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The determinants of cluster activities in the Australian wine and tourism industries

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This paper discusses wine and tourism clusters and the recent innovation of wine tourism in which businesses operate within both industries. The concept of micro-clusters is examined in terms of trust, networking, collaboration and other activities, all of which are argued to depend on the concepts of game theory and sunk costs. The study involved both interviews and a questionnaire. Conceptual variables are created from the questionnaire responses using factor analysis. The determinants of cluster activities are modelled using regression analysis. The effects of industry, place and respondents' entrepreneurial characteristics are used as exogenous variables. The study finds that industry does seem to be more important than place in the determination of networking and cooperative cluster activities, and that members of the wine tourism industry participate more in these activities than members of the tourism or hospitality industries. The addition of three variables that embody the entrepreneurial characteristics of the respondents approximately doubles the explanatory power of the original models. There is evidence to suggest that cluster activities are idiosyncratic for each industry–place cluster. The effects of firm size on cluster activities are also examined. No evidence is found of cooperative activities depending on cluster size. The main results support the contention that sunk costs are important in the determination of cluster activities.

Keywords: clusters; wine tourism; game theory; trust; co-opetition; regression analysis

Clusters are co-located agglomerations of businesses, institutions and other organizations that generate external increasing returns to scale because of their proximity to each other and because of the resulting interactions between them.

The standard argument is that increasing returns arise through spillovers of knowledge and information, attraction of capital and customers, common infrastructure and factor supply. There is increasing evidence that the growth and performance of existing enterprises are significantly improved through being located in a cluster and that entrepreneurship and new venture creation are more likely to be observed in clusters (Rosenfeld, 2001; Porter, 2003).

Clusters and clustering are, according to Martin and Sunley (2003), a chaotic concept promoted by leading thinkers in the context of an emerging knowledge economy. In particular, they ask; 'Why has Porter's notion of clusters gatecrashed economic policy when the work of economic geographers on spatial agglomeration of economic activity and the growing salience of the region in the global economy is being largely ignored?' Others have concluded that there is great similarity between Porter's conceptualization of clusters (Porter, 1998a,b) and Marshall's discussion of the localization of industry into distinct districts, not only due to natural geographical factors but also due to external economies ranging from the evolution of local markets for labour and subsidiary trades and from the passing on of ideas (Marshall, 1920: ch X, especially section 3). Much of the work on clusters has emanated from the classic industrial districts of northern Italy (Harrison, 1991). In this paper, the dimensions of clusters are explored and their determinants analysed, not only in terms of place and industry but also using game-theoretic approaches involving sunk costs and the distinctive entrepreneurial traits of the participants.

Micro-clusters and networking

Recently, the concept of micro-clusters has emerged involving niche markets, co-location and, usually, some aspect of tourism. This concept seems to originate in a study by Michael (2002) of the co-location of antiques retailers in Australia. Earlier studies of the same phenomenon include a study of book towns by Seaton (1996, 1999), although in retrospect, its existence can be seen in other studies. Michael (2003, 2006) develops the theory further, which enables the concept of clustering itself to be examined more clearly. Michael (2006) compares the concept of micro-clusters with the concept used by Porter and simple co-location in two ways.

The first comparison is that there are separate direct benefits of micro-clusters and co-location that accrue to the customers and the businesses in the cluster. The direct benefits to the customers are not simply reduced search and associated travel costs, but also the associated tourism experience. The direct benefit to the business is that the development of clustering activities can reduce business costs. It may be noted that clusters of law firms around courts, diamond businesses in Hatton Garden, London, and many retailers and wholesale markets are also co-located, essentially for the direct benefit of customers. Although it is possible to see other cluster-type activities within such localities – for example, the existence of more efficient labour markets – such activities generally do not require the development of social capital by the businesses themselves. These activities are spillovers and external economies of scale.

The second comparison is that, in the case of rural clusters at least, there

are complementary products for customers, one of which is essentially the tourism and hospitality aspect. Complementary products for customers are basically economies of scope in consumption, which may or may not be delivered by a single producer. If not, then they can be achieved by a formal alliance between producers at one extreme, or by arm's-length competitive market relationships. Where two products depend on each other to a high degree, mutual interdependence has to be recognized and supported by something such as an explicit contract (formal alliance) or an implicit contract in the form of trust. For a discussion of relationships and implicit contract, see Kay (1993: ch 4). The supply of complementary products by different firms is likely to be stimulated by clustering activities. However, Michael (2006: pp 73–78) shows that these developments do not always occur. Whether this is because not all potential clusters yield net benefits or because there is a missing precondition, such as trust, is not easy to ascertain. For a discussion of the wide variety of cluster forms and applications, see Karlsson (2007). In micro-clusters, networking is likely to facilitate the provision of complementary products through the exchange of operational information, whereas in Porter-type clusters, the argument is that networking facilitates the exchange of technical information and ideas.

Michael (2003) explains that the typology of micro-clusters not only includes vertical and horizontal clustering activities – that is, clustering activities between businesses along the value chain and between businesses at a particular stage in the value chain, respectively – but also includes diagonal clustering activities. These are defined as clustering activities between firms in different value chains that enable the production of complementary products or services.

At the heart of any discussion of cluster activities is the issue of what sustains the existence of a cluster or micro-cluster. One explanation is simply the existence of beneficial spillover effects or externalities. However, once the discussion of clusters includes relationships *per se*, this is insufficient. If firms pursue their own self-interest without considering the effects on other firms in the cluster, the benefits of being part of the cluster may be competed away (Michael, 2006: p 30). The problem of the sustainability of the cluster may be seen as a classic example of the game-theoretic case of the *prisoners' dilemma* (see Gibbons, 1992; Kay, 1993: ch 3). This problem can be overcome in several ways, but the particular solution that would appear to be fundamental to the sustainability of clusters is the evolution of trust. Trust is the state in which participants expose themselves to potential risks as a result of expecting other participants not to take advantage of them. Trust enables cooperation and reciprocation. Trust will evolve if there is an expectation in the minds of the participants that the game will be played repeatedly to infinity or, in practice, to a time horizon that is distant or ill defined. Thus, the sustainability of clustering activities depends, in essence, on repeated plays of the game and, if the participants believe that the cluster is beneficial to them, then they will participate in repeated plays to infinity. Lynch and Morrison (2006: p 50) argue that the mechanism that enables trust to evolve is networking.

An alternative solution to the problem of sustainability, and which, in some circumstances, is also a precondition for the evolution of trust, is the existence

of a cost in order to leave the game, that is, of getting out of the business. If it is costly to leave, then the person has to stay and make the best of things, which may be to cooperate. The essential concept here is that of sunk costs, that is, costs that cannot be avoided or assets which cannot be recovered by shutting down production. This is examined more fully later. The game-theoretic implications are analogous to the idea of 'burning one's boats', that is, to construct a situation in which one has to stay and make the best of things, in whatever way remains, whether having to fight or to cooperate.

Brandenburger and Nalebuff (1997) show that if two firms produce complementary products, they should not regard each other as competitors. However, the supplying of complementary products by two (or more) producers is, again, essentially a prisoner's dilemma problem. If there is cooperation between the two suppliers, then the market for the complementary products can develop, but if the two firms each pursue their own individual short-term self-interest, then the market will not develop and, if in existence already, will collapse. According to Michael (2006: p 31), these arguments provide a rationale for cooperation in cluster behaviour: 'In this sense, effective clustering positions the member firms to compete more effectively, not with each other but with those outside the cluster that deliver a similar product.'

The idea that networks can lead to the evolution of trust raises a number of interesting issues. One relates to the idea of the necessity of a critical mass and of network economies of scale. In essence, this can be illustrated by the notion that there is no point in having a telephone if no one else has one; and that having a telephone becomes progressively more attractive the greater the number of other people who decide to have telephones. In addition, there is a strong interdependence between ideas about cluster development and ideas about networking. Within the literature, there are two forms of networks, namely, interorganizational (formal) networks and personal or social (informal) networks. Lynch and Morrison (2006) conclude that it is 'the process of networking that generates the desired outcome'. Tinsley and Lynch (2001) use a case study of a tourist destination to investigate networking between small tourism businesses, hotels, bed and breakfast providers, a gift shop, an art and craft shop and a grocery store in order to investigate the role of cooperation in the development of the destination.

Gibson *et al* (2005) add the category of semi-formal networks, which are a mixture of social and business activities, but which have identified aims. They discuss the Ayrshire Food Network, with its slogan of 'thinking collaboratively', and which, although claiming to be an informal network, is really a formal network of 35 members, but with sufficient informality to enable complex interaction within the network.

The wine and tourism industries and sunk costs

The two industries are different in a number of ways that affect the potential impact of clustering on firms and, in turn, the influence that the firms exert on the development of the cluster in which they operate. The following distinctions are appropriate in the Australian context:

Wine	Tourism
Homogeneous sector	Heterogeneous sector
Few micro businesses	Many micro businesses
Major barriers to entry	Few barriers to entry
Major barriers to exit	Few barriers to exit
High technical skills	Varied technical skills
Can exist in isolation	Needs co-location
Rapid growth/rapid change	Rapid growth/slow change
Large-scale economies	Limited-scale economies
Major consolidation	Little consolidation
Internationally competitive	Limited international competitiveness

Some of these differences may be seen largely in terms of the concept of sunk costs.

Sunk costs, as discussed earlier, are costs that cannot be recouped when a firm leaves an industry because a market is no longer viable. Sunk costs include not only physical assets, such as vineyards, but also intangible assets, such as trust and network relationships. They are generally lower in tourism and hospitality than they are in wine production, mainly because most of the assets used in wine production have no or few alternative uses.

Sunk costs are essentially the loss that would be incurred on any asset for which the intended use failed, that is, its second-use value would be only a small proportion of its intended use value, possibly zero. Examples include: intangible assets, such as the cost of developing and maintaining a brand, for example, Ratner's chain of jewellery shops collapsed after its chairman derided the quality of its jewellery; or physical assets, such as the channel tunnel between England and France or the Millennium Dome in London. Vineyards involve very large sunk costs, as do hotels in new and untried locations. Aircraft and ships, although are very high-cost assets, do not involve high sunk costs providing that they can be redeployed easily for use on other routes. Hence, railway companies can use lease finance to purchase rolling stock, but not to upgrade the track and infrastructure. For a fuller discussion of sunk costs, see Kay (1993: pp 116–119).

There is a drive from both industry and the Australian government to foster greater complementarity between the two industries by the promotion of a 'wine tourism' product (Dowling, 1998; Johnson, 1998; Sutton, 1998; Cambourne and Macionis, 2000; Hall *et al*, 2000; Macionis and Cambourne, 2000; Mitchell and Schreiber, 2006). This has led to diversification, primarily by wine producers diversifying into hospitality and tourism. In the current study, all but one of the 27 respondents who had diversified into wine tourism had done so from a wine production base. Such diversification is likely to involve sunk costs in the form of start-up costs at least. These costs are sunk and so, in the event of business failure, they could not be avoided by the diversifying firm going bankrupt in the way that a new start-up firm could. The diversifying wine producer would have to meet the full extent of such sunk costs, unless the whole business went bankrupt. In addition, having to face the full extent of such sunk costs, diversifying firms are thus in a *stand and fight* situation and so are likely

to take actions that enable them to survive. Participation in a network would be one such action.

Some tourism start-ups will involve sunk costs but others will not. For instance, a new hotel in a new location has high sunk costs, whereas bed and breakfast accommodation and coach tour services, apart from having few sources of competitive advantage, are easy markets to enter and exit and involve few sunk costs. In addition, tourism has many business start-ups that are not based on strategic assets or resources and so such start-up firms will be unlikely to be able to gain competitive advantage.

As discussed earlier, the existence of sunk costs can mean that the prisoners' dilemma problem does not emerge, and so it is likely that networks and cooperation will develop between firms that have sunk costs. In turn, the development of such intangible assets will itself involve sunk costs. Thus, networking behaviour between wine producers is likely to be stronger and more developed than between firms in the tourism and hospitality industries. In addition, where a prisoner's dilemma game is not symmetrical, such that one player has no incentive to cheat (for example, has considerable sunk costs) but the other does have an incentive to cheat (for example, has no or low sunk costs), then the game may not be worth playing. In the case of complementary products, this would be the situation where cooperation would not be sufficiently stable for production to take place, and so production would only be possible in-house through diversification. This provides one explanation of why wine producers tend to diversify into tourism rather than collaborate in some form of alliance with existing tourism firms.

The study

The economic importance of both the tourism and wine industries in Australia varies from region to region. Clustering may well be a contributing factor. As well as the differences discussed earlier, the industries have some similarities. Both industries benefit from external economies, have a significant lifestyle segment, may be co-located, have seen major growth and are internationally traded. While these two industries provide only a limited test of the place versus industry debate in the clustering literature, they are also interesting because both have been a target for various initiatives designed to improve competitiveness and regional growth in many parts of Australia.

In order to investigate the complementarities between the two industries, in-depth interviews and a questionnaire survey were undertaken to assess whether the respondents collaborated in production, logistics, innovation or marketing; whether they were aware and responded to each other's competitive moves; and whether they benefited from being co-located with other enterprises. Three locations were identified in Western Victoria where there was co-location of both the wine and tourism industries. Interviews were undertaken with industry members at each location.

The interviews indicated that tourism generally exhibited passive interaction. That is, most tourism enterprises did not seem to engage in joint activity or actively seek to grow their business through interaction with other related businesses within the cluster. On the other hand, in most cases, the wine

clusters demonstrated more active collaboration between wine producers. In addition, it was evident that businesses in the wine clusters were more inclined to show active complementarity with the tourism cluster, although the reverse was not the case. These initial findings support a sunk costs interpretation. In one of the locations, however, there appeared to be a greater level of complementarity between the two clusters. This suggested that, in the particular location, there were factors that led to greater clustering activity, both within and between the different sectors. This would seem to indicate that there might be determinants which are idiosyncratic or the result of historical accident.

Targeted questionnaires were directed to all participants in the wine and tourism industries who were identified through their involvement in industry associations and through the in-depth interview process. The sample selection process employed for this data collection was judgmental, as the participants were identified on the basis of their involvement in the phenomenon prior to the commencement of the survey.

Modelling the relationships

The central objective of the research was to analyse the essential determinants of the business behaviour of members of clusters. The method of analysis employed was to construct regression models in which measures of the behaviour of members of the cluster were the dependent variables as a function of independent variables that have been suggested in the literature. These were not only place and industry, but also the entrepreneurial characteristics of the members. However, it was also recognized that the entrepreneurial characteristics would likely be determined, in part, by the cluster activities themselves. This was because entrepreneurs would be attracted to set up businesses in clusters that had the attributes from which they could most readily benefit. The interdependence between cluster activities and entrepreneurial characteristics meant that the variables might, to some extent, be determined as part of a simultaneous set of equations. Hence, the potential problem of simultaneous bias was investigated using the Hausman test, and instrumental variable methods were used where necessary (see Gujarati, 2003). The estimation and results of the entrepreneurial characteristics structural equations are discussed in McRae-Williams *et al* (2007).

The questionnaire contained measures relating to perceptions of the behaviour of the cluster in which respondents were located, and measures relating to aspects of the entrepreneurial and innovative behaviour of the respondents. From these it would be possible to derive underlying conceptual variables by applying factor analysis to the data relating to these two different groups of questions. Hence, several factor score measures of clustering activities and several factor score measures of entrepreneurial behaviour could be derived. Factor analysis determines the underlying factors, but the nature of the underlying constructs that the factors measure is a matter of interpretation. The factor scores could therefore be used as measures of cluster activities and as measures of entrepreneurial characteristics, respectively. The scores would be orthogonal to each other, which would mean that knowledge of respondents' scores for one

factor would be no indication of the scores for any other factor in that derivation. Orthogonality between the entrepreneurial variables would also mean that there would be no multicollinearity between them when used as independent variables in regression analyses.

In addition to creating the two sets of factor scores, dummy variables were also created to distinguish between places and industries in the regression models. As there were three regions, Ballarat was used as the base and two zero–one dummy variables were created to denote the BENDIGO and N. GRAMPIAN regions. Industry was split into several groups: TOURISM, HOSPITALITY and WINE+WT, with other industry being the base category. The industry category, WINE+WT, included all wine producers, that is, not only those that simply produced wine but also those diversified firms that produced wine and were involved in the tourism or hospitality industry. Those wine producers that had diversified into tourism and hospitality thus constituted the subgroup WINETOURISM within the WINE+WT group. Note that the total impact of wine tourism firms in a regression equation is therefore the sum of both the WINE+WT coefficient and the WINETOURISM coefficient.

The creation of the conceptual variables

The questionnaire, as discussed above, contained a range of questions asking respondents to express their opinions, measured on five-point Likert scales of agreement/disagreement, with statements designed to explore the facets of clustering. These statements related to views regarding attitudes to working with other similar businesses, both within the region and in other regions, and relationships with other types of businesses and agencies. Together, these statements were designed to draw out information about the attitudes and behaviour of the respondents. There were also questions relating to the respondents' businesses and backgrounds.

In total, there were 16 measures of clustering, competitive and collaborative behaviour. Factor analysis revealed that four underlying factors had eigenvalues greater than one and which accounted for 30%, 14%, 9% and 7% of the total variation in the data. This reduction and consolidation of measures of cluster activities thus enabled the impacts of the key explanatory factors, place and industry, to be analysed.

The strongest factor related to the extent to which the respondent's business worked closely with local public sector agencies, trade associations, other external bodies and individuals and with other local businesses. The emphasis was on sources of skills, knowledge and information. This factor may be seen to be indicative of network activity. This factor was thus labelled NETWORKING.

The second strongest factor related to the respondent's awareness of what other similar firms were doing, to setting higher standards than such firms and to working closely with local suppliers. This factor indicated keeping abreast with the competition, rather like the sort of behaviour exhibited in the copying and adoption of successful operational and management practices (Porter, 1998a,b). This factor was labelled COMPETITIVE RESPONSIVENESS as it

indicated responsiveness to competition. This is the spur of competitive behaviour that is often cited as an aspect of cluster activity.

The third strongest factor was related to cooperative interdependence and collaboration between businesses in terms of working together, sources of skills and performance. This factor was labelled COOPERATIVE ACTIVITIES.

The final factor was related to the sources of skill and knowledge from businesses in the same industry, both locally and from outside of the region, and to being influenced by what other businesses were doing. In addition, it indicated that although respondents did not see similar businesses as direct competitors, they did not work with such businesses. This factor was labelled SPILLOVER EFFECTS as it indicated that benefits were gained from such businesses, but without any direct contact or market relationship.

Factor analysis of the ten questions relating to different aspects of entrepreneurial behaviour and characteristics revealed three underlying factors which accounted for 21%, 17% and 11% of the total variation in the data. The strongest factor was positively related to the respondent pursuing an innovation strategy, negatively related to pursuing a growth strategy and positively related to wanting to develop his or her own business. This seemed to indicate qualities of being an INNOVATOR.

The second strongest factor was related to the existence of entrepreneurs, innovators and icon personalities in the region being factors in the growth of the respondent's business and of the availability of skill and knowledge. These characteristics were interpreted as those of a rational decision maker, an imitator, a cautious risk-averse person, and so the factor was named CALCULATOR.

The third and final factor was strongly related to a question about business opportunities being important in the decision of where to locate and whether the respondent was an owner-manager/owner-operator. This factor was named VENTURER, although not in any derogatory sense.

The empirical results regarding the industry versus place debate

The initial analyses involved regression models of each of the four cluster variables against the two place dummy variables and the four industry dummy variables. The results are presented in Table 1. The estimated equations may be thought of as *ad hoc* tests, although they are almost the reduced-form equations of a simultaneous model. They are also equivalent to two-way analysis-of-variance without interactions. The equations are shown to have low R^2 values which, although statistically significant for models I and II, that for model III is only significant at the 7.4% level, while that for model IV shows virtually no fit: a 26.4% level of significance.

It must be remembered that both factor scores and dummy variables are in essence proxy variables and, as such, intrinsically suffer from measurement error. The statistical effect of this is not only to reduce the R^2 below its 'true' value, but also to flatten the estimated slope coefficients and so usually, unless intercorrelations make it otherwise, to reduce t-ratios. Thus, rejection of null hypotheses is generally less likely. Hence, it is often reasonable to consider weaker levels of rejection when investigating relationships between independent and dependent variables.

Table 1. The determinants of cluster activities and attributes: place and industry.

Model	I	II	III	IV
Dependent variable	NETWORKING	COMPETITIVE RESPONSIVENESS	COOPERATIVE ACTIVITIES	SPILLOVER EFFECTS
Method	ols	ols	ols	ols
Place variables				
Bendigo	–0.0885	0.2664	0.1335	–0.1181
	(0.328)	(0.003)	(0.146)	(0.204)
N. Grampian	–0.0207	0.0286	0.0714	0.0568
	(0.818)	(0.746)	(0.435)	(0.540)
Industry variables				
Tourism	0.0910	0.0979	0.0553	0.0878
	(0.543)	(0.506)	(0.715)	(0.568)
Hospitality	–0.1349	0.1229	0.1021	0.0293
	(0.384)	(0.420)	(0.516)	(0.854)
Wine+WT	0.0525	–0.1411	0.3019	0.2073
	(0.747)	(0.377)	(0.069)	(0.216)
Wine tourism	0.1631	0.2901	–0.0001	–0.0460
	(0.104)	(0.004)	(0.996)	(0.654)
R^2	0.0974	0.1294	0.0716	0.0482
Significance level of R^2	(0.014)	(0.002)	(0.074)	(0.264)
Number of observations	160	160	160	160
Restricted models:				
R^2 industry variables only	0.0912	0.0677	0.0586	0.0254
	(0.005)	(0.027)	(0.051)	(0.405)
R^2 place variables only	0.0117	0.0727	0.0154	0.0269
	(0.397)	(0.003)	(0.295)	(0.117)
The saturated model:				
R^2 all place–industry interactions	0.1906	0.2417	0.1538	0.1696
F-ratio	2.1014	2.7027	1.7728	2.6681

Note: The coefficient values are standardized and the figures in brackets beneath them are the probability levels of the t-ratios. The figures in brackets beneath the R^2 values are the probability levels of their F-ratios.

The only significant variable shown to have an impact in the NETWORKING equation (model I) is WINETOURISM, the additional effect of wine producers diversifying into tourism. The impact is positive and significant at the 10.4% level, which indicates that the diversified firms engage in a higher level of networking. This may be due to the sunk costs that such diversification involves, as discussed earlier. The sunk costs provide a signal and a 'non-returnable deposit', which indicates that trust in the respondent is likely to be reciprocated. The estimated coefficient of WINETOURISM is higher than that for TOURISM, which implies that a wine producer that has diversified into tourism engages in more networking than a firm working solely in tourism. In the COMPETITIVE RESPONSIVENESS equation (model II), WINETOURISM also has a positive coefficient which is very highly significant

(0.4% level). From this it can be concluded that diversification and its associated sunk costs lead to much higher COMPETITIVE RESPONSIVENESS by cluster participants. Here, a sunk cost interpretation would be 'stand and fight after burning one's boats'.

WINETOURISM is not significant in either model III or IV, although the effect of WINE+WT *per se* in the COOPERATIVE ACTIVITIES equation (model III) is positive and significant at the 6.9% level. This would support the argument that both the higher physical assets and sunk costs that underlie wine production relative to tourism and hospitality, support the evolution of cooperative behaviour. No coefficient in the SPILLOVER equation (model IV) shows a reasonable level of statistical significance, which corresponds with the lack of significance of the R^2 value. This would indicate that spillover effects are likely to be independent of individual places and industries.

It can be seen that the only place effect is BENDIGO in model II, significant at the 0.3% level, but there is no obvious interpretation. A cluster interpretation would need a particular place to be better or worse for both industries. The attributes of particular clusters is discussed later.

Models I–IV were subsequently re-estimated in restricted forms in order to see separately the overall effects of place variables and industry variables. The R^2 values of the restricted models are shown near the bottom of Table 1. For the NETWORKING equation (model I), the R^2 value falls from 0.0974 to 0.0912 when the place variables are removed, leaving only the industry variables. However, it falls from 0.0974 to 0.0117 when all the industry variables are removed, leaving only the place variables. An F-test could be used to test the significance of these reductions in the R^2, but the magnitudes of the reductions show quite clearly that industry is more important than place in the determination of NETWORKING activities in the clusters in the study.

For the COMPETITIVE RESPONSIVENESS equation, the R^2 value falls from 0.1294 to 0.0677 when the place variables are removed and to 0.0727 when the industry variables are removed. These approximately equivalent reductions would seem to indicate that both place and industry are equally important determinants of this attribute. As regards COOPERATIVE ACTIVITIES, the R^2 value falls from 0.0716 to 0.0586 when the place variables are removed, but falls to 0.0154 when the industry variables are removed. Hence, COOPERATIVE ACTIVITIES are affected more by industry differences than by locational differences. Finally, the R^2 value in the SPILLOVER EFFECTS equation (model IV) falls from 0.0482 to 0.0254 when place variables are removed and falls to 0.0269 when industry variables are removed. This would indicate that neither place nor industry is more important.

That industry effects dominate place effects in the NETWORKING and COOPERATIVE ACTIVITIES equations provides more support for a sunk costs interpretation, while competitive responsiveness may differ from place to place.

In order to investigate whether each cluster had idiosyncratic characteristics irrespective of place or industry, each model was expanded into a saturated model with a different dummy variable for each industry–place cluster. There were three regions and five industry groups and so there were 15 different industry–place clusters. This is equivalent to including all the interaction effects in a two-way analysis-of-variance. The resultant R^2 values are shown as 'all place–industry interactions' at the bottom of Table 1. It can be seen that the

R^2 values approximately double for models I–III and more than triple for model IV. The F-ratios for the differences caused to the R^2 values by the interactions are shown below the R^2 values. The critical values for $F(8,120)$ are 1.72 (10% level), 2.02 (5% level) and 2.66 (1% level). The calculated F-ratios thus provide strong support for each of the 15 clusters having its own individual characteristics, especially as regards COMPETITIVE RESPONSIVENESS and SPILLOVER EFFECTS. One explanation of this could be that each cluster was at a different stage of development, although this explanation would not explain why the effect was stronger for models II and IV.

The additional effects of the entrepreneurial characteristics

An alternative explanation of why each of the individual cluster characteristics was different is that each cluster would have entrepreneurs who had different entrepreneurial characteristics. Models I–IV were thus augmented to include the three entrepreneurial factor scores. The resultant estimated equations are shown in Table 2 as models V–VIII. It can be seen that the addition of the entrepreneurial characteristic variables raises the R^2 values by a multiple of between approximately two and four, relative to the Table 1 models. This would indicate that entrepreneurial characteristics had a significant impact in addition to industry and place. As discussed earlier, both cluster activities and entrepreneurial characteristics might be simultaneously determined.

In model V, in which NETWORKING is the dependent variable, both the INNOVATOR and CALCULATOR variables are highly significant. However, INNOVATOR has a negative impact on NETWORKING, and CALCULATOR has a positive impact. This might imply that the presence of innovators means that NETWORKING behaviour is less likely to develop, while the presence of calculators means that NETWORKING behaviour is more likely to develop. Intuitive arguments can be formulated to support either a positive or a negative sign for the INNOVATOR characteristic variable, so the negative sign would indicate that innovators in the sample operate independently and do not reciprocate in the way necessary to develop and sustain NETWORKING. However, the expected sign for the CALCULATOR variable must be positive, given the discussion in the earlier part of the paper. This result thus both supports the theory and gives credence to the model.

Place does not seem to affect the development of NETWORKING behaviour in model V, the strongest probability level being 0.152. Neither does industry, the strongest probability level being 0.207 for WINETOURISM. The value of the coefficient would again give some credence to a sunk costs interpretation, although the 20.7% level of significance is too weak to draw a clear conclusion. This is rather surprising as in Table 1, industry was found to have a very significant effect on NETWORKING behaviour. However, the earlier model only includes the place and industry variables and so it may be argued that the results from model I may be due to excluded variable bias.

The cluster activity variable COMPETITIVE RESPONSIVENESS is the dependent variable in model VI. All three entrepreneurial behaviour variables have a positive, statistically significant impact on COMPETITIVE RESPONSIVENESS. This is as expected. Place has a notable impact as the

Table 2. The determinants of cluster activities and attributes: entrepreneurial variables, place and industry.

Model	V	VI	VII	VIII
Dependent variable	NETWORKING	COMPETITIVE RESPONSIVENESS	COOPERATIVE ACTIVITIES	SPILLOVER EFFECTS
Method	ols	ols	iv	ols
Entrepreneurial variables				
Innovator	–0.2033	0.1749	–0.0624	0.0129
	(0.003)	(0.023)	(0.501)	(0.873)
Calculator	0.4999	0.1594	0.2551	0.2111
	(0.000)	(0.036)	(0.005)	(0.009)
Venturer	–0.0461	0.1862	–0.0177	–0.1958
	(0.528)	(0.024)	(0.851)	(0.024)
Place variables				
Bendigo	–0.1109	0.2812	0.1496	–0.0983
	(0.152)	(0.001)	(0.153)	(0.282)
N. Grampian	–0.0850	0.0022	0.1029	0.0936
	(0.287)	(0.980)	(0.318)	(0.321)
Industry variables				
Tourism	0.0040	0.0939	–0.0930	0.0345
	(0.975)	(0.509)	(0.581)	(0.818)
Hospitality	–0.1311	0.1305	–0.0577	0.0790
	(0.321)	(0.377)	(0.736)	(0.613)
Wine+WT	–0.0307	–0.0341	0.1659	0.1534
	(0.827)	(0.828)	(0.370)	(0.355)
Wine tourism	0.1081	0.2361	–0.0100	–0.0779
	(0.207)	(0.015)	(0.930)	(0.441)
R^2	0.3710	0.2125	0.1358	0.1209
Number of observations	160	160	136	160
The saturated model:				
R^2 all place–industry interactions	0.4670	0.3629	0.1853	0.2558
F-ratio	3.2195	4.2197	0.8545	3.2402

Note: The coefficient values are standardized and the figures in brackets are the probability levels of the t-ratios.

BENDIGO dummy variable is highly significant, having a 0.1% probability level. Industry is also significant, but the effects are slightly weaker than in model II; respondents who were involved in both the wine and tourism industries (WINETOURISM) exhibited higher levels of COMPETITIVE RESPONSIVENESS than the rest, at about the 1.5% level of significance. This would not only indicate that respondents who have diversified are also more likely to respond to competitors' innovations and competitive moves, but also supports the view that diversified firms are likely to be more responsive because they have incurred the sunk costs of the diversification process.

The COOPERATIVE ACTIVITIES equation (model VII) was estimated using the instrumental variable method (iv), as the test for simultaneity

indicated that ordinary least squares regression analysis (ols) would produce biased results. The two-stage least squares (tsls) variant had been estimated, but the very low explanatory power of the reduced-form equation formulated produced poor results. The equation containing the instrumental variables used to produce the CALCULATOR variable had an R^2 of 0.7652. The CALCULATOR variable in equation VII is highly significant and has a positive sign, as would be expected. Both place and industry variables show poor statistical significance and so appear not to influence COOPERATIVE ACTIVITIES in model VII directly. However, it can be argued that cooperative activities seem to be higher in the wine industry; this is shown directly in model III and indirectly through the CALCULATOR variable in model VII.

In the SPILLOVER EFFECTS model (VIII), both the CALCULATOR and VENTURER entrepreneurial variables have a significant impact and have positive and negative signs, respectively. This is as expected for the CALCULATOR variable, although rather surprising for the VENTURER variable. None of the place or industry dummy variables show anything approaching statistical significance.

Finally, as was undertaken for the Table 1 models, models V–VIII were augmented with dummy variables to test whether the individual characteristics of each of the 15 industry–place clusters had any additional effects. The R^2 values and the F-ratios are shown at the bottom of Table 2. The critical values of the F-statistic are the same as for Table 1, reported earlier. It can be seen that the additional effects on the R^2 values are highly significant at the 1% level for models V, VI and VIII, but are not significant for model VII. However, the latter could be affected by the instrumental variable method. It may thus be concluded that NETWORKING, COMPETITIVE RESPONSIVENESS and SPILLOVER EFFECTS are idiosyncratic to individual industry–place clusters. It may cautiously be concluded that COOPERATIVE ACTIVITIES are determined largely by industry.

The effects of firm size on cluster activities

The questionnaire contained a variable of five categories of turnover which were used as measures of firm size. Initially, the midpoints of the categories were used to create a single ratio variable. However, this indicated that the relationships were non-linear and so four dummy variables were used to denote each successive size threshold. Hence, the dummy variable SIZE50 was coded zero for all firms with an annual turnover of less than AUS$50,000 and coded one for all firms equal to or greater than AUS$50,000 per annum; the dummy variable SIZE100 was coded zero for all firms with a turnover of less than AUS$100,000 and coded one otherwise; and so on.

The four dependent variables were regressed against these and subsequently other measures of size, and size was found, by itself, to have a significant statistical impact. Models I–VIII were then re-estimated with the addition of the four size dummy variables to investigate whether there was any incremental effect of firm size on the Table 1 and Table 2 models. Again, the method of restricted least squares was used to test for such incremental effects. The results are presented in Table 3. The R^2 values for the original models are in the two

Table 3. Tests of size thresholds: significance and coefficient signs.

(a) Models I–IV

	Number of cases	I	II	III	IV
R^2nosize		0.1012	0.1363	0.0709	0.0420
R^2size		0.1459	0.1974	0.1005	0.0763
F-ratio		1.9365	2.8133	1.2155	1.3744
Size < AUS$50,000	73				
Size > AUS$50,000	23	+ve	+ve (0.041)	–ve (0.067)	+ve
Size > AUS$100,000	64	+ve	+ve (0.046)	+ve (0.094)	–ve
Size > AUS$500,000	18	+ve	–ve	+ve (0.048)	+ve
Size > AUS$1m	5	+ve	–ve	–ve	–ve

(b) Models V–VIII

	Number of cases	V	VI	VII	VIII
R^2nosize		0.3743	0.2227	0.1385	0.1125
R^2size		0.4170	0.2881	0.1744	0.1632
F-ratio		2.6561	3.3292	1.3367	2.1950
Size < AUS$50,000	73				
Size > AUS$50,000	23	+ve	+ve	–ve (0.191)	+ve
Size > AUS$100,000	64	–ve	–ve (0.021)	+ve (0.150)	–ve (0.010)
Size > AUS$500,000	18	+ve	+ve (0.033)	+ve (0.151)	+ve (0.173)
Size > AUS$1m	5	+ve (0.034)	–ve	–ve	–ve

Note: Only the signs of the estimated coefficients and only the more significant *t*-ratios are shown for simplicity.

rows denoted 'R^2nosize'. Note that these vary slightly from the values presented in Tables 1 and 2 because not all respondents indicate the annual turnover of their businesses. Similarly, the figures shown for the number of cases in each size category are for the sample as a whole, some of which would not have answered all the questions that would have enabled them to be included in the Table 1 and Table 2 results.

The resultant *F*-ratios can be compared to the tabulated critical values of the *F*-statistic. For *F*(4,120), these are: 1.99 (10%), 2.45 (5%) and 3.48 (1%). Thus, the addition of the size dummy variables produces significant *F*-ratios for models II, V and VI at the 5% level, and model VIII at the 10% level. For model I, the ratio is almost significant at the 10% level. Hence, it is reasonable to conclude that size has an effect on NETWORKING activities and COMPETITIVE RESPONSIVENESS, although the pattern of signs of the

individual coefficients is not entirely clear. Indeed, they could indicate that larger size reduces COMPETITIVE RESPONSIVENESS. However, there is no evidence of an overall or systematic effect on COOPERATIVE ACTIVITIES. As might be expected, there is little evidence that SPILLOVER EFFECTS are affected by size; although the augmentation of model VIII is significant at the 10% level, the signs and the significance of the individual dummy variables do not indicate a clear scale effect.

Conclusions

The regression analyses of cluster activities as a function of industry and place only showed that networking and cooperative activities were affected more by industry than by place. The addition of entrepreneurial characteristics reduced these effects, but the interpretation was hampered by the possibility of cluster activities and entrepreneurial characteristics being interdependent and simultaneously determined. The calculator entrepreneurial characteristic was found to be highly significant in the determination of all four cluster activities and, notably, was strongest as regards networking. All three entrepreneurial characteristics were found to have a significant positive effect on the competitive responsiveness cluster activity. In addition, augmentation of the regression models provided evidence that the development of cluster activities was likely to be cluster-specific. That is, each cluster was also determined by its own history and chance events. There was weak evidence that larger firms were more likely to be involved in networking, although firm size was unrelated to participation in cooperative activities. Generally, the effect of size was mixed, as size reflected more fundamental characteristics rather than magnitude *per se.*

The view that the determination of cluster activities was dependent on the sunk costs incurred by members of the clusters was generally supported through the interpretation of the regression results. The reason why tourism and hospitality were generally less important determinants relative to wine production and wine tourism may be explained in terms of the relative importance of sunk costs, which make entry, exit and innovation easier when sunk costs are relatively low. Thus, when sunk costs are higher, cooperative activities are more likely to develop in clusters and the clusters are more likely to be sustained. The efforts involved in the development of cluster activities are themselves additional sunk costs. It is interesting to note that wine tourism has the highest industry coefficients in the networking, competitive responsiveness and cooperative activities regression models, as would be expected from having to operate in both industries. It is also interesting to note that cluster theory suggests that integration between production activities is likely to be through the market rather than through hierarchies. Wine tourism may be viewed as integration through a hierarchy, although it could simply represent the utilization of existing fixed assets more fully.

Firms entering the tourism and hospitality industries are generally smaller-scale enterprises that have lower sunk costs than firms in the wine production industry. As a result, the tourism industry may be seen as chaotic, with firms entering and exiting rapidly (Russell and Faulkner, 2004). This is likely to mean that firms and workers in the tourism industry do not invest sufficiently

in their own business preparation and training as the expected return on such sunk costs may not be positive (Wanhill, 2000; Beeton and Graetz, 2001; Thomas and Long, 2001). In the same way, cluster activities in tourism may not develop readily as they also are essentially long term and impose sunk costs on participants. In addition, the tourism industry, by its very nature, is driven by the external economies of place, which are the essence of tourism. These are not clustering activities *per se*. Tourism may, therefore, be a case where a difference between cluster activities and external economies can be observed and thus enable us to distinguish between the concepts of clustering and micro-clustering on the one hand and Marshall's insights into the localization of industry into distinct districts on the other.

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