

Note: Confidence intervals for the indirect effects were obtained via bootstrapped with 5000 replicates.

tourism and innovation diversity with performance is shown in a contour plot (see Fig. 2). It demonstrates that, when setting either of the explanatory variables to 0, an increase in the other leads to little or no increase in predicted performance. However, as both explanatory variables increase together, so does the predicted performance. Thus, the data supported Hypothesis 2.

Table 6 shows the results for the unadjusted mediation analyses, which indicate a negative direct relationship between uncertainty and performance (Wave 2), supporting Hypothesis 3. Further, we found a positive indirect relationship between uncertainty and performance (Wave 2) via innovation diversity (beta = 0.06; 95% CI = 0.01, 0.13), supporting Hypotheses 3a. However, after adjustment (see Table 7), the indirect effect for uncertainty attenuated to the null (beta = 0.03; 95% CI = −0.02, 0.09), although none of the covariates was themselves significantly related to the outcome. Prior to adjustment, results support Hypothesis 3, as the direct effect of uncertainty on performance was negative. However, the indirect effect via innovation diversity was positive, suggesting that uncertainty could increase performance by encouraging innovation diversity.

Table 7
Direct and indirect (via innovation) effects of tourism percentage and uncertainty with performance [adjusted for covariates].

	Performance (Wave 2)	
	Beta (95% CI)	p-value
Innovation diversity	1.67 (0.91, 1.43)	< 0.001
Tourism percentage	0.08 (0.01, 0.15)	0.027
Uncertainty	−0.27 (−0.46, −0.09)	0.004
Uncertainty via innovation	0.03 (−0.02, 0.09)	–
Industry		
- Manufacturing	reference	
- Retail	−2.57 (−7.84, 2.70)	0.338
- Service	−1.75 (−6.68, 3.17)	0.485
- Other	0.76 (−4.41, 5.94)	0.772
ln(size)	0.82 (−0.41, 2.05)	0.192
ln(age)	−0.21 (−1.92, 1.49)	0.804
Constant	46.60 (38.19, 55.00)	< 0.001
F-statistic	4.49 (8, 337)	< 0.001
R^2	0.096	
R^2-adjusted	0.075	

Note: Confidence intervals for the indirect effects were obtained via bootstrapped with 5000 replicates.

Table 8
Final model including indirect and moderated effects [not adjusted for covariates].

	Performance (Wave 2)	
	Beta (95% CI)	p-value
Innovation diversity	1.78 (1.06, 2.49)	< 0.001
Tourism percentage	0.07 (0.00, 0.13)	0.039
Tourism by innovation	0.04 (0.00, 0.08)	0.028
Uncertainty	−0.23 (−0.41, −0.05)	0.014
Constant	49.22 (44.83, 53.63)	< 0.001
F-statistic	8.30 (4.353)	< 0.001
R^2	0.086	
R^2-adjusted	0.076	
Uncertainty via (innovation by tourism)		
CIE (tourism = 0)	0.05 (0.01, 0.12)	–
CIE (tourism = 5)	0.06 (0.01, 0.13)	–
CIE (tourism = 15)	0.08 (0.02, 0.17)	–
CIE (tourism = 60)	0.14 (0.03, 0.39)	–
CIE (tourism100)	0.20 (0.03, 0.60)	–

Note: The conditional indirect effects (CIE) [uncertainty via (tourism by innovation)] are shown at different values of tourism (%) with confidence intervals for the CIE's and indirect effect obtained via bootstrapping with 5000 replicates.

Table 8 shows the unadjusted analysis of the model including the conditional indirect effect, whereby uncertainty predicts performance via innovation diversity and the relationship between innovation diversity and performance depends on the value of tourism. All the model coefficients are significant, and the bottom half of the table shows that the conditional indirect effect strengthens as tourism increases. Table 9 shows the final model including the adjusted conditional indirect effect estimates, which increase in magnitude and become more strongly statistically significant as reliance on tourism increases (shown in the bottom of Table 9), which supports Hypothesis 4.

4.2. Robustness

Table 10 shows the results from the final model in which performance (Wave 1) was included as a covariate. The results are similar to those shown in Table 9 except for the conditional indirect effects (i.e., the indirect effect of uncertainty on performance via innovation diversity conditional on tourism). Calculated at low levels of tourism (0% and 5%), these effects were no longer significantly associated with performance (Wave 2). Table 11 presents the main effects of the log transformation of performance at Wave 2 regressed on innovation diversity, tourism percentage and uncertainty, and adjusted for covariates. They were computed as a Poisson regression as an acceptable alternative to log-normal regression. This robustness analysis shows that innovation diversity and uncertainty produce significant associations, with the former associated with an increase, and the latter a decrease in the outcome, thus being consistent with the main analysis. However,

Table 9
Final model including indirect and moderated effects [adjusted for covariates].

	Performance (Wave 2)	
	Beta (95% CI)	p-value
Innovation diversity	1.71 (0.96, 2.47)	< 0.001
Tourism percentage	0.09 (0.02, 0.17)	0.009
Tourism by innovation	0.05 (0.00, 0.08)	0.029
Uncertainty	−0.28 (−0.47, −0.09)	0.003
Industry		
- Manufacturing	reference	
- Retail	−2.72 (−7.96, 2.52)	0.309
- Service	−2.04 (−6.95, 2.87)	0.414
- Other	0.50 (−4.65, 5.65)	0.848
ln(size)	0.92 (−0.31, 2.15)	0.143
ln(age)	−0.32 (−2.01, 1.38)	0.713
Constant	51.00 (42.74, 59.25)	< 0.001
F-statistic	4.57 (9, 346)	< 0.001
R^2	0.109	
R^2-adjusted	0.085	
Uncertainty via (innovation by tourism)		
CIE (tourism = 0)	0.05 (0.01, 0.12)	–
CIE (tourism = 5)	0.06 (0.01, 0.13)	–
CIE (tourism = 15)	0.07 (0.02, 0.17)	–
CIE (tourism = 60)	0.14 (0.02, 0.43)	–
CIE (tourism100)	0.21 (0.02, 0.67)	–

Note: The conditional indirect effects (CIE) [uncertainty via (tourism by innovation)] are shown at different values of tourism (%) with confidence intervals obtained via bootstrapping with 5000 replicates.

Table 10
Robustness analysis 1: Replicating the final model adjusting for performance (Wave 1 - Robustness analysis 1).

	Performance (Wave 2)	
	Beta (95% CI)	p-value
Innovation diversity	0.87 (0.20, 1.53)	0.011
Tourism percentage	0.11 (0.05, 0.17)	0.001
Tourism by innovation	0.05 (0.01, 0.08)	0.006
Uncertainty	−0.16 (−0.32, −0.00)	0.044
Industry		
- Retail	−4.43 (−8.94, 0.08)	0.054
- Service	−2.96 (−7.18, 1.25)	0.168
- Other	−2.22 (−6.66, 2.23)	0.327
ln(size)	0.05 (−1.01, 1.12)	0.992
ln(age)	0.81 (−0.67, 2.29)	0.280
Performance (Wave 1)	0.50 (0.42, 0.59)	< 0.001
Constant	24.43 (16.07, 32.79)	< 0.001
F-statistic	18.60 (10, 329)	< 0.001
R^2	0.36	
R^2-adjusted	0.34	
Uncertainty via (innovation by tourism)		
CIE (tourism = 0)	0.02 (−0.01, 0.07)	–
CIE (tourism = 5)	0.03 (0.00, 0.08)	–
CIE (tourism = 15)	0.05 (0.01, 0.13)	–
CIE (tourism = 60)	0.12 (0.01, 0.39)	–
CIE (tourism100)	0.19 (0.02, 0.62)	–

Note: The conditional indirect effects (CIE) [uncertainty via (tourism by innovation)] are shown at different values of tourism (%) with confidence intervals obtained via bootstrapping with 5000 replicates.

Table 11
Robustness analysis 2: Replicating the main effects with log transformation of performance (Wave 2) as the dependent variable (Robustness analysis 1) [showing untransformed coefficients].

	Ln(Performance (Wave 2))	
	IRR (95% CI)	p-value
Innovation diversity	1.04 (1.02, 1.06)	< 0.001
Tourism percentage	1.00 (1.00, 1.00)	0.060
Uncertainty	0.99 (0.099, 1.00)	0.004
Industry		
- Retail	0.94 (0.83, 1.08)	0.1.08
- Service	0.96 (0.85, 1.09)	0.544
- Other	1.02 (0.89, 1.56)	0.818
ln(size)	1.02 (0.99, 1.05)	0.145
ln(age)	1.00 (0.96, 1.03)	0.788
Log pseudo likelihood	−1568.86	
Psuedo R^2	0.040	

Note: Estimates (IRR, incidence rate ratios) were obtained using Poisson regression with robust standard errors [relaxing the assumption E(Y) = V(Y)], which is an alternative to log-normal regression.

Table 12
Robustness Analysis 3: Associations between performance with interactions of innovation by uncertainty [separate models, not adjusted for covariates].

	Performance (Wave 2)	
	Beta (95% CI)	p-value
Innovation diversity	1.71 (0.99, 2.43)	< 0.001
Uncertainty percentage	−0.22 (−0.40, −0.04)	0.016
Uncertainty by innovation	−0.07 (−0.16, 0.02)	0.144
Constant	44.05 (42.68, 45.41)	< 0.001
F-statistic	9.08 (3, 371)	< 0.001
R^2	0.071	
R^2-adjusted	0.064	

Note: Explanatory variables were centered prior to coding of the multiplicative terms.

Table 13
Robustness Analysis 4: Direct and indirect (via innovation) effects of tourism percentage with performance [adjusted for covariates].

	Performance (Wave 2)	
	Beta (95% CI)	p-value
Innovation diversity	1.67 (0.91, 1.43)	< 0.001
Tourism percentage	0.08 (0.01, 0.15)	0.027
Tourism via innovation	0.00 (−0.02, 0.01)	–
Uncertainty	−0.27 (−0.46, −0.09)	0.004
Industry		
- Manufacturing	reference	
- Retail	−2.57 (−7.84, 2.70)	0.338
- Service	−1.75 (−6.68, 3.17)	0.485
- Other	0.76 (−4.41, 5.94)	0.772
ln(size)	0.82 (−0.41, 2.05)	0.192
ln(age)	−0.21 (−1.92, 1.49)	0.804
Constant	46.60 (38.19, 55.00)	< 0.001
F-statistic	4.49 (8, 337)	< 0.001
R^2	0.096	
R^2-adjusted	0.075	

Note: As both models included all variables only one analysis was necessary. Confidence intervals for the indirect effects were obtained via bootstrapped with 5000 replicates.

tourism was not associated with the outcome. Table 12 shows that the interaction between uncertainty and innovation diversity was not associated with performance, thus increasing confidence that the interaction identified between tourism and innovation diversity was not spurious. Last, we also showed that there was no indirect effect of tourism on performance via innovation diversity (see Table 13), which provides additional support for the indirect effect identified in Hypothesis 3a.

5. Discussion

This study contributes to the literature on tourism innovation by investigating the innovation diversity–performance relationship, and how innovation can help tourism firms to mitigate the effects of uncertainty. Although innovation in tourism has been researched, most studies are conceptual or qualitative in nature, while those that use quantitative techniques are usually cross-sectional studies or focused narrowly on specific tourism sub-sectors. This has led scholars to ignore the influence of the degree of tourism dependence on innovation, and the temporal impact of innovation diversity on subsequent performance. To address this, we showed how innovation diversity and uncertainty influence tourism SME performance. Our contribution is threefold.

First, we address the rarely considered issue of innovation diversity in SMEs (Love et al., 2011). By clarifying it and its associated dynamics, we argue that innovation diversity is a more accurate measure to use in community innovation surveys that adopt the Oslo Manual's definition of innovation (OECD, 2005). Doing so attempts to remedy the often observed mismatch between how innovation constructs are conceived and practiced, which currently weakens empirical studies in this field. We show that innovation diversity is a more accurate measure of the combinative effect of innovation types by providing evidence for the synergistic and cumulative effects of innovation types on performance (Damanpour et al., 2009).

Second, we find a strong relationship between innovation diversity and performance, which is strengthened by tourism sales. This is notable because tourism sales were not significantly related to either innovation diversity or performance. We explain this through three main arguments: (1) our measurement based on tourism sales, rather than a dichotomous variable, allows the scale of tourism dependence among tourism SMEs to be ascertained; (2) tourism firms are more strongly exposed to international forces than other firms because they are more likely to operate in local and international markets (Stabler et al., 2009) and hence in a more competitive environment; and (3) tourism is the only export where both production and consumption of services occur simultaneously. This allows tourism firms to receive immediate customer feedback, often through social media, helping to refine their innovations and improve their performance.

Third, we show that SMEs struggle with performance in the face of uncertainty. Correlational analysis showed that while innovation diversity and uncertainty were positively related, the relationship between uncertainty and performance was negative. This means that perceived uncertainty requires adaptive behavior and provides greater scope for opportunity seeking that manifests as innovation, a premise that is supported in the literature (Freel, 2005; Naranjo-Gil, 2009; Prajogo & McDermott, 2014). Innovation diversity provides a mechanism to mitigate uncertainty's negative effect on firm performance, and SMEs with greater innovation diversity could gain performance benefits even when facing uncertainty. This relationship held for tourism firms and suggests that, if tourism firms can find ways to increase innovation diversity, they can overcome barriers related to uncertainties in relation to labor shortages, access to capital, new technologies, and challenges associated with developing new markets and products in a highly competitive environment. Our findings thus show that increased uncertainty will impede performance unless SMEs improve their innovation diversity. Innovation diversity is the mechanism that (especially tourism) SMEs use to survive and thrive under conditions of uncertainty.

6. Conclusions

This paper has examined the relationship between innovation and performance, and identified gaps in the empirical literature, which stem from: (1) a lack of consensus about the measurement of innovation, (2) the use of cross-sectional studies that do not allow for the time required for innovations to be implemented and to impact performance, and (3) not accounting for the impact of uncertainty and tourism sales dependence on this relationship. These gaps were addressed using longitudinal data that examined how innovation comprising a range of activities (termed innovation diversity) relates to performance in small tourism firms. We found a strong relationship between innovation diversity and SME performance, which was strengthened by increasing reliance on sales to tourists. The paper then examined how innovation diversity supported performance in tourism firms facing conditions of uncertainty. We found that innovation diversity positively mediates the negative uncertainty: performance relationship, allowing tourism firms to better cope with resource and market uncertainties. This interaction is, however, conditional on the level of tourism dependence in the firm's turnover. In summary, the study presents new insights into the complexities of tourism innovation, and addresses innovation diversity, tourism dependence, and uncertainty.

This paper is not without limitations. One potential problem using historical comparisons in testing performance is the potential effect of unusual economic or business cycles (e.g., the GFC). Hence the timing of the research could have affected the value that firms were able to extract from innovation diversity. Because controlling for such cyclical fluctuations in the current dataset is difficult, caution should be exercised when interpreting the longitudinal results. This leads us to our first suggestion for future research, namely to consider controlling for economic cycles by incorporating a Gross Domestic Product annual growth rate variable in the regression models (Bozec, 2005).

Another limitation to this paper relates to the dichotomous nature of the innovation data. While the benefits of yes/no measures are clear regarding low bias and efficiency, these measures miss some of the complexity involved in the innovation–performance determinants (de Jong & Vermeulen, 2006). In common with most research on innovation, this paper relies on dichotomous measures of the individual innovation types which are combined to produce a composite index of innovation types. This measure captures the diversity of innovation, but not the nuanced ways in which different innovations may be combined. Last, the degree of novelty, or the distinction between incremental, radical and disruptive innovation is also not tested, given the focus of the paper on innovation diversity. Future research could explore the impact of different configurations of innovation diversity. Although such data are difficult to obtain for SMEs, future research would benefit by incorporating more nuanced measures of innovation performance (e.g. number of actual innovations implemented for each type of innovation relative to sales/profit/cost reduction), inputs (monetary and time invested in innovation or R&D – and implicitly the opportunity cost in respect of time diverted from other managerial tasks) and the novelty dimensions of combinations of innovation.

Another avenue for future research is the impact of different types of uncertainty on firm innovation and performance. This study focused on pervasively uncertain markets and resources, rather than extreme events such as crises and disasters. The literature on tourism related crises and disasters is rapidly growing, yet studies on the resilience of tourism firms are embryonic (Jiang, Ritchie, & Benckendorff, 2017). Literature on SME and organizational resilience (Linnenluecke, 2017; Sullivan-Taylor & Branicki, 2011; Sullivan-Taylor & Wilson, 2009) could be applied to understand firm resilience to crises and disasters. The literature suggests that responses can be innovative and may also lead to new tourism products, services and markets after recovery (Ritchie, 2004). However, empirical research on types of innovation during such events and whether they lead to long-term firm resilience is required. The entrepreneurial resilience literature (Korber & McNaughton, 2017) may provide a starting point to examine tourism innovation in a crisis and disaster context. The nature of a crisis or disaster (e.g. terrorism, earthquake), and the characteristics of tourism firms (e.g. type, size and location), should be incorporated to better understand the relationship between tourism innovation, extreme events and resilience. Due to the nature of tourism it is unsurprising that differences in planning for crises and disasters have been found (Ritchie, Bentley, Krouth, & Wang, 2011; Sullivan-Taylor & Wilson, 2009). A one-size fits all approach that ignores contextual factors may not be helpful for researchers or policy makers (Sullivan-Taylor & Branicki, 2011).

We conclude by highlighting some policy and practical implications of this study. For policy-makers there are several implications. Effective policy focuses on strengthening markets for innovative offerings. Not only are well-designed demand-side policies less expensive than direct support measures, but they also target a key area of uncertainty and address one of the fundamental determinants of productivity (Park et al., 2016). They do not choose winners (and implicitly losers), but reward effective innovation, and come in the form of, for example, public procurement and facilitating access to information about markets and other opportunities. In other words, they reduce uncertainty about how markets will respond to new or modified products. The main implication for supply side policies is the importance of providing holistic one-stop advice and support to firms which covers the range and specific combination of diverse interventions necessary to ensure that the impact of innovation on performance is maximized. These policies also need to address the specific challenges presented by uncertainty in different regions or localities. Supply-side policies can, for example, focus on supporting the development of human capital in remote areas where many tourism SMEs in Australia are situated. SMEs with staff who are knowledgeable and aware of opportunities are more likely to innovate.

This paper has demonstrated that innovation diversity provides a useful approach for tourism SMEs to improve performance outcomes. The main sources of uncertainty identified in this paper are availability of finance, access to labor, technological change, access and demand from markets, and competition. Innovation improves access to labor and finance by signaling to employees and funders that SMEs are more strategic and therefore more likely to survive over the longer term (McCarthy, Oliver, & Verreynne, 2017). Focusing on diversity of innovation reinforces this point, underlining the need to avoid relying on relatively simplistic 'single innovation' approaches. In other words, engaging in the appropriate mix of innovations is an important strategic decision for firms. The lack of resources available to SMEs when engaging with uncertainty would seem to exacerbate this challenge. Therefore, tourism SMEs are advised to reverse the negative impact of uncertainty on performance by capitalizing on the strategic opportunities for competitive advantage that uncertainty offers through innovating across a broader range of innovation types.

CRediT authorship contribution statement

Martie-Louise Verreynne: Conceptualization, Funding acquisition, Project administration, Methodology, Writing – original draft, Writing – review & editing. **Allan M. Williams:** Writing – review & editing. **Brent W. Ritchie:** Writing – review & editing. **Sarel Gronum:** Writing – review & editing. **Kim S. Betts:** Formal analysis, Visualization.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tourman.2018.11.019.

Appendix 1. Equations for conditional indirect effects

Structural equation model for conditional indirect effects:

$$z_i = \beta_0 + \beta_{x_1z}x_1 + \varepsilon_{z_i}$$

$$y_i = \gamma_0 + \gamma_{z_1y}z_i + \gamma_{x_1y}x_1 + \gamma_{x_2y}x_2 + \gamma_{(Z_1\times X_2)Y}\,(z_1 \times x_2) + \varepsilon_{Y_i}$$

Where:

- z_i denotes innovation
- x_1 denotes uncertainty
- β_{x_1z} denotes the coefficient for the change in innovation per unit increase in uncertainty
- y_i denotes performance (Wave 2)
- γ_{z_1y} denotes the coefficient for the change in performance per unit increase in innovation
- γ_{x_1y} denotes the coefficient for the change in performance per unit increase in uncertainty (i.e., the direct effect)
- x_2 denotes tourism percentage
- γ_{x_2y} denotes the coefficient for the change in performance per unit increase in tourism
- $z_1 \times x_2$ denotes the interaction term for innovation and tourism
- $\gamma_{(Z_1\times X_2)Y}$ denotes the coefficient for the change in performance per unit increase in the interaction

$$And\ \varepsilon_{z_i} \sim N(0, \sigma_z), \quad \varepsilon_{y_i} \sim N(0, \sigma_y)\ and\ Corr\left(\varepsilon_{z_i},\ \varepsilon_{y_i}\right) = 0$$

Estimates for the conditional indirect effect can then be obtained using bootstrapping conditional on certain values of tourism (in which l indicates the level of tourism percentage):

$$\beta_{x_1z} \times \left[\gamma_{z_1y} + \left(l \times \gamma_{(Z_1\times X_2)Y}\right)\right]$$

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