Effects of Extreme Weather Events on SMEs: A Literature Review and Synthesis

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Abstract:
Small and Medium-scale Enterprises (SMEs), which generate more than one half of the employment (58.9%) and turnover (51.9%), form an important sector of the UK economy. Although they are the main drivers of the UK economy, they are also said to be the most vulnerable to the impacts of Extreme Weather Events (EWEs). The world in recent years has experienced a significant number of EWEs, and SMEs have suffered significant economic losses as a result. The now apparent climate change, which is mostly attributed to human interference with the environment over the past few decades, is believed to have a strong link with the increase of EWEs in the recent past. Threats of EWEs are expected to further increase due to their increased frequency and magnitude and increased vulnerability to their effects. Interestingly, EWEs seem to present businesses with various business opportunities and positive consequences as well, besides the much feared and overwhelming threats and negative consequences they present. Understanding such impacts has become a necessity to improve the resilience of SMEs so that they will be better prepared to minimize the negative consequences and maximize the positive consequences posed by EWEs. This paper attempts to bring together and evaluate the current knowledge with regard to the effects of EWEs on SMEs. The paper establishes the case for more in-depth study with this regard and concludes by stressing the need for improving the resilience of SMEs to EWEs.

Keywords:
Business failure, Climate change, Extreme Weather Events, SMEs

1 Introduction

The world in recent years has witnessed increases in the intensity and frequency of EWEs (Beniston and Stephenson, 2004; Thibault and Brown, 2008). Evidence shows that there has been a long-term upward trend in the number of EWEs since the latter part of the 20th century (Munich Re, 2006), which has experienced over 170 "billion-dollar events" related to weather extremes, in particular windstorms, floods, droughts and heatwaves (Beniston and Stephenson, 2004). There is wider speculation that this increased intensity and frequency of EWEs is primarily due to intensified climate change and that there is a strong link between the two (Stern, 2007). Thus, EWEs are expected to further increase in number and severity in future, due to the impacts of climate change (Environment Agency, 2005; Munich Re, 2007; Stern, 2007).

These EWEs can produce severe impacts on society and the environment (Easterling et al, 2000b; Nicholls and Alexander, 2007). Recent years have seen a number of weather events causing large losses of life as well as a tremendous increase in economic losses (Easterling et al, 2000a). Consequently, the cumulative economic and social costs of extreme weather related events have been increasing around the globe (McBean, 2004; Tompkins, 2002). Munich Re group (2006, 2008) confirms that economic and insured losses due to EWEs have gradually increased over the last few decades, after analysing data since 1950. Figure 1 shows the overall and insured losses due to "great weather disasters" (events with high overall monetary losses and/or with a large human impact) since 1950, which confirms the trend of increasing losses due to weather related disasters.

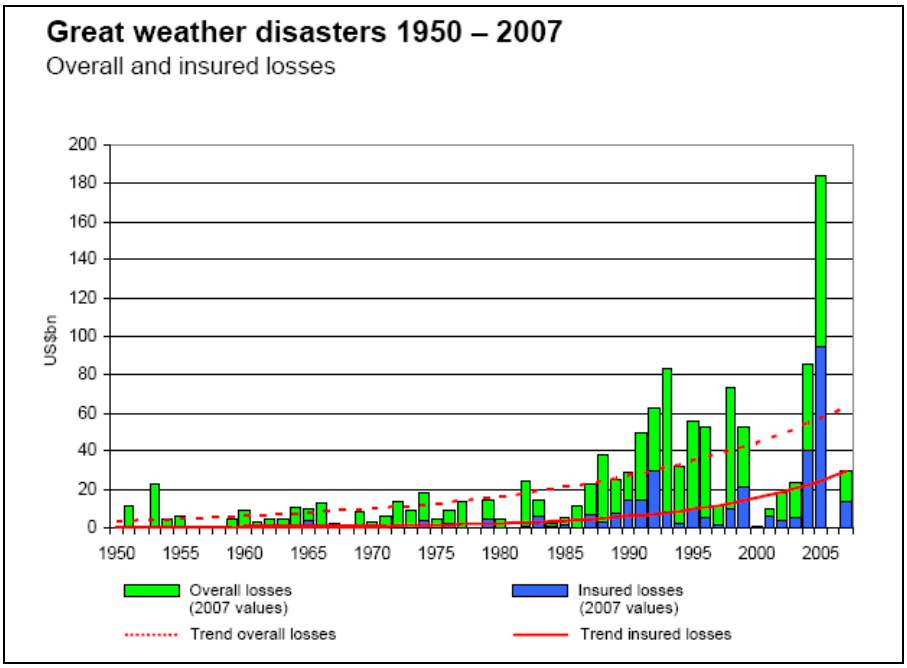

Figure 1. Overall and insured losses due to great weather disasters since 1950 (Source: Munich Re NatCatSERVICE, 2008)

Although many tend to attribute the increased costs primarily to increased intensity and frequency of EWEs, some argue otherwise. McBean (2004) puts forward that there is some debate over how much of this past increase has been due to social factors and how much due to changes in frequency or characteristics of extreme events. Kunkel et al (1999) argue that the increasing losses are primarily due to increasing vulnerability arising from a variety of societal changes, including a growing population in higher risk coastal areas and large cities, more property subjecting to damage, and lifestyle and demographic changes subjecting lives and property to greater exposure. Therefore it seems that both the increased vulnerability and increased number of EWEs have contributed towards the increased costs.

Despite the presence of debate as to what are the exact causes, it is evident that society as a whole has become more prone to suffer the effects of EWEs both economically and socially. SMEs, being a major stakeholder in any economy, also have to suffer the effects of EWEs, perhaps at a higher magnitude than their larger counterparts. Therefore, it has become a necessity to improve their resilience to EWEs. First it is required to obtain a greater understanding of the effects of EWEs on SMEs in order to arrive at ways and means of coping with them successfully.

This paper presents a literature review on effects of EWEs on SMEs, with the aim of obtaining a background understanding of such effects. The objectives of the paper are to establish the need to focus on SMEs with regard to EWE impacts and to identify their effects. The paper is organised in such a way to facilitate achieving these objectives. First, the need to focus on SMEs is established before going on to discuss the effects created on them by EWEs. Thereafter both the negative and positive effects of EWEs are discussed and the directions for future research are identified. Finally, the conclusions drawn are presented.

2 Why Focus on SMEs?

SMEs constitute the majority of business establishments responsible for the majority of jobs created and account for one-third to two-thirds of the turnover of the private sector in any economy (Gibb, 2004). In the UK, 99.9% of private sector enterprises are SMEs and they account for more than one-half of employment and turnover (BERR, 2007b). Statistically, SMEs have generated 52% of turnover and 59% of employment in the year 2006 (BERR, 2007a). SMEs are thus considered as the backbone of the UK economy (Crichton, 2006; Lukacks, 2005) due to their significant economic importance.

SMEs create entrepreneurial spirit and innovation and thus are crucial for fostering competitiveness (European Commission, 2006). Tilly and Tonge (2003) state that SMEs make important contributions to the UK economy in terms of technological progress, increased competitiveness, creation of new jobs and the economic revival of certain regions. Furthermore, SMEs are often said to contribute to a more equal distribution of income and wealth (Hallberg, 2000). They often represent the early stages of large enterprises, which grow further to reach a higher level. All these factors add more weight to the economic importance of SMEs.

Despite their significant economic importance, SMEs are considered as the most vulnerable section of the UK economy to the impacts of extreme weather (Crichton, 2006). Their vulnerability arises virtually by definition from the small scale of their human and financial resources (Bannock, 2005). Therefore, while extremes affect both large firms and SMEs equally, they may affect SMEs disproportionately hard (Finch, 2004; Tierney and Dahlhamer, 1996). On the other hand, since a majority of SMEs are local in their operations and rooted in local communities (Bannock, 2005), their owners are often hit twice by EWEs; as local citizens and as business owners (Runyan, 2006).

Added to the increased vulnerability, previous studies show that many small businesses are ill-prepared for recovery after a disaster (Yoshida and Deyle, 2005). Thus, SMEs may have to face severe consequences if and when they are affected by an EWE. In fact, Cumbie (2007) avows that they are highly vulnerable to failure after a disaster. A previous study (Wenk, 2004) states that 43% of companies experiencing a disaster never reopen, and that 29% of those remaining close within two years. The economic impacts associated with such business failures will undoubtedly be substantial. While the loss of an individual SME may not cause a significant impact on the local economy in terms of the earnings it generates or the number of people it employs, the collective losses of a number of small businesses from natural disasters may devastate a local economy (Yoshida and Deyle, 2005). Despite the presence of these issues, disaster management literature has not dealt in depth with small business response to disasters (Alesch et al, 2001; Runyan, 2006; Tierney, 1994). Thus, the combination of all these: significant economic importance of SMEs; their increased vulnerability to EWEs; and dearth of research focused on SME resilience to EWEs, justify the focus on SMEs.

3 Effects of EWEs on SMEs

Though the effects of EWEs tend to be negative in many obvious ways, for some systems in some areas, extreme events are beneficial (Meehl et al, 2000). This is the case with businesses as well. Thus it is intended to discuss both the negative and positive effects of EWEs here. Most of these impacts are drawn in from climate change and disaster studies as only a very few number of studies are available with regard to EWEs and businesses.

3.1 Negative effects on SMEs

A recent report by Heliview Research (2008) reveals increase in total cost and decrease in turnover as the main negative consequences suffered by European businesses due to EWEs in the year 2007. It further reveals damage to buildings and other tangible assets, productivity losses, extraordinary costs and less profit as the other main negative consequences. Figure 2 shows the findings of the study with regard to negative consequences experienced by businesses in 2007. More importantly, the study has enabled the identification of a range of negative impacts that EWEs create on businesses, in a European context.

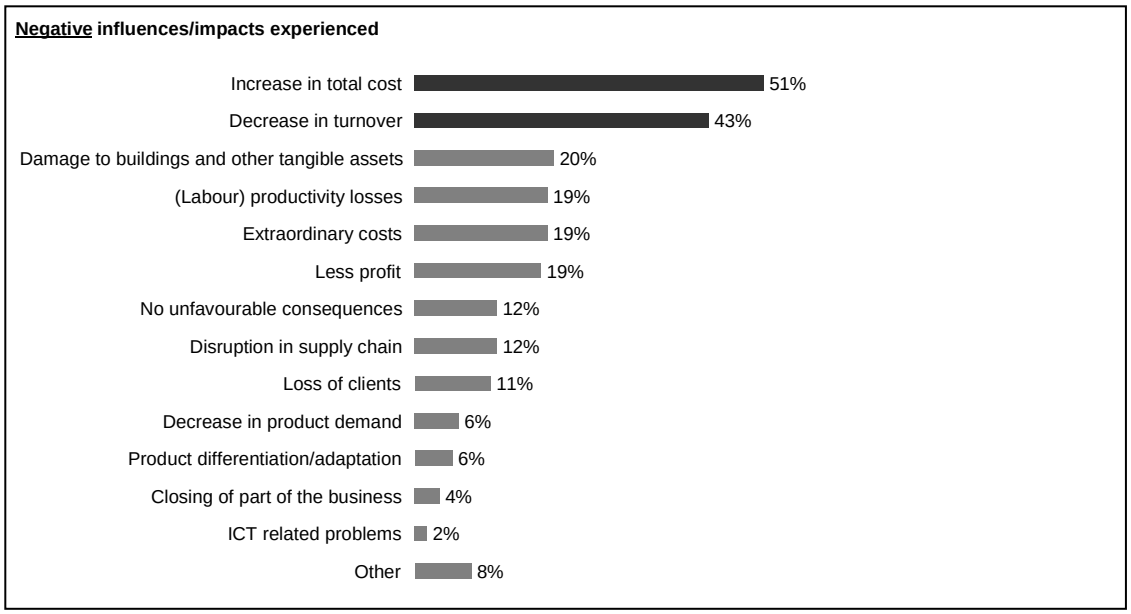

Figure 2. Negative influences experienced by businesses due to extreme climate events.
(Source: Heliview Research, 2008 pp 17)

Burnham (2006) also reveals increased costs and loss of revenue as the main risks that the businesses have to suffer due to EWEs. Increased costs may arise in many different ways. These may include, but are not limited to, higher costs of transportation, costs of alternate supply of goods and services, costs of premises improvements/relocation etc. On the other hand, SMEs may have to forgo sales revenue due to business shutdown, reduced sales, productivity losses etc. They may also have to suffer increased costs and loss of sales revenue due to the vulnerability of the supply chain, utilities and transport infrastructure (Burnham, 2006; Tierney, 1994). Businesses may not be able to receive supplies in time and may not be able to deliver goods on time due to the effects of EWEs such as flooding, storms and extreme rains.

Another recent study conducted on behalf of Climate South East (Norrington and Underwood, 2008) reveals that damage to property/stock and reduced customer

visits/sales are the most experienced negative EWE impacts by South East SMEs in the past two years. Furthermore, it is now widely agreed that the risks of blackouts and damage to property and inventory from EWEs are increasing (AXA Insurance UK, 2008). Damage to business premises or contents can affect the ability of a business to survive, not only because of lost sales or lost production hours, but also because of increased costs such as alternative premises, overtime etc (Association of British Insurers, 2008). Furthermore, damage to property may create business disruptions, eventually giving rise to more costs. The impacts of business interruption include the costs of replacing or repairing the assets, the loss of revenue during the disruption period as a result of inability to produce and sell particular products and complementary products, and loss of revenue from all products due to perceived loss of quality etc (Aba-Bulgu and Islam, 2007). For an SME, these costs can be substantial.

On top of the initial direct loss of cash flows, SMEs may also experience other forms of crises such as loss of market share, loss of key personnel, loss of production efficiency, withdrawal of supplies, withdrawal of licences, and loss of quality/standard accreditation and so on (Aba-Bulgu and Islam, 2007). Tierney (1997) puts forward that, in addition to direct physical impacts and the interruption of critical utility services, disasters cause business losses by affecting productivity in other ways, for example, by disrupting customer traffic and causing problems for employees. It is further revealed that losses escalate when employees cannot come to work because of transportation and other problems, when owners must suddenly cope with losses both at home and within the business, when customers cannot purchase goods and services, and when the flow of supplies and materials is disrupted.

EWEs driven by climate change such as extreme temperatures, extreme rainfall etc, may create decreased demand for certain goods and services. Loss of traditional markets, loss of local competitive advantage and new competition in existing markets for agriculture sector industries can be cited as an example (Metcalf and Jenkinson, 2005). Some regional industries may suffer due to the enhanced position of competitors in other regions. SMEs operating in such vulnerable business activities may be adversely affected. Businesses which do not apply adaptive measures against weather extremes may face the risk of attracting and retaining staff due to their reputation as a poor employer (Metcalf and Jenkinson, 2005). Furthermore, climate change impacts might result in the relocation of workers, or changes in commuting patterns (London Climate Change Partnership, 2002). Businesses may face problems with regard to these issues.

Difficulty in securing finance and obtaining insurance cover at reasonable cost are also negative effects that SMEs may have to face (Metcalf and Jenkinson, 2005). The investors and credit suppliers will be reluctant to supply finance (Metcalf and Jenkinson, 2005) and the insurers will quote a higher premium for cover if the possibility of damage to a business due to an EWE is high (Dlugolecki, 2004). Further to that it is expected that the insurance premiums that deal with weather losses will increase in general due to the increased risk of EWEs (Association of British Insurers, 2005). In addition to the costs of higher premiums, this might cause another severe risk to SMEs. As the costs are high, they may tend to underinsure their assets, leaving them vulnerable to further losses in case of an EWE, hence creating a vicious cycle. AXA insurance (2008) reveals that 90% of small businesses are underinsured even now. SMEs may tend to further underinsure their assets due to higher insurance costs. The businesses, particularly SMEs in which the power of negotiation is less when compared with large-scale organizations, will have to suffer losses because of these reasons.

Alesch et al (2001) have found that only the weakest small businesses fail right after a disaster. They reveal that many owners continue to struggle to recover until, one by one, their resources, energy, and their options are exhausted, leading to more economic and social losses. Therefore, EWE-struck SMEs who struggle to recover but fail ultimately may have to suffer further losses in addition to their initial ones.

The above discussion conceals some of the negative impacts that SMEs may face due to EWEs in general. The amount of losses suffered by individual organizations may vary to a great extent depending on many factors. As an example, Webb et al (2002) state that businesses in crowded, highly competitive, and relatively undercapitalized economic niches appear to have the most serious problems. Alesch et al (2001) point out that the initial losses experienced by a small business depend on four factors: exposure; vulnerability; intensity and the duration of the event; and amount of warning time available. Furthermore, the effects may vary according to the type of EWE and the industry sector that it operates in and the locality (Metcalf and Jenkinson, 2005). Thus, it is necessary to identify these impacts on a case by case basis.

3.2 Positive effects on SMEs

Certain weather extremes may present businesses with new business opportunities. Extreme high temperatures such as the 2003 heatwave are expected to give rise to opportunities such as pavement cafes, fiestas, and higher sales of food and drink products (Metcalf and Jenkinson, 2005). Furthermore, consumer behaviours may change significantly due to their perceptions regarding weather changes. Changing markets, customer needs and investor expectations will present significant opportunities for businesses (Firth and Colley, 2006). Specific industries like flood defence and environmental services may be affected favourably due to the EWE. Industries like construction will also benefit from extreme weather, due to the increased need for reconstruction and more robust structures (Dlugolecki, 2004). Although such increased demand is seen as a positive consequence, excessive demand over and above the normal production capacity may also create some problems. For an example, Ingirige et al (2008a) mention that excessive demand for reconstruction in Sri Lanka after the impact of the South Asian tsunami in 2004 fuelled inflationary price increases within the whole industry. Thus the SMEs will have to be careful of such effects associated with demand increases after an EWE.

Webb et al (2002) state that because disasters produce reconstruction booms and allow community improvements to be made rapidly, rather than gradually, they create windows of economic opportunity. Citing Skidmore and Toya (2002) they further declare that “recent cross societal research on the macroeconomic impacts of disasters suggests that climate-related disasters have long-term positive economic consequences related to physical capital, human capital, and productivity”. Thus, SMEs will also benefit from rapid economic developments in the locality, if it is in a position to capitalize on the favourable conditions.

SMEs who successfully survive an EWE may experience increased customer loyalty, new customers, cost savings and additional sources of revenue (Holmes, 2006). They may also be able to enjoy enhanced staff attraction and retention by improving working conditions for staff by climate proofing the work premises and ensuring that the premises are comfortable to work in (London Climate Change Partnership, 2005). Furthermore, a well-resilient business against probable EWEs will be able to enjoy reduced insurance premiums, secured investment opportunities and stakeholder reputation, all of which contribute towards business success.

Alesch et al (2001) have found that the weaker small businesses tend to fail right after a disaster. They also reveal that many small firms on the edge of failure often tumble when the event strikes, even if they only suffer marginal damage. Businesses making losses may also be triggered by EWEs and consider moving or closing even without suffering damages. From an economist's point of view, the failure of such firms will reduce further unnecessary costs to both the owners and society. Thus it can be regarded as an indirect benefit for the business owners as well, as they can avoid further losses.

Metcalf and Jenkinson (2005) have identified a range of threats and opportunities created by climate change on businesses under seven major elements of a business. Some of the impacts identified in the report are related to EWEs. Table 1 show the EWE related impacts extracted from their report.

Table 1. Threats and opportunities to businesses arising from EWEs

(Adapted from: Metcalf and Jenkinson, 2005)

Business area	Threats	Opportunities
Logistics	• Vulnerability of supply of goods and services • Disruption to utilities • Vulnerability of transport and delivery systems	• Maintaining supply and transport of goods and services through awareness and adaptation planning • Creating secure systems of water storage and electricity generation on site
Finance	• Difficulties in securing investment and/or insurance cover at reasonable cost • Potential liabilities if EWE risk is not factored into long-term decisions	• Reputation with all stakeholders • Security for investment • Reduced insurance premiums
Markets	• Decreased demand for certain products • Competitors' position enhanced by weather extremes	• New products or modifications to existing ones • Become an early mover in response to changing markets
Process	• Increased difficulties or entirely new problems due to extreme temperatures, storms, and rain	• Some aspects of production process or service delivery made easier specially due to temperature extremes
People	• Threats to working conditions and travel arrangements • Failure to attract or retain staff through reputation as poor employer	• Improve working conditions and travel arrangements for staff • Reputational opportunities as good employer
Premises	• Vulnerability to flooding, storms and rain • Challenge of copying with temperature extremes	• Maintain, manage and re-furbish premises • Optimise location of premises
Management implications	• Business failure or reduced profits	• Proactively manage impacts and adaptation issues • Mainstream EWE impacts and adaptation into business activities

Since the focus of their study is primarily on climate change, the contents of the table have been adjusted to better reflect the effects of EWEs. Most of the threats identified here have been discussed under the previous sub-heading. The opportunities identified by them reveal that especially the businesses that plan for probable EWEs and manage them successfully may enjoy positive business opportunities as opposed to the negative

impacts. Thus, the need for improving SME resilience and adaptive capacities to EWEs so that they will be in a better position to cope with EWEs emerges.

4 The Way Forward

Although the scant amount of literature available limits comprehensive understanding, the facts discussed above show that EWEs pose considerable negative impacts as well as some positive impacts on SMEs. These impacts necessitate SMEs to be prepared to minimize the effects of negative impacts on themselves and also to capitalize on the positive impacts. In spite of higher vulnerability to these crisis impacts, the SME sector is renowned for being least prepared for such events (Ingirige et al, 2008b). There is thus an obvious incentive to focus on research related to SME resilience to EWEs. Improving the resilience of SMEs is not only about understanding problems confronted by them but it is also about gaining a better understanding of how to overcome them (Tilley and Tonge, 2003) and how to integrate best practices into the mainstream of SME activities, so that they will be in a better position to manage the risk in case of an EWE.

We intend to undertake extensive research on SME resilience to EWEs, addressing this research potential and requirement. In a broader sense, the aim of the proposed study would be to develop a decision making framework that supports SMEs to improve their resilience to EWEs. Essentially, in order to achieve this aim, a major objective of the study would be to gain a comprehensive understanding on effects of EWEs on SMEs, SME coping strategies, their adaptive capacities and resilience, and barriers to implementing various coping measures. Other objectives of the study would include understanding the decision making process of SMEs, and developing and testing a decision making framework that supports SMEs to improve their resilience to EWEs. These objectives will be further refined as the study progresses. The study will involve a comprehensive literature review covering many facets of the research issue identified above. This will be followed by a questionnaire survey targeting a considerable SME sample and a series of interviews targeting a fewer SME sample. The decision making framework to be developed will then be tested with the participation of a target SME sample. This paper acts as an initial literature survey in this regard and fulfils the objective of obtaining a background understanding on effects of EWEs on SMEs.

5 Conclusion

The SME sector is considered the backbone of the UK economy due to its significant economic and social importance. The sector is also considered as the most vulnerable section of the UK economy to the impacts of EWEs. Successful operation of the SME sector has been challenged by the increased intensity and frequency of EWEs coupled with increased vulnerability to EWEs, during the recent past. EWEs are capable of creating significant negative impacts on SMEs, especially due to their inherent characteristics such as resource constraints and local presence etc. Interestingly, EWEs seem to present businesses with some positive consequences as well. The exact effect on individual businesses seems to depend on a variety of factors including exposure, vulnerability, type of EWE, intensity and duration of the event, the industry sector that it operates in and locality etc. Consequently, it is difficult to identify a comprehensive list of effects on SMEs due to these variations and also due to the scant amount of literature available with regard to this subject. Thus the paper identifies the need for conducting more in-depth study to investigate these impacts in order to gain a comprehensive understanding.

The factors like economic and social importance of SMEs, their higher vulnerability to EWEs, significant negative effects on them and potential positive opportunities available, all contribute towards the growing need for enhancing their adaptive capacities to deal with EWEs. This paper thus highlights the importance of improving SME resilience to EWEs. Although the need is ever increasing, matters like ways and means of achieving SME resilience to EWEs and barriers to implement them practically seem to be still in the dark. The need for further study with regard to SME resilience to EWEs is also escalating. The paper also provides fundamental background information for a comprehensive study to follow on SME resilience to EWEs, which is to be undertaken to address gaps in knowledge mentioned above. In addition, the paper leads to further studies aimed at identifying existing coping strategies adopted by SMEs in order to manage the consequences discussed.

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