The relationship between dynamic capabilities, the firm's resource base and performance in a post-disaster environment

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Abstract

This article draws on quantitative survey evidence to explore the role of dynamic capabilities in a post-disaster environment, that of Christchurch in New Zealand after the 2010 and 2011 series of major earthquakes. We develop a model to examine the relationship between dynamic capabilities, disaster-related changes to the firm's resource base and its performance. The hypotheses are tested using a sample of 545 small firms that have been affected by the earthquakes. Results highlight the importance of a firm's proactive posture and capability to integrate resources in recognising new opportunities in an environment characterised by high volatility and increased uncertainty. These findings offer important theoretical and practical implications.

Keywords

Disaster, recovery, New Zealand, earthquake

1 INTRODUCTION

On 4 September 2010, the city of Christchurch in New Zealand was shaken by a MM[1] 7.1 earthquake which was followed by a more devastating MM 6.3 earthquake on 22 February 2011. Although the September 2010 earthquake did not produce widespread damage, it

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[1] The Modified Mercalli scale is a seismic scale used for measuring the intensity of an earthquake.

resulted in increased vulnerability for buildings in the city centre to further earthquakes and many were either damaged or collapsed causing major loss of life from the February 2011 event. The city continued to suffer aftershocks with further major earthquakes in December 2011 and June 2012. The city's infrastructure was badly damaged by the series of earthquakes resulting in more than 1,000 commercial buildings being demolished and more than 7,000 residential buildings being red-zoned meaning that they were on land that was considered too uncertain, costly and disruptive to repair. The damage to the local economy is estimated to be about 19 percent of New Zealand's GDP with the costs of rebuilding estimated to reach NZ$40billion (Canterbury Earthquake Recovery Authority, 2012). In terms of insurance losses the Christchurch earthquakes are considered to be the third most expensive disaster in history (Swiss Re, 2012). With a population of 376,700 in June 2010, Christchurch was New Zealand's second largest city, but the combined effects of the series of earthquakes and aftershocks led to a fall of 9 per cent in the City's population to 341,469 by March 2013 (Statistics New Zealand, 2013).

It is arguable that in terms of impact, the Christchurch earthquakes were more damaging and lasting on the New Zealand economy than other better known disasters in other developed nations such as, for example, the well documented effects of hurricane Katrina on the city of New Orleans and the US economy. This is because the major disruption in Christchurch had a proportionately greater effect since New Zealand is a small, open economy with a population of 4.4 million (Statistics New Zealand, 2013). The Inland Revenue Department reported that two thirds of business owners in Christchurch have been adversely affected by the earthquakes (Inland Revenue, 2012). By July 2013, net business migration was still negative indicating that more businesses are leaving the earthquake affected region than arriving into the region (Canterbury Earthquake Recovery Authority, 2013). Despite significant damage to commercial and residential property as well as public infrastructure

resulting in high numbers of relocation as well as changes in demand, some small firms have proven to be able to recover quickly from the disaster.

This article draws on quantitative survey evidence of small firms that have survived a natural disaster to explore why some firms perform better than others despite having been affected by the same disaster. Building on the dynamic capability view as well as the disaster management literature we develop and test a research model of the relationships between dynamic capabilities, a disaster's impact on the firm's resource base and its performance.

The dynamic capabilities view is relevant for the study of small firm behaviour in post-disaster environments for two reasons. First, natural disasters affect the business environment in a number of ways such as for example through damage to infrastructure, changes in the labour market, changes in customer demand as well as changes to supply availability and costs. These changes create a highly volatile and uncertain environment for businesses that can be seen as characteristic of Schumpeter's creative destruction i.e. the process through which economic value is created by destroying and replacing established economic structures with new ones (Schumpeter, 1994). The extent to which entrepreneurs respond to these new opportunities will depend on their ability to adapt the firm's resource (Teece, 2012). Sullivan-Taylor and Branicki (2011) argue that focusing on the capabilities of small firm will contribute to a better understanding of their recovery.

Second, the dynamic capabilities view emphasises the important role of managers in the deployment of resources and how their perception of environmental volatility impacts on the deployment of those resources. It has been argued that dynamic capabilities lie within the firm's core management (Helfat and Martin, 2015; Helfat and Peteraf, 2015; Teece, 2007) and it is the managerial judgement that influences the deployment of dynamic capabilities (Ambrosini and Bowman, 2009). Similar firms can therefore deploy different dynamic capabilities as a result of differences in their managers' perception of environmental

uncertainties (Aragon-Correa and Sharma, 2003). In the context of small firms, this highlights the importance of entrepreneurial behaviour in the recognition and exploitation of opportunities in a Schumpeterian environment that is characteristic of post-disaster economies.

This study contributes to the literature on disaster management as well as dynamic capabilities in four ways: First, much of previous disaster research has been on people and/or family units, government agencies and on households as a unit of analysis (Zhang, Lindell and Prater, 2009). By contrast, research evidence on businesses has been limited (Liu, Xu and Han, 2013). Particularly, work that focuses on disaster recovery and resilience of small firms has been rare (Herbane, 2010; Herbane 2013). This study provides much needed evidence on the role of small businesses in the recovery of local economies.

Second, previous research is predominantly based on qualitative case-studies due to the challenges associated with studying businesses in a post-disaster environment. Further, previous research has predominantly focused on the effects on businesses within the impact zone (Deitch and Corey, 2011; Webb, Tierney and Dahlhamer, 2000). This article draws on quantitative survey evidence of 545 micro, small and medium-sized firms inside and outside the impact zone. This approach allowed for a detailed and in-depth exploration of the varied effects the earthquakes had on businesses depending on size, sector, locality and age.

Third, this article applies the dynamic capabilities view to a novel context: i.e. small firms in a post-disaster environment. Nelson and Winter (2002) have demonstrated that firms establish routines and structures through planning that are then taken for granted. They can, however, leave firms unprepared in the event of a disaster. Disasters create highly volatile environments that pose challenges to a firm's planning process. For planning to be effective, environments need to be relatively stable and predictable to allow for reliable analysis and forecasting that are at the heart of strategic planning (McGrath, 2013). Post-disaster

environments, however, can be compared to transient advantage economies (McGrath, 2013), where opportunities are temporary and changing. Dynamic capabilities represent the ability of firms to quickly learn and adapt to the new circumstances and therefor provides an ideal theoretical lens that has – to our knowledge – not yet been explored post-disaster environments.

Fourth, using a multidimensional construct this study makes a theoretical contribution to the dynamic capabilities view by further clarifying the conceptual distinction between regenerating and renewing dynamic capabilities building on Ambrosini, Bowman and Collier's work (2009). We specifically focus on the role of resource integration as a renewing dynamic capability which has received comparably little attention to date. By introducing two adapted measurement scales from the organisational resilience literature (Lee, Vargo and Seville, 2013; Stephenson, Vargo and Seville, 2010) we measure dynamic capabilities in a novel context.

In a recent review, Koryak *et al.* (2015) noted that few studies have explicitly focused on dynamic capabilities in small firms. By integrating concepts from the disaster management literature, this article contributes to our understanding of the role of dynamic capabilities in small firms in a unique context.

The article is organised with the following sections: literature review and hypotheses development, research model, research methods, survey evidence and discussion and conclusions.

2 LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1 Disaster impact on small firms' resource base

Previous studies have predominantly focused on post environments of economic disasters such as that of the Global Financial Crisis which has indicated varying effects on

small firms (e.g. Bamiatzi and Kirchmaier, 2014; Cowling *et al.*, 2015; Smallbone *et al.*, 2012; Williams and Vorley, 2014). To date, there is only a small number of studies that explore how natural disasters impact on small firms (Chang and Falit-Baiamonte, 2002; Dahles and Susilowati, 2015; Deitch and Corey, 2011; Kroll *et al.*, 1990; Neef Panyakotkaew and Elstner, 2015; Parker *et al.*, 2009; Tierney, 1997; Webb, Tierney and Dahlhamer, 2000).

Natural disasters can impact on different types of resource. In the case of an earthquake, the firm's physical resources such as for example its premises might be damaged resulting in temporary closure or a need for relocation. Further, staffing levels and availability might be affected by physical or mental health issues caused by the disaster as well as dislocation or migration effects. Similarly, disasters can affect customer levels as well as supply availability. These examples illustrate that a disaster can affect a business directly i.e. through immediate damage, but also – and more importantly – indirectly through for example changes in the market and the extent to which the firm's customers were adversely affected by the disaster. It is likely that natural disasters such as an earthquake impact unevenly on the resource base of small firms. Depending on the size or age of the firm, sector and locality some might be affected worse than others, some might experience positive effects while others experience negative effects or no effects at all.

Dolfman, Wasser and Bergman (2007) demonstrate the diverse effects of Katrina on the New Orleans economy on the resource base of firms in different sectors. Using labour market data the authors show that retail trade, accommodation and food services, health care and social assistance were the three worst affected sectors in terms of job losses. Because of the disproportionate loss of jobs in these three sectors, the average wage for the remaining jobs rose by almost 30 percent. Even four years later, the retail and service sectors were still performing worse than the manufacturing and construction sector due to ongoing problems related to loss of customers, acquiring labour, supply and capital restrictions (Deitch and Corey, 2011). This pattern has also been confirmed in earlier studies such as the 2001

Nisqually earthquake where retail businesses experienced a significantly higher financial loss compared to other sectors (Chang and Falit-Baiamonte, 2002) and the 1989 Loma Prieta earthquake where retail and service sector businesses were also the most vulnerable (Kroll *et al.*, 1990).

In the case of Christchurch, it had a population of 376,700 in June 2010, and was New Zealand's second largest city, but the combined effects of the series of earthquakes and aftershocks during September 2010 to June 2011 led to a considerable fall in the City's population caused by a net outflow of residents. The working age population shrunk by around 28,000 and this number is likely to underestimate the full migration effects due to difficulties collecting this data in a post-disaster environment (Parker and Steenkamp, 2012).

As a result, customer numbers were dropping and the level of retail spending in the region was well below the national average (Potter *et al.*, 2015). Further, the impact of the Christchurch earthquakes was overly concentrated on the central business district, where the majority of firms were service providers in retail, hospitality, tourism and education. As a result, the following hypothesis has been developed:

Hypothesis 1a: For services firms, it is significantly more likely that a disaster has a negative impact on their resource base compared to manufacturing firms.

In relation to locality, previous research has predominantly focused on the effects of a disaster on businesses within the impact zone (Deitch and Corey, 2011; Webb, Tierney and Dahlhamer, 2000) and there is a lack of evidence on how firms outside the impact zone are affected. It is for example more likely that the physical resources (e.g. premises) of firms inside the impact zone are more negatively affected as a result of the immediate effects of a disaster. In contrast, firms outside the impact zone might be more likely to be negatively affected as a result of changes to customer demand or supply availability (Zhang, Lindell and Prater, 2009).

This suggests that a disaster can affect a firm's resource base even if it is not located within the impact zone.

Hypothesis 1b: A disaster can impact on a firm's resource base independent of their location within the impact zone or outside the impact zone.

It has been argued that small firms have more limited internal resources compared to larger firms and therefore fewer resources to prepare for disruptive events (Smallbone *et al.*, 2012). Webb, Tierney and Dahlhamer (2000) concluded in their review of research on the effect of disasters on businesses, that larger firms have a higher propensity to prepare for disasters as they have more resources available in terms of dedicated staff as well as finances. Further, small firms often rely on local and/or niche markets being highly dependent on a limited number of key customers as well as suppliers who are often small firms themselves (Smallbone *et al.*, 2012; Storey, 1994). As those relationships are often strong and long-established, they can be difficult to replace when lost as a result of a disaster. Small firms also often operate out of a single location and have fewer options to quickly relocate if necessary (Kroll *et al.*, 1990). While a disaster might cause a similar loss of resources for small and large firms alike such as for example that both have their physical premises destroyed, this resource loss might have a more negative impact on small, niche-focused firms due to lack of preparedness and/or difficulty replacing resources. As a result, the following hypothesis has been developed:

Hypothesis 1c: For smaller firms it is significantly more likely that a disaster has a negative impact on their resource base compared to larger firms.

Related to the above is the discussion of the relationship between firm age and resources. The limited empirical evidence that exists to date is on the relationship between firm age and recovery and it is inconclusive. While older firms were less likely to recover after Hurricane Andrew, age was not a significant predictor of recovery after the Loma Prieta

earthquake (Webb, Tierney and Dahlhamer 2002) or hurricane Katarina (Fraccastoro 2008). To our knowledge no empirical evidence exists on the relationship between firm age and the effects disasters have on the resource base of small firms. In light of the absence of previous research in this area, we draw on the liability of aging assumption to hypothesise this relationship. It states that as firms age, they establish structures, rules and routines that might lead to efficiency gains in stable environments. In highly volatile environments, however, these structures, rules and routines impede a firm's ability to act in a timely manner due to inertial forces (Aldrich and Auster, 1986; Barron, 1994; Ranger-Moore, 1997; Thornhill and Amit, 2003). The rapidity and flexibility in decision-making, however, has been emphasised as a key factor that determines how firms respond to disaster situations (Sullivan-Taylor and Branicki, 2011; Vargo and Seville, 2011). As a result, it could be argued that while older firms might have accumulated a larger and potentially more valuable resource stock, these resources might no longer be relevant in a disaster situation. Inertial forces might limit the firm's ability to adapt and they therefor experience the impact a disaster has on their resource base as more negatively than younger firms.

Hypothesis 1d: For older firms, it is significantly more likely that a disaster has a negative impact on their resource base compared to younger firms.

2.2 Relationship between dynamic capabilities, disaster-related changes to a firm's resource base and its performance

The concept of dynamic capabilities has evolved from the resource-based view (RBV) of the firm. The RBV argues that resources that are valuable, rare, imperfectly imitable and imperfectly substitutable (VRIN) are a source of competitive advantage, but it does not explain how these resources evolve over time and how they can be adapted to quickly changing environments (Barney, 1986; 1991). As a result, the RBV is only able to explain the importance of resources to the competitive advantage and performance of firms in stable

environments. The dynamic capability view addresses some of these shortcomings by focusing on a firm's capacity to renew and reconfigure its resource base in the light of changing environments (Ambrosini, Bowman and Collier, 2009; Eisenhardt and Martin, 2000; Teece, Pisano and Shuen, 1997). Helfat *et al.* (2007, p.1) define dynamic capabilities as a firm's capacity to 'purposefully create, extend and modify its resource base'.

This indicates that capabilities are built rather than bought in the market, embedded in the firm, repeatable and of strategic importance (Helfat and Peteraf, 2003). More specifically, capabilities are understood as organisational and managerial processes i.e. the firm's 'routines or patterns of current practice and learning' (Teece and Pisano, 1994, p.541) that enable it to change its resource base. Dynamic therefore refers to intentional change of the firm's resource base rather than the change in the environment (Ambrosini and Bowman, 2009).

Previous literature distinguishes predominantly two or three types of capabilities. The first type of capabilities describes the resource base itself i.e. the VRIN resources that are the foundation of a firm's ability to perform basic functional activities. This type has been labelled as first category capabilities (Collis, 1994), zero-level capabilities (Winter, 2003) or substantive capabilities (Zahra, Sapienza and Davidson, 2006). The second type are capabilities that allow for a more dynamic improvement through creating, modifying and extending the resource base. This type of capabilities has been labelled second and third categories (Collis, 1994), first-order capabilities (Winter, 2003) or dynamic capabilities (Teece, Pisano and Shuen, 1997; Zahra, Sapienza and Davidson, 2006). The third type of capabilities is referred to as meta-capabilities (Collis, 1994) or higher-order capabilities (Winter, 2003) and is characterised by learning-to-learn capabilities.

Ambrosini, Bowman and Collier (2009) propose a hierarchical model of dynamic capabilities. While the firm's resources are considered to be the foundation of the model they

are not a dynamic capability *per se* as in other typologies described above. According to Ambrosini Bowman and Collier (2009) dynamic capabilities consist of incremental, renewing and regenerative dynamic capabilities. Incremental dynamic capabilities are used to adjust and incrementally improve the resource base without changing the nature of the resources. While applying incremental dynamic capabilities might be sufficient in stable environments they are unlikely to sustain rent generation in dynamic environments. In this case, renewing dynamic capabilities allow creating new resources and therefore change the nature of the resource base of the firm. Regenerative dynamic capabilities are employed to change the firm's current set of incremental and renewing dynamic capabilities rather than its resource base. They become relevant in highly volatile environments where the existing capabilities to change the firm's resource base are no longer appropriate or sufficient to sustain rent generation. Regenerative dynamic capabilities are therefore about learning. Ambrosini, Bowman and Collier (2009) argue that different types of dynamic capabilities are needed depending on how stable or dynamic the environment is perceived. The model also highlights the need to renew the capabilities rather than just the resource base.

The following processes have been described as core dimensions of dynamic capabilities: reconfiguration, leveraging, learning, sensing and seizing, knowledge creation as well as knowledge integration (Ambrosini and Bowman, 2009; Ambrosini, Bowman and Collier, 2009; Eisenhardt and Martin, 2000; McKelvie and Davidson, 2009; Teece, 2007, Teece, Pisano and Shuen, 1997; Zahra and George, 2002; Zollo and Winter, 2002). According to Makkonen *et al.* (2014) reconfiguration, leveraging and learning represent regenerative dynamic capabilities while sensing and seizing, knowledge creation and knowledge integration represent renewing dynamic capabilities.

For the purpose of this article, two concepts from the organisational resilience literature are introduced to represent dynamic capabilities in a post-disaster environment: proactive

posture (Lee, Vargo and Seville, 2013; Stephenson, Vargo and Seville, 2010; Sullivan-Taylor and Branicki, 2011) and capability to integrate external resources (McManus *et al*., 2008).

2.2.1 Proactive posture as a regenerative dynamic capability

It has been argued that the strategic posture of an organisation determines its ability to respond to change and its level of innovativeness. Through its strategic posture, a firm interprets and responds to its environment by adapting its strategy to the changing requirements (Mintzberg, 1978; Porter, 1985). Sullivan-Taylor and Branicki (2011) argue that despite the flexibility and nimbleness of small firms, they do not have the necessary resource base associated with resilience suggesting that small firms need to be more proactive in their approach to disaster management. Proactive posture is defined as a firm's "*strategic and behavioral readiness to respond to early warning signals of change in the organization's internal and external environment before they escalate into crisis*" (Lee, Vargo and Seville, 2013, p34). A proactive posture allows for individual and collective learning (Larson and Fowler, 2009; Stern, 1997) that enables firms to be more innovative (Oezsomer, Catalone and Bonetto, 1997) and it was found to be a key determinant of recovery after a disaster (Lee, Vargo and Seville, 2013). In this study we argue that proactive posture corresponds with the learning dimension of dynamic capabilities (Bowman and Ambrosini, 2003; Zollo and Winter, 2002) which Makkonen *et al*. (2014) classify as a regenerative dynamic capability. As a regenerative dynamic capability, proactive posture does not directly impact on a firm's resource base, but changes 'how' firms operate e.g. through collaborating with external partners to acquire and develop new capabilities that allow them to position themselves favourably in a highly volatile environment. As a result, the following two hypotheses have been developed.

Hypothesis 2a - A firm's proactive posture positively affects its capability to acquire and integrate resources from external sources.

Hypothesis 2b – A firm's proactive posture mediates the relationship between its capability to acquire and integrate resources from external sources and the extent to which a disaster impacts on its resource base.

2.2.2 Resource integration as a renewing dynamic capability

In a disaster some firms might not be able to recover their resources or they find that the resources are no longer relevant in a significantly altered post-disaster environment. As a result, they might become reliant on external networks to help them access new resources to be able to effectively respond to and recover from the disaster (McManus *et al.*, 2008; Lee, Vargo and Seville, 2013). In an extension of the RBV approach, social capital is seen as a relational concept in which the extent of an entrepreneur's embeddedness in networks is a key factor in determining the acquisition of resources (Nahapiet and Ghosal, 1998). In this approach the entrepreneur is able to use networks to access a 'reservoir' of resources (Anderson and Jack, 2002, p.195). To what extent a disaster impacts on a firm's resource base might therefore depend on how well it is able to explore new opportunities by creating and mobilise this 'reservoir' of resources as part of an interdependent network. Hence, the current study considers a firm's capability to acquire and integrate new resources from external sources a salient part of the knowledge integration dimension of dynamic capabilities (Ambrosini, Bowman and Collier, 2009; Eisenhardt and Martin, 2000; Zollo and Winter, 2002). Knowledge integration has been defined as the "*capability to acquire and integrate new knowledge through external sources such as networks, also referring to the utilisation of social capital*" and represents a renewing dynamic capability (Makkonon *et al.*, 2014, p.2709). As a renewing dynamic capability it directly affects the firm's resource base i.e. the 'what' the firm experiences in relation to changes to customers, staff, supply or premises as a result of a disaster.

Hypothesis 3 - A firm's capability to integrate resources from external sources positively affects the extent to which a disaster impacts on its resource base.

<u>2.2.3 Relationship between disaster-related changes to a firm's resource base and its performance</u>

Previous research evidence on how disasters affect firm performance shows a rather inconsistent picture. Anecdotal evidence suggests that disasters result in a decline of performance as evidenced by significant numbers of closure and failure for businesses, usually shortly after the event. Tierney (2007) argues that performance changes as a result of a disaster can take many forms. A disaster does not necessarily need to lead to formal bankruptcy as a result of declining performance, but can also lead to what has been called "dead business walking" i.e. when the business operates at a significantly lower level than before the disaster, records a loss and has little prospect of continued viability. This points to the long-term and cumulative effects of a disaster on a firm's performance that are quite distinctive from the immediate and short-term effects of a disaster. Webb, Tierney and Dahlhamer (2000), however, found that most businesses, even those that were hard-hit, recover from a disaster. The performance of the vast majority of firms returned to pre-disaster levels, with a substantial number of businesses even reporting increased performance. Deitch and Corey's (2011) study on businesses in New Orleans post-Katrina found 75 percent of surviving businesses were doing as well or even better than pre-Katrina, with some doing outstandingly better. They conclude that to persevere under adverse conditions, a business needs enough resources. This can be interpreted that small business can make up some of the disadvantages of resource scarcity by rapidity of response and flexibility. If they manage to adapt quickly, they can seize the opportunity – if not, they are likely to run out of resources that are necessary for a recovery. This finding is in line with Ambrosini, Bowman and Collier's (2009) argument that it is the firm's resource base that is directly linked to its performance

rather than its dynamic capabilities. Changes to the firm's resource base due to a disaster are therefore likely to cause changes in performance.

H4 – The extent to which a disaster positively impacts on a firm's resource base affects its performance i.e. the more negative the disaster's impact on a firm's resource base, the more likely it is that the firm reported decreased performance.

2.3 Research model

The research model presented in Figure 1 depicts the formulated hypotheses. The model represents the relationship between regenerative (i.e. proactive posture) and renewing dynamic capabilities (i.e. resource integration), disaster-related changes to the firm's resource base and its performance in a post-disaster environment. It illustrates conceptually why some firms perform better than others despite them being affected by the same natural disaster.

--- Insert Figure 1 about here ---

3 METHODOLOGY

This study uses survey data from a 2011 nation-wide survey of SMEs in New Zealand. The study follows SME definitions that have been recommended for New Zealand (Cameron and Massey 1999): micro firms with up to five full-time equivalent staff numbers (FTE); small firms with six to 49 FTEs; and medium-sized firms with 50 to 99 FTEs. As of 2011, there were 468,283 SMEs in New Zealand (Ministry of Economic Development, 2011). Of these, 90 percent were micro-sized, 9 percent were small and one percent was medium-sized. With respect to industry, 31 percent represent the manufacturing sector (including construction) and 69 percent the services sector (including wholesale and retail, business, finance and property and other services).

The study followed Dillman's (2007) Total Design Method (TDM) in choosing the sample as well as in developing, designing, pilot-testing and administering the postal, self-

administered questionnaire. The actual survey was carried out over four mailouts between October and December 2011. The respondents to the questionnaire were owner-managers of the sample firms. Owner-managers specifically refer to individuals who have an ownership stake in the firms that they themselves manage in a variety of executive roles (e.g., proprietor, general manager, director or CEO).

The sample drawn is a stratified random sample of SMEs in New Zealand to allow comparison of different SME size groups and industry sectors.

The sample used in this study was derived from the Martins database, a commercial provider of business-to-business information in New Zealand. Martins offers the largest and most comprehensive business database in New Zealand that is constantly updated and offers a range of selection criteria.

The survey was sent to 3,527 firms and obtained 1,138 usable responses. The response rate of 32 percent is well above the minimum acceptable rate for this type of mail survey (Bartholomew and Smith 2006). To analyse response bias, Armstrong and Overton's approach (1977) was followed by comparing the answers of those respondents who completed the survey early with those who completed the survey late. The insignificant differences suggested that non-response bias was non-existent or too small for detection.

--- Insert Table 1 about here ---

This study utilises a subsample of 545 firms that reported being affected by the Christchurch earthquakes, but have survived long enough to be included in the study, to explore why some firms perform better than others despite having been affected by the same disaster.

About one fifth of firms are located within the impact zone. Half of the sample are small firms with between six and 49 employees. Thirty-six percent of firms are relatively young with

ages ranging from 0 to 20 years. Slightly more than half of the firms are engaged in manufacturing.

3.1 Measurement

Proactive posture (POST) and *Resource integration (INTEG)* were measured by selecting and adapting items from Stephenson, Vargo and Seville (2010) who has developed a model and benchmarking tool for organisational resilience. For *Proactive posture* five items were chosen to measure a firm's strategic and behavioural readiness to adopt, acquire and create new capabilities and resources to be able to respond to early warning signals of change in its internal and external environment. For *Resource integration*, five items were chosen to measure a firm's capability to acquire and integrate new resources from external sources in the event of a disaster. A five-point Likert scale was used ranging from 1-strongly agree to 5-strongly disagree. Items for both constructs are listed in Table 2.

Disaster-related changes to a firm's resource base (BASE) was measured by five items using a five-point Likert scale (1-strong positive impact, to 5-strong negative impact) that have been developed as part of this research. The items asked respondents how the Christchurch earthquakes have impacted on the firm's resources in terms of number of customers, staffing availability, staffing levels, use of premises and supply availability.

Firm performance (PERF) was measured by three items using a five-point Likert scale (1-strongly increased, to 5-strongly decreased) which asked respondents to indicate the firm's current performance (i.e., at the time of the survey) relative to that of the previous 12 months in terms of turnover, profitability, and productivity. These three measures of performance have been used repeatedly in previous studies to capture various facets of the multi-dimensional nature of firm performance (Darroch, 2005; Wang and Han, 2011).

Firm size (SIZE) refers to the total number of employees. *Firm age (AGE)* refers to the number of years a firm has been operating since inception. *Sector (SEC)* refers to whether

the firm is engaged in manufacturing (coded 1) or service activities (coded 0). Location (LOC) refers to the location of the firm inside the impact zone (coded1) or outside the impact zone (coded 0)

3.2. Data Analysis

Structural equation modelling (SEM) using a partial least squares (PLS) approach was used to test the hypotheses aided by the software called WarpPLS v. 2 (Kock, 2011). The PLS approach to SEM is a variance-based path analysis which has the capability to deal with complex models. Following Anderson and Gerbing's (1988) two-step approach to SEM, confirmatory factor analysis (CFA) was first performed on all of the constructs in order to examine the validity and reliability of the constructs used in the study (Brown, 2006). The second step involved the development and testing of the structural model in order to test the hypotheses.

4. FINDINGS

In this section we present SEM results to advance our understanding of the relations between the dynamic capabilities of a firm, the extent to which its resource base was affected by the earthquakes and its performance in a post-disaster environment. First, however, we present a brief descriptive overview of how the Christchurch earthquakes impacted on the resource base of small firms to provide a richer context to the SEM results.

4.1 Effect of the Christchurch earthquakes on the resource base of small firms

Overall, the results have highlighted some interesting differences and similarities in how the Christchurch earthquakes have impacted on small businesses in New Zealand.

Nationwide, 17 percent of respondents reported a negative effect on the firm's premises, but this number rose to 42 percent for firms within the impact zone. The majority of firms (79 percent), however, reported that their firm's premises were unaffected by the earthquakes, with only four percent reporting a positive effect.

Results suggest that the firm's market - through changes to its customer base – was the worst area affected with 44 percent of respondents reporting that the earthquakes had affected them negatively. At the same time, however, 23 percent reported a positive effect on their customer base indicating that that a disaster can have positive as well as negative effects on firms.

Further, 37 percent of firms reported that the earthquakes negatively impacted on the availability of supplies, four percent reported a positive effect and the remaining 59 percent were unaffected.

Fifteen percent of respondents reported that the earthquakes negatively impacted on staff availability, but this number rose to 28 percent for firms within the impact zone. A minority of six percent of respondents, however, reported positive effects on staff availability.

In relation to staffing levels, 13 percent of respondents reported that the earthquakes had negative effects and six percent reported positive effects with the remaining 81 percent being unaffected.

No industry effects were found suggesting that the disaster impacted equally on the resource base of services and manufacturing firms.

4.2 Relationship between a firm's dynamic capabilities, disaster-related changes to its resource base and performance

To test the hypotheses, SEM was used following Anderson and Gerbing's (1988) two-step approach. First, confirmatory factor analysis (CFA) was performed on all of the constructs

in order to examine the validity and reliability of the constructs used in the study (Brown, 2006).

--- Insert Table 2 about here ---

Details of the CFA in Table 2 show that all of the items measuring each of the four constructs loaded highly on the pre-determined factors (Brown, 2006).

The measurement model fits the data well, as shown by the significant loadings of items in their corresponding constructs at $p<.05$ with low cross-loadings, which indicates the convergent validity of the constructs. The values of Cronbach's α and composite reliability coefficients (CRC) were all above the minimum threshold of .70 (Bagozzi, Yi and Phillips, 1991; Fornell and Larcker, 1981).

Table 3 shows the correlations of the eight constructs and variables used in the succeeding analysis. The bold figures are the square root values of the AVEs of each construct. AVE[2] values that are higher than the correlation coefficient values of each construct relative to other constructs are indicative of discriminant validity (Bagozzi, Yi and Phillips, 1991; Fornell and Larcker, 1981).

--- Insert Table 3 and 4 about here ---

Finally, to address the common method variance problem, Harman's single factor test was performed (Harman, 1976). The results show that no single factor emerged and no factor accounted for more than 50 percent of the variance. These findings suggest that common method variance does not appear to be an issue in the current study.

Overall, the results of fitting the measurement model to the data suggest that the constructs used in this study have satisfactory levels of construct validity, internal consistency (i.e., reliability), convergent as well as discriminant validity.

The second step of Anderson and Gerbing's (1988) approach to structural equation modelling requires the development and testing of the structural model in order to test the hypotheses. The results of fitting the proposed structural models to the data are shown in Figure 2. The structural model shows the path coefficients of the relationships between a firm's proactive posture, its resource integration capability, the disaster-related changes to a firm's resource base and its performance as well as the coefficients of determination (r^2 values). It also shows the relationships of the variables of the study taking into account the effects of the control variables on the disaster-related changes to a firm's resource base.

--- Insert Figure 2 about here ---

The model shows the positive and significant effect a firm's proactive posture has on its capability to integrate resources from external sources (H2a) which in turn positively and significantly affects the extent to which a firm's resource base was affected by the earthquakes (H3). Results also show that a firm's proactive posture mediates the relationship between its capability to acquire and integrate resources from external sources and the extent to which a disaster impacts on its resource base (H2b). Firms, whose resource base was negatively affected by the earthquakes, reported significant performance decreases (H4). Of the control variables, only firm age has a positive and significant effect on how the earthquakes impacted on the firm's resource base (H1d). Older firms were therefore more likely to experience negative effects on their resource base. No location effects were found confirming H1b. Finally, results show that firm size and industry have no effects on the how the earthquakes impacted on the firm's resource base, rejecting H1a and H1c.

Proactive posture explains 59 percent of the variance of the firm's capability to integrate resources from external sources. The two dynamic capabilities along with the four control variables explain 17 percent of the variation in the firm's resource base, while the latter explains only three percent of the variations in firm performance.

A graphic analysis of the significant path coefficients using the 'warping' function of WarpPLS (Kock, 2011) shows the curvilinear relationships between the variables. As shown in Figure 3, the relationship between proactive posture and resource integration can be best described as quasi-linear i.e. the stronger a firm's proactive posture, the better its capability to integrate resources from external sources. The relationship between the firm's capability to integrate resources and the extent to which the firm's resource base was affected by the earthquakes is, however, slightly j-shaped. This indicates that initially the effects are rather flat, but then drastically increase suggesting cumulative or learning effects supporting a case for dynamic capabilities and positive relationship with firm performance. The relationship between the extent to which a firm's resource base was affected by the earthquakes and its performance is s-shaped. Firms that experienced positive effects on their resource base increased their performance, but firms that experienced negative effects decreased their performance. At a certain point, however, this effect reverses suggesting that those firms that were the worst affected were able to increase their performance. This suggests that depending on the extent of the negative effect the earthquakes had on the resource base of firms, the performance changes were different. Finally, the relationship between age and a firm's resource base showed an inverted u-shape indicating the extent to which the firm's resource base is negatively affected by the earthquakes increases as the firm matures, but then flattens and curves downward after it reaches a certain point.

--- Insert Figure 3 about here ---

5 DISCUSSION

The current study aimed to gather empirical evidence on the relationship between dynamic capabilities, disaster-related changes to a small firm's resource base and its performance in a post-disaster environment.

For the purpose of this study, dynamic capabilities have been defined as renewing and regenerating dynamic capabilities following Ambrosini, Bowman and Collier's (2009) model. While the firm's proactive posture represented the learning dimension of regenerative dynamic capabilities, resource integration represented the knowledge integration dimension of renewing dynamic capabilities (Makkonen *et al.*, 2014). Resource integration has received less attention as a dynamic capability compared to for example learning. As small firms have limited resources, networks are particularly important for them (Eriksson, 2014). Resource integration from external sources is therefore an essential element of a small firm's strategy to survive and recover from a disaster situation in which internal resources might not be readily available. Results show that proactive posture helps small firms to manage the resource integration and resource integration in turn affects the extent to which a disaster impacts on a firm's resource base. This corresponds with Voudouris *et al.* (2012) who argue that for small firm to be able to effectively integrate networks resources, they need to have learned how to manage this integration process.

Results further support the view that dynamic capabilities enhance the firm's performance via its resource base (Ambrosini, Bowman and Collier, 2009; Teece, 2012) rather than directly. This clearly demonstrates that higher level managerial or entrepreneurial competences place the firm in a better position to deal with a rapidly changing economic environment such as that associated with post-disaster environments. The extent to which small firms can respond to new opportunities created by changes to their resource base, depends on their dynamic capabilities. Through dynamic capabilities small firms can capitalise on their flexibility and offset some of the challenges associated with limited resources. Consequently, dynamic capabilities are important for small business resilience and recovery in post-disaster environment.

The research model developed in this study tests regenerative and renewing dynamic capabilities. Building on the existing body of literature on dynamic capabilities, the findings

have contributed to our understanding of the conceptual distinction between regenerating and renewing dynamic capabilities by using a multidimensional construct of dynamic capabilities. As a conceptual model that has not yet been applied in a post-disaster environment, no relevant empirical measures were available. Consequently, two adapted measurement scales have been introduced from the organisational resilience literature (Lee, Vargo and Seville, 2013; Stephenson, Vargo and Seville, 2010) to allow measuring dynamic capabilities in a novel context.

Results clearly showed that a disaster can have negative as well as positive effects on firms illustrating that post-disaster environments can be interpreted in the light of Schumpeter's creative destruction. Contrary to previous research, however, no industry and firm size effects were found on how the Christchurch earthquakes affected customers, supply availability, use of premises, staffing availability and staffing levels. This suggests that the earthquakes impacted equally on firms from the manufacturing and services sectors. This result cannot necessarily be put down solely to the nature of the hazard, as previous studies in earthquake-hit regions have consistently pointed towards the service sector being more negatively affected (Chang and Falit-Baiamonte, 2002; Deitch and Corey, 2011; Dolfman, Wasser and Bergman, 2007; Kroll *et al.*, 1990).

One possible explanation is that the distinction between manufacturing and services industry was too broad to pick up more subtle sub-sector dynamics. However, it could also be argued that it is the entrepreneur's perception of the environment together with the extent and nature of a firm's dynamic capabilities that influences how the effects of a disaster are experienced. While the impact of a disaster might be the same on manufacturing and services, smaller and larger firms, the individual experience and perception of this impact might have been different depending on how well-equipped the firm is to change and adapt. In other words, while one firm might perceive the glass to be half full, the other one perceives it to be half empty. How small firms perceive the impact of a disaster depends to a

considerable extent on their ability to change and adapt i.e. their dynamic capabilities. This confirms the importance of the manager's or entrepreneur's perception of environmental volatility (Ambrosini and Bowman, 2009; Teece, 2007). Similar firms can therefore deploy different dynamic capabilities as a result of differences in their managers' perception of environmental uncertainties (Aragon-Correa and Sharma, 2003).

Results further demonstrate the wide-reaching effects of a disaster. In the literature it has been argued that it is possible for a business outside the impact zone to be more affected than those inside the impact zone if they are involved in a vulnerable sector or vulnerable supply chain (Zhang, Lindell and Prater, 2009). Previous research, however, predominantly focused on the effects disasters have on businesses inside the impact zone. Results from this study suggest that a disaster has wide-ranging knock-on effects on firms outside the impact zone. While this finding is not necessarily new, it is the scale of the indirect impact that is surprising. Forty-five percent of firms outside the impact zone reported negative effects of the earthquakes on customers. Similarly, roughly one third reported negative effects on supply availability. This finding illustrates the complex, dynamic and fragile nature of a firm's relationship with its market and environment.

The age related effect confirms the existence of a liability of aging indicating that older firms perceived the impact the disaster had on their resource base to be more negative than younger firms (Aldrich and Auster, 1986; Barron, 1994; Ranger-Moore, 1997; Thornhill and Amit, 2003). While older firms might have developed more valuable resources, they are also more likely to have established structures, rules and routines that allow them to generate efficiency gains in stable environments. In highly volatile environments, such as post-disaster environments, these structures may however lead to inertia and reduce the business ability to respond and adapt quickly and flexibly. As a result, older firms experience the impact a disaster has on their resource base as more negatively than younger firms.

6 CONCLUSIONS

Business recovery from a natural disaster is extremely important in relation to providing jobs, goods and services as well as tax income (Cochrane, 2004). The ability of a firm to mobilise resources is a key factor in its capability to cope with extreme events (Weick and Sutcliffe, 2011). This suggests that the dynamic capabilities view of the firm has the potential to greatly enhance our understanding of firm recovery and growth in post-disaster environments. Surprisingly though, the dynamic capabilities concept has not yet been applied in studies of small firm recovery in post-disaster environments.

This article has presented empirical research evidence on the role of dynamic capabilities in a post-disaster environment, that of Christchurch in New Zealand after the 2010 and 2011 series of major earthquakes. The earthquakes are still comparatively recent with the last major event in December 2011 and the full long term effects will take up to 10 years to materialise, assuming no further major events. Based on a research model, it demonstrates that a firm's dynamic capabilities impacts on the extent to which it experiences negative or positive effects on its resource base and consequently on its performance. Results highlight the importance of a firm's proactive posture and capability to integrate external resources in recognising new opportunities in an environment characterised by high volatility and increased uncertainty.

Several practical recommendations for small firms arise from this study: The most important one is to proactively prepare for disaster situations. This includes developing an understanding of how the firm is connected with customers, suppliers and other businesses in the neighbourhood and what they key resources are that the firm relies upon for survival. Further, it is important for small firms to understand how they can mobilise and access the resources they need. Active participation in industry or business networks might assist with this task. Finally, business owners might benefit from critically assessing their ability to quickly

adapt as well as their ability to identify and exploit new opportunities to strengthen their adaptive behaviour.

6.1 Limitations and future research

However, the authors recognise a number of limitations. First, the current study uses proactive posture and resource integration to represent renewing and regenerating dynamic capabilities in a post-disaster environment. Results, however, suggest that there might be other capabilities and mechanisms that affect the extent to which a firm's resource base is affected by a disaster. Second, the study only measured a firm's capability to acquire and integrate new resources from external sources, but did not take into account the nature or type of these resources and external sources. Third, the cross-sectional nature of the current study is rather limited in its ability to capture the incremental and long-term impacts of dynamic capabilities on a firm's resource base and performance. Finally, as with much of the post-disaster research, survivor bias requires careful interpretation of results. The study is based on a sample of firms that have been struck by a disaster and have survived long enough to be included in the study. As a result, the findings might be overly optimistic in relation to the extent to which firms recover from disaster. It has to be stressed that the results represent only *surviving* small firms. Firms that have experienced very strong negative impacts may have closed or relocated. This is an inevitable bias with much of the post-disaster research and results need to be carefully interpreted in the light of this survivor bias.

Nonetheless, these limitations can be addressed in future studies dealing with dynamic capabilities of small firms in a post-disaster environment. There is a general scarcity of research of this nature particularly on businesses as the unit of study. This article contributes to that limited research evidence. There remains, however, a need for further research in post-disaster environments including longitudinal research – both qualitative and quantitative - that examines the specific adaptive strategies firms have used and how they

changed over time. Also, future research would benefit from including small firms that did not survive as is likely that the factors that contribute to recovery are different from the factors that contribute to closure. Finally, post-disaster research will remain challenging due to the specific context that is required. Defining a research agenda that builds on the emerging, but fragmented empirical evidence will contribute to a better theoretical understanding of the role of small firms in post-disaster environments.

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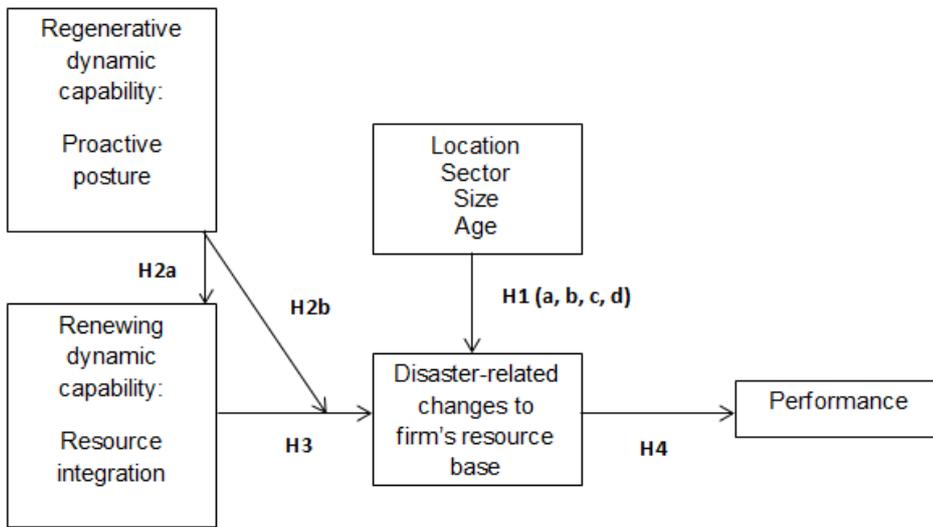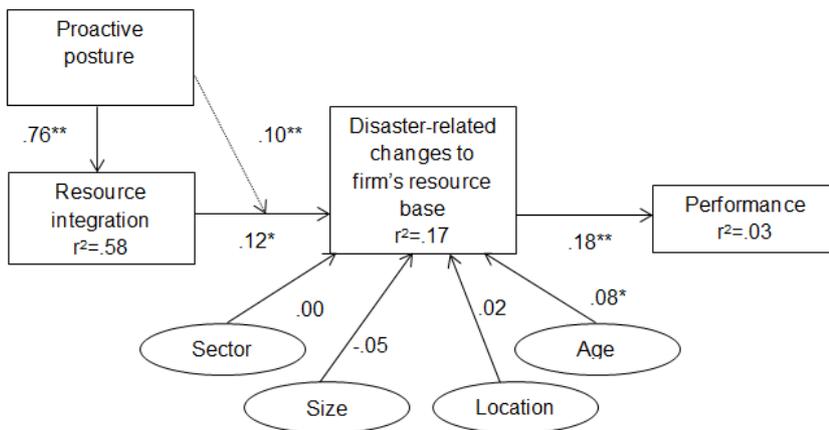Figure 1. Research model

Figure 2. Structural model

Goodness of Fit Indicators:
Average Path Coefficient (APC), p-values = .19, p<.001
Average R-squared (ARS), p-values = .26, p<.001
Average Variance Inflation Factor (AVIF) = 2.8

*p<.05; **p<.01
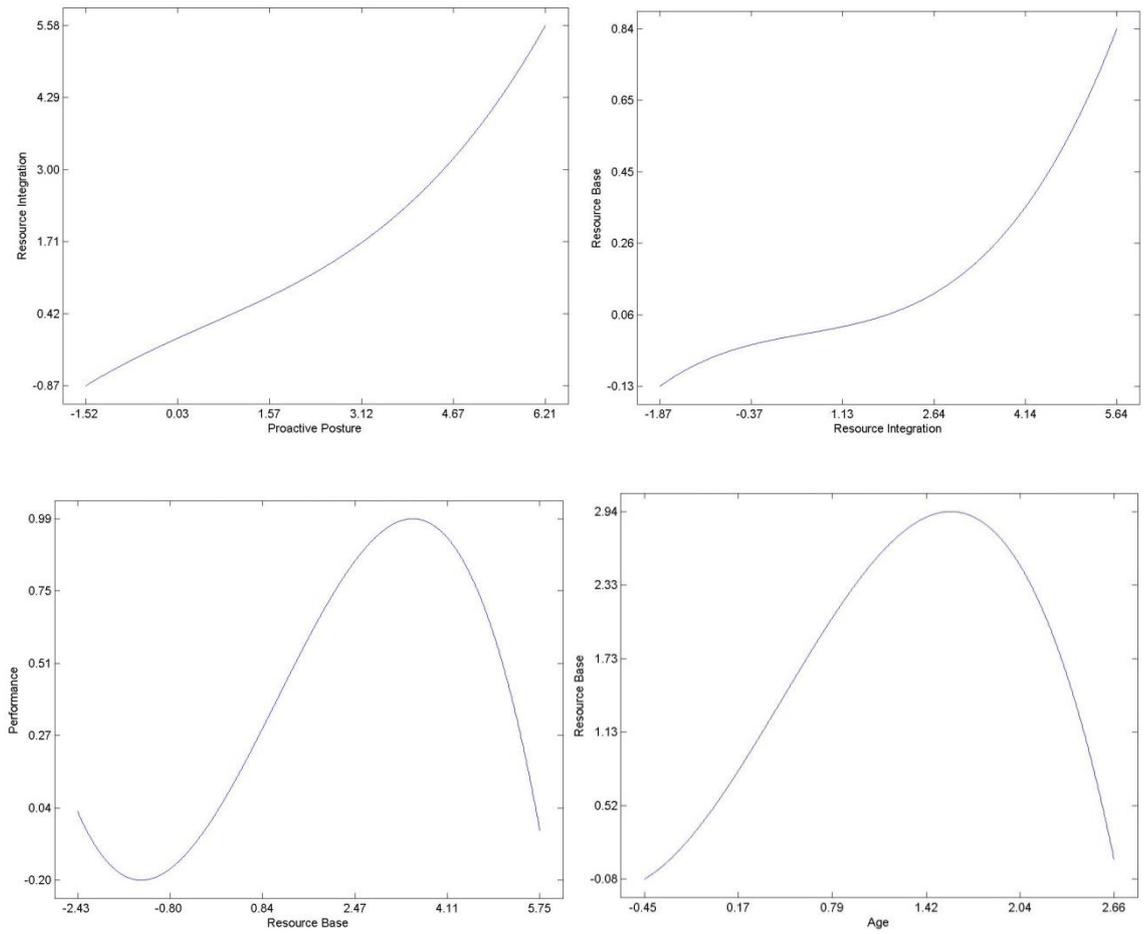
Figure 3. Illustration of relationship between variables

Table 1. Characteristics of the sample firms

Firm size		*f*	*%*
5 employees and less		*235*	43
6 to 49 employees		*279*	51
50 to 99 employees		*31*	6
	Total	*545*	100
Firm age		*f*	*%*
10 years and younger		*61*	11
11 to 20 years		*137*	25
21 years and older		*347*	64
	Total	*545*	100
Sector		*f*	*%*
Manufacturing		*288*	53
Service		*257*	47
	Total	*545*	100
Location		*f*	*%*
Inside impact zone		*98*	18
Outside impact zone		*447*	82
	Total	*545*	100

Table 2. Measurement model

Constructs and indicators	Standardised factor loadings
Proactive posture (ave = .67)	*α = .88 CRC=.91*
We are able to shift rapidly from business-as-usual mode to respond to a disaster.	.79
We are focused on being able to respond to the unexpected.	.89
Whenever we suffer a close call, we use it as a trigger for self-evaluation rather than confirmation of success	.78
We have clearly defined priorities for what is important during and after a disaster.	.83
We clearly understand the minimum level of resources it needs to operate successfully.	.83
Resource integration (ave = .68)	*α = .88 CRC=.91*
We actively participate in industry and sector groups.	.81
We collaborate with others in our industry to manage unexpected challenges.	.85
We have agreements with other organisations to provide resources in a disaster.	.82
We keep in contact with organisations that we might have to work with in a disaster.	.82
We understand how we are connected to other businesses in the same industry and location, and actively manage those links.	.83
Disaster-related changes to firm's resource base (ave = .63)	*α = .84 CRC=.89*
Customers	.54
Staffing availability	.88
Staffing level	.91
Premises	.86
Supply availability	.78
Firm performance (ave = .66)	*α = .74 CRC=.85*
Turnover	.87
Profitability	.86
Productivity	.70

Legend:
AVE – average variance extracted
α – Cronbach's alpha
CRC – composite reliability coefficient

Table 3. Means, standard deviation and correlations of variables

Constructs and variables	Mean	SD	POST	INTEG	BASE	PERF	SIZE	SEC	AGE	LOC
Proactive posture (POST)	2.55	.70	**.82**							
Resource integration (INTEG)	2.91	.68	.74**	**.83.**						
Disaster-related changes to firm's resource base (BASE)	3.2	.47	.33**	.34**	**.79**					
Performance (PERF)	2.8	.78	.18**	.11*	.12*	**.81**				
Size (SIZE in number of staff)	13.93	24.65	-.07	-.08	-.02	-.16	**n/a**			
Sector (SEC)	-	-	.04	.02	-.01	-.08	.05	**n/a**		
Age (AGE in years)	28.52	19.91	.03	.01	.04	.02	.01	.02	**n/a**	
Location (LOC)	-	-	.06	.01	-.01	-.04	.06	-.06	.02	**n/a**

*p<.05; **p<.01*
n/a – *not applicable/not a construct*

Table 4: Direct, indirect and total effects

	Direct effects	Indirect effects	Total effects
Proactive posture -> Resource integration	.76**		.76**
Proactive posture -> Resource base	.29**	.10**	.39**
Proactive posture -> Performance		.02	.02
Resource integration -> Resource base	.12*		.12*
Resource integration -> Performance		.02	.02
Resource base -> Performance	.18**		.18**
Size -> Resource base	-.05		-.05
Sector -> Resource base	.00		.00
Age -> Resource base	.08*		.08*
Location -> Resource base	.02		.02
Size -> Performance		-.01	-.01
Sector -> Performance		.00	.00
Age -> Performance		.01	.01
Location -> Performance		.00	.00

	Direct effects	Indirect effects	Total effects
	.76**		.76**