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Adaptability and Survival in Small and Medium-Sized Firms

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ABSTRACT

This article considers the causal connection between adaptability and survival in populations of small and medium-sized firms (SMEs). Some literatures have downplayed adaptability by focusing on statics and equilibria (parts of mainstream economics). Others have argued that it is very difficult to make individual firms more adaptable and the focus should be on selection forces in the population as a whole (early organizational ecology). By contrast, writers on strategy devote much attention to improvements in adaptability. Here we outline an approach to the measure of adaptability that focuses on organizational dispositions and routines, and is usable within large samples of firms. This approach was field tested on 909 firms in 2008 in the East of England. A follow-up survey during the severe recession and shake-out in 2009 provided an opportunity to assess the relationship between adaptability and survival. The results were then replicated and interpreted using a computer simulation. While preliminary, our overall findings suggest that adaptability can have a small but important effect in some circumstances. But our evidence is also consistent with a decline in adaptability in individual firms through time, and the strong overall effect of selection forces. Our interpretative methodology may signpost a route toward the reconciliation of ‘selectionist’ and ‘adaptationist’ views in the literature.

Adaptability and Survival in Small and Medium-Sized Firms

Geoffrey M. Hodgson, Stephen Herman and Denise E. Dollimore

What is the relationship between adaptability and survival in business?¹ Some writers and policy-makers suggest that adaptability is supreme, and exhort managers and workers to be flexible and fleet-footed. Against this, the founding organizational ecology literature (Hannan and Freeman 1977, 1984) has suggested that any adjustment is difficult, and the forces of selection explain the characteristics of the industry as a whole.²

The purpose of this paper is to investigate adaptability in SMEs and evaluate its importance for their endurance. We develop a methodology for measuring adaptability across several dimensions and use these measures to help explain firm survival.

We outline a new exploratory approach to the measure of adaptability that focuses on a survey of organizational dispositions and routines, potentially within large samples of firms. This approach was field tested on 909 small and medium-sized enterprises (SMEs) in 2008 in the East of England. A follow-up survey during the severe recession and shake-out in 2009 provided an opportunity to assess the relationship between adaptability and survival. Our evidence is limited and preliminary, but, when interpreted through a computer simulation, it suggests an accommodation of both ‘selectionist’ and ‘adaptationist’ views, with an enhanced agenda for further empirical research.

Our limited evidence is consistent with a small but significant effect of adaptability on survival. We also found that mean adaptability scores were higher in the older group of firms. Although we had no direct evidence, we used a computer simulation to suggest that this overall result was (counter-intuitively) associated with slowly declining adaptability and ossification in most individual firms, the latter being prominently suggested by some early authors (Olson 1965, Stinchcombe 1965).

Our overall findings suggest that adaptability can have a small but important effect in some circumstances. But also it is possible that adaptability tends to decline in individual firms through time, and selection forces have a strong overall outcome. To investigate this empirically, firm-level and population-level effects have to be separated. We underline the importance of this separation through a computer simulation of our empirical results. In this

¹ This paper reports some of the results developed in Herman (2012). The authors thank Neil Spencer for extensive help with the statistical analysis. We are also grateful for useful comments by referees.

² But subsequent scholars working within a population ecology perspective (Barnett and Hansen 1996, Barnett 2008) have emphasized adaptation on the individual organization level.

way, ‘selectionist’ and ‘adaptationist’ views can be reconciled, within a framework where their relative empirical importance can be appraised.

The next section considers the neglect of adaptability in much of organization studies and some prominent approaches in economics, in contrast to its emphasis in the strategy literature and in other parts of management studies. Section two considers past definitions of adaptability and proposes a suitable formulation. Section three outlines our new approach to the measurement of adaptability in large samples of SMEs. Section four outlines our 2008 survey and analyses some of the results. Section five reports our 2009 survey, after a large shake-out of firms in the severe recession. Section six uses a computer simulation to further analyze the results. Section seven concludes the essay.

1. The neglect of adaptability in much of organization studies and economics

The purpose of this section is to consider why much of organization studies and much of mainstream economics has evaded the question of adaptability. By contrast, there is considerably greater discussion of the topic in the management literature, particularly in business strategy, but often it is under-theorized. This points to the need for sharper definitions and an improved theoretical framework. These tasks are addressed in subsequent sections.

Balaji Chakravarty (1982, p. 35) wrote on his seminal paper on business adaptation that: ‘The essence of management is coping with change.’ Similarly, Ari Ginsberg (1988, p. 559) stressed: ‘Strategic management is fundamentally concerned with environmental changes and organizational adaptation.’ Daryl McKee et al. (1989, p. 21) wrote: ‘The problem of balancing the benefits and costs of adaptability is fundamental to business strategy.’ Likewise, in an essay where the question of adaptation is central, Daniel Levinthal (1992, p. 441) stressed: ‘The question of firm survival in changing environments is a fundamental issue of business strategy and an intellectual challenge to our theories of organizational and industry evolution.’

Similar statements are plentiful in the subsequent literature, especially in management studies and notably in a growing number of diverse sub-fields (Reeves and Deimler 2011, Reeves et al. 2012, Rud 2012, Valentin et al. 2012, Klarner et al. 2013). Today, a web search for ‘adaptation’ or ‘adaptability’ will find many recent references to the concept in a diverse literature in business strategy, management studies, human resource management and marketing science. And it seems obvious that any firm considering its future strategy must take into account its own capacity to adapt.

Yet remarkably, the concept of adaptation was downplayed in a key part of organization studies and much of mainstream business economics for several decades. It has yet to become a significant topic in the mainstream textbook economic analysis of the firm.

In their founding works on organizational ecology, and Michael Hannan and John Freeman (Hannan 2005, Hannan et al. 1996, Hannan and Freeman 1977, 1984, 1989) argued that processes of selection on populations of firms are much more important in determining industry level changes through time than individual adaptations among firms themselves. Following Arthur Stinchcombe (1965) and others, they argued that firms have limited capacities to adapt.³

³ Since Stinchcombe’s (1965) claim that newly-founded firms face the highest risks of failure, other authors have posited ‘the liability of adolescence’ (Bruderl and Schussler 1990, Fichman and Levinthal 1991) underling vulnerability after an initial burst of investment and enthusiasm, and still others to the liabilities of senescence or ossification (Barron et al. 1994). We are faced with a number of varied speculations.

Furthermore, there are costs and risks involved in adaptation. Organizational adaptation typically involves costly investment and training, and in a complex and uncertain world there is no guarantee that the adaptations are even in the right direction. Caution and conservatism are often wise counsel (Kolb 2002, Stadler 2007). As James March (1981, p. 567) put it, given the costs and risks of reorganization, for some organizations 'efforts to survive will have speeded up the process of failure.'

Clearly selection and extinction are likely to be much more important forces in determining industry characteristics in industries with numerous small firms. Larger firms are able to influence their environments and avert some selection pressure. They have also greater capacity to survive external shocks. Consequently, in the mix of adaptation and selection processes that influence organizational evolution, the relative role of selection seems less profound for large organizations (Lumsden and Singh 1990). But the fact remains that the overwhelming majority of firms are small, and we need to consider the arguments of Hannan and Freeman on their own terms – particularly in regard to SMEs.⁴

Although there is much evidence supporting the idea that all types of firm are constrained by inertia and some inability to adapt, the earlier arguments by organizational ecologists swept the strategic dilemmas facing any firm under the carpet. Their work seemed to imply that most firms have a negligible zone of strategic discretion, and they can do little more than hope that the scythe of selection does not cut them down. At the firm level, practical and policy advice emanating from much work in organizational ecology is thus limited.

What is given relatively little attention in Hannan and Freeman's organizational ecology is whether differences in adaptability between firms are of significance. Firms are far from identical (Nelson 1991). Even if the scope for adaptation is generally small, it is likely that the more adaptive firms may possess an advantage relative to their rivals. This must be particularly the case if the organizational ecologists are right in their argument that the biggest threat to the existence of a firm is the difficulty of expanding to a more cost effective size and scale. This would place any slight advantage in terms of adaptability, particularly greater adaptive capacity to grow from a small size, at a premium.

It is also important not to overlook the enormous amount of adaptation that does occur. After all, the move from a single person firm to an enterprise of three or four members involves a considerable amount of organizational adaptation, especially in complex and changing environments. Furthermore, given rapidly changing circumstances – new entrants, new technologies, new products, changing government policies – most firms are required to adapt to some degree, on an almost continuous basis, or face extinction.

Turning to mainstream economics, the neglect of adaptability is more noticeable. Until recently, apart from discussion of the work of Oliver Williamson (1975, 1985) and a few others, textbook economic theory has had little to say about the internal structure of firms. For many years after the Second World War, much of the controversy in the 'theory of the firm' concerned its objective function – whether firms maximize profits or sales, or 'satisfice' instead (Machlup 1967). Market structure was treated as a proxy for the degree of competition, to the neglect of the internal structure and workings of the firm itself. Much of the mainstream 'theory of the firm' has been about market structure and market behavior, rather than a theory of the firm as an organizational entity. Many modern mainstream developments (e.g. Hart and Moore 1990)

⁴ UK government statistics for 2007 show that small and medium-sized enterprises (SMEs) together accounted for 99.9 per cent of all enterprises, 59.2 per cent of private sector employment and 51.5 per cent of private sector turnover.

continued to treat the firm as if it were a single entrepreneur, rather than an organizational structure with its own internal tensions and dynamics.

There have been numerous important attempts to rectify this deficiency, but with the exception of Williamson's work they have had relatively little impact on the microeconomic textbooks. Some efforts to overcome these lacunae have achieved classic status – notably Simon (1947), Penrose (1959) and Nelson and Winter (1982) – but because they adopt assumptions that differ radically from those in mainstream economics, they are relatively neglected in economics textbooks or in courses in mainstream economics.

Mainstream analyses are often concerned with equilibrium outcomes; firm behavior is determined as an equilibrium solution to a problem of constrained maximization. Even in the case of transaction cost analysis, as Williamson (1985, pp. 143-4) himself acknowledges, the analysis is in terms of comparative statics, where one organizational arrangement is deemed to have lower transaction costs than another. This leads to a well-noted neglect of dynamic aspects of the problem, notably adaptation, learning, innovation and technological development (Langlois 1992, 2007).

In the motionless worlds of equilibria or comparative statics, any capacity for adaptation is superfluous. Any novelty of technology or policy is treated as a single incremental shift leading to a new equilibrium. There is little sense of the real-world firm, buffeted by numerous ongoing technological, institutional, competitive, legal, fiscal and policy changes on a stormy sea. By contrast, more dynamic and evolutionary approaches (Penrose 1959, Nelson and Winter 1982) embrace change and do not devalue adaptation by focusing on equilibria.

In sum, while the original approach to organizational ecology by Hannan and Freeman makes bold empirical claims concerning the limitedness of adaptation, much of mainstream business economics side-lines adaptation as a logical result of its static orientation toward equilibria. In stable equilibrium the need to adapt to changing circumstances does not arise. We have to turn to the management literature to find an adequate recognition of the importance of adaptability. But in this case, as shown in the next section, there are problems over defining its meaning.

2. Defining and identifying organizational adaptability

In moving forward, the first task is to define the concepts of adaptation and adaptability. Here we move from the literature on mainstream economics and organizational ecology to the broader management literature. The relatively scarce definitions in the literature are mired by conflicting definitions and confused by additional terms with similar meanings. In an early statement Russell Ackoff and Fred Emery (1972, p. 125) define adaptability as 'the ability of an individual or system to modify itself or its environment, when either has changed to the individual's or systems disadvantage, so as to regain at least some of its lost efficiency.' This has the value of focusing on adaptability as a *capacity* to adapt or change. Consonant with this, other writers (noted below) refer to adaptations as actual changes. We shall retain this distinction.

But a problem with the Ackoff-Emery definition is that it is so broad that the capacity of an entity to alter its environment is regarded as adaptability. An organizationally inflexible oligopoly that forced its rivals to go bankrupt by any means would be deemed adaptable. In biology, adaptation refers to an evolutionary change in the structure or functioning of an organism that makes it better suited to its environment (Daintith 2005). When an organism changes its habitat this is described differently, as niche construction (Odling-Smee et al. 2003) for example. We prefer to focus on organizational adaptability and classify the capacity to

manipulate the environment as a different phenomenon. Another problem with their definition is that it relies on the concept of efficiency, which is itself capable of several different interpretations.

Turning to the word adaptation, in the organizational studies literature it typically refers to a change in a specific organization rather than an environmental or other change. For Daniel Levinthal (1992, p. 432) ‘adaptation is defined to have occurred when an organization changes its strategy, structure or some other core attribute to fit some new environmental contingency.’ More narrowly, for Ross Brennan and Peter Turnbull (1999, p. 182): ‘Adaptations can be defined as behavioral modifications made by one company, at the individual, group or corporate level, to meet the specific needs of another organisation.’ Although this focuses appropriately on organizational change, it overly restricts adaptations to serving the undefined ‘needs’ of another entity. Despite the importance of inter-firm adaptations (Hallén 1991), we see no reason to restrict the meaning of organizational adaptation to business-to-business relations.

A further complication is that the concept of adaptation has acquired different meanings in biology and organization studies. In biology, adaptation refers to change *in a whole population*, including population changes resulting from natural selection. In organization studies and business economics it has shifted its meaning to changes performed by any one organization, to refer to the process or outcomes of adjustment of the characteristics of an individual organization in a given environment. These different meanings complicate the growing use of ideas originally developed in biology to help understand processes of organizational change (Hodgson and Knudsen 2010, Hodgson 2013).

To tangle matters even further, alternative terms have arisen that seem to describe outcomes or processes that others refer to as adaptations. For example, Henk Volberda (1998, p. 100) flags the idea of ‘organizational flexibility’, which he defines as ‘the degree to which an organization has a variety of management capabilities and the speed at which they can be activated, to increase the control capacity of management and improve the controllability of the organization.’ His persuasive argument that flexibility and stability are two sides of the same coin, and flexibility without stability results in organizational chaos, ties in with similar statements in the organization studies literature on adaptation (e.g. Levinthal 1992). But his notion of ‘flexibility’ also signals a capacity for adaptation.

Another prominent term is ‘dynamic capabilities’, which David Teece et al. (1997, p. 516) defined as ‘the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.’ Again this amounts to another way of describing adaptability as a capacity.

Another related term is ‘organizational resilience’, which is defined loosely by Timothy Vogus and Kathleen Sutcliffe (2007) in their overview as ‘the maintenance of positive adjustment under challenging conditions such that the organization emerges from those conditions strengthened and more resourceful’. This definition is so close to some definitions of adaptability that there seems little value in an additional term, unless a clear definitional demarcation is in place.

It is not easy to clear up this terminological mess, but we propose the following solution. When addressing organizations and their strategic dilemmas, the primary matter is the *capacity* of an organization to change, in a manner that improves its performance by some appropriate criterion, and increases its chances of survival.

The capacity of any organization to change – even a small firm – depends on structured internal relations and not on the intentions of individuals alone. The study of organizational

adaptability is much about internal structures and procedures and their capacity to enable appropriate change. The internal culture of the firm is intimately connected to those structures and procedures, as well as to the values and beliefs of individuals (Schein 1996, Sørensen 2002).

We define organizational adaptability as *the inbuilt capacity of an organization to change its strategies, structures, procedures or other core attributes, in anticipation or response to a change in its environment, including changes in relations with other organizations*. The resulting adaptations do not necessarily improve performance, but they are generally intended by some criterion to do so. In the appropriate context we sometimes use the word *adaptability* as an abbreviation of *organizational adaptability*.⁵

Note that much change in organizations is not necessarily adaptable in this sense. Scaling up, scaling down, divesting a non-core process, or closing down a less-efficient plant, are all examples of change that do not necessarily affect core strategies, structures or procedures. In contrast, changing the nature of the main product or restructuring the company are adaptations, whether successful or unsuccessful. Adaptability is the ability to make such core changes.

The next step is to consider how adaptability can be identified. By virtue of the facts that an organization is more than the sum of its individual members, that organizations have emergent properties not possessed by those individuals, and that organizational personality or attitudes are irreducible to the personality or attitudes of its members, investigation into organizational adaptability cannot be reduced to the profiling of individuals within the firm. It is vital – and more meaningful – to focus on the strategies, structures and procedures within the organization.

Our definition of organizational adaptability is compatible with a number of possible empirical approaches. Just as with the definition of a mammal as ‘an animal that suckles its young’, our taxonomic definition omits a number of important features. The role of this type of definition is to demarcate one type of entity from another using parsimonious criteria, and not to include all details or to indicate one particular line of empirical enquiry.⁶ But the focus on particular embedded routines in our empirical (see below) study is consistent with our definition of organizational adaptability as an ‘inbuilt capacity’, as long as routines are understood as dispositions rather than overt behaviors. Relevant routines are operative or dormant procedures that can help deal with change. Hence the focus on capacities in our definition of adaptability points to an empirical examination of routines (understood as dispositions).

Here we forge a link with the growing literature in evolutionary economics on routines (Nelson and Winter 1982, Cohen and Bacdayan 1994, Cohen et al. 1996, Becker 2008, D’Adderio 2011, Vromen 2011). Routines are defined as organizational dispositions to energize conditional patterns of behavior within organizations, involving repeated sequential responses to cues that are partly dependent on social positions in the organization (Hodgson 2008). Establishing a routine in a firm means building or using internal relations and positions that enable similar and repeated sequential behaviors. These in turn help to develop particular habits and other specific conditional dispositions among individuals.

This chosen approach raises questions that relate to the old claim that organizations tend to ossify and become less adaptable through time (Olson 1965, Stinchome 1965). This claim

⁵ Our definition of adaptability is very close to the above-cited definition of ‘dynamic capabilities’ in Teece et al. (1997, p. 516). But their notion seems to be broader, because we exclude changes that are not intended as responses to challenges from the firm’s environmental. There is clearly scope for future refinement of these terms.

⁶ For more on the tasks of definition in this context see Robinson (1950) and Hodgson (2016).

would be consistent with a decreasing capacity of higher-level, diagnostic routines to prompt changes in strategy and associated alterations to lower-level routines, to cope with changes in the firm's environment. There is also some evidence that the chances of firm survival are positively correlated with age (e.g. Dunne et al. 1988, 1989).⁷ This, by contrast, might suggest that adaptability *increases* through time. But our analysis (see below) shows – counter-intuitively – that the declining adaptability of individual firms is entirely consistent with increasing longevity in the survival population. Hence we offer a way of reconciling these results.

Our empirical approach involved a relatively high number of observations, rather than more detailed case studies. This ruled out any detailed internal investigation of specific routines. But nevertheless we tried to capture and identify specific types of routine within each firm through a Web-based questionnaire. We know of no other attempt to study routines with such a relatively large sample of observed firms.

3. Measuring adaptability in SMEs

How can adaptability be measured? Empirical studies of adaptability contain terms and definitions with conflicting meanings. The chosen variables also differ because of contrasting research aims. And while there is also general consensus that the generic components of adaptability cover marketing, operations, organizational structure and strategy, their operationalization varies strikingly from one study to the next. As Tuominen et.al (2004) noted, there are no sophisticated and validated measurement proxies for adaptability and relatively little systematic effort has been given to methodological issues in developing adaptability scales.

Addressing the location, size, sector and other characteristics over which adaptations or adaptability are to be measured, the literature is also wide-ranging and diverse. There is also a preponderance of manufacturing firms in existing studies, while manufacturing makes up a relatively small proportion of employment and output in modern industrial economies.

Some studies provide guideposts for the decomposition of adaptability into different components. For example, Oktemgil and Greenley (1997) looked at marketing activities and the speed of operational response, particularly with regard to product and market opportunities. Schinedehutte and Morris (2001) added questions of flexibility of organizational structure, HR priorities and financial capacity. Subsets of these concerns were addressed by Tuominen et al. (2004), Verdu-Jover et al. (2006) and Green et al. (2006).

We argue that adaptability may be usefully conceived within a routines perspective, where routines are organizational dispositions that shape the way various overlapping individuals and teams within the firm respond to information signals, resulting in patterned behaviors observed across all functions of the firm. But organizational dispositions cannot be observed directly. While the conceptual tools for characterizing the variable properties of static objects are well developed, tools for characterizing the sequential structure behind patterns of action are not (Pentland and Reuter 1994). There is also the view (Nelson and Winter 1982, Sørensen and Stuart 2000) that routines in a firm should be analyzed at different functions such as production

⁷ Some later studies challenge this, or show weaker results (e.g. Coad 2010, Bottazzi et al. 2011). Peter Thompson (2005) pointed that the greater survivability of older firms may not be due to their age, but to the culmination of selection biasing effects upon other firm qualities. So survivability may not be caused directly by age, despite being correlated with it.

and marketing as well as at different hierarchies, such as routine management and strategic management.

We considered not only routines that regulate existing functions, but also routines to monitor and change routines in an organized manner. From this perspective, adaptability as a capacity involves routines to monitor performance and to trigger internal changes. The empirical task was not to measure individual routines but the adaptability of these constituent bundles of routines in the four constituent areas, as well as the interrelationships between them and with the firm's environment.

This was approached through examining not so much the operational outcomes, as in many previous studies, but the reported levels of differing aspects of adaptability in the firm, as well as other contributing factors to adaptability, such as staff involvement and flexibility, levels of formal procedures, and the frequency of managerial review of its routines. In this approach, the capacity of a firm to change depends on structured internal relations and not simply on individual intentions or capacities.

Considerable abstraction and simplification is required for any theoretical or empirical analysis in this area. We concentrated on four constituent areas, as highlighted in a wide range of former studies. They are:

1. production,
2. sales (including marketing),
3. administration (including human resources), and
4. corporate strategy.

Adaptability can then be measured as a composite of survey scores for reported adaptability across the four areas, along with a scale for formal procedures and a scale for congruence across all four variables, capturing a picture of the interactions between the strategies, structures and procedures within the firm.

We also considered company-wide traits such as:

- How loyal are the customers and what is the length and strength of the relationship.
- Preferences for adopting new technologies (early adopter *versus* wait and see).
- Dynamic dispositions to respond to new entrants and other competitive pressures.
- The entrepreneurial/risk-taking disposition of the management team as a whole.

We measured these variables and traits empirically and created a dataset for a whole population of firms taken from multiple industries and sectors. Firm performance depends on these internal and external contingencies and their interaction.

4. Pre-recession survey and analysis

We had access to the East of England Development Agency's (EEDA) regional database of businesses in the six counties of Bedfordshire, Cambridgeshire, Essex, Hertfordshire, Norfolk and Suffolk to obtain a large and representative selection of firms to test. The East of England

region had an overall 2011 population of over 5.8 million and is a major segment of the UK economy. Our first survey was carried out in April 2008.⁸

The timing of this survey is important. The credit crunch and the run on the Northern Rock bank were about eight months earlier. The crisis had already begun. These deteriorating financial conditions had probably already affected the companies in our sample. But in GDP terms the UK economy peaked in the first quarter of 2008. Also, in April 2008, rates of company liquidations were far from their subsequent peak. This is confirmed by the quarterly data shown in Figure 1. The average quarterly numbers of (voluntary and involuntary) company liquidations in England and Wales for the whole of 2006 and 2007 respectively were 3,127 and 3,284. The numbers for the first and second quarters of 2008 were respectively 3,262 and 3,689. A sharp rise of company liquidations immediately followed our first survey, jumping to 4,059 in the third quarter of 2008 and reaching a peak of 5,110 in the first quarter of 2009 (Insolvency Service 2014). These data suggest that the first survey was conducted before the crisis hit with full force.

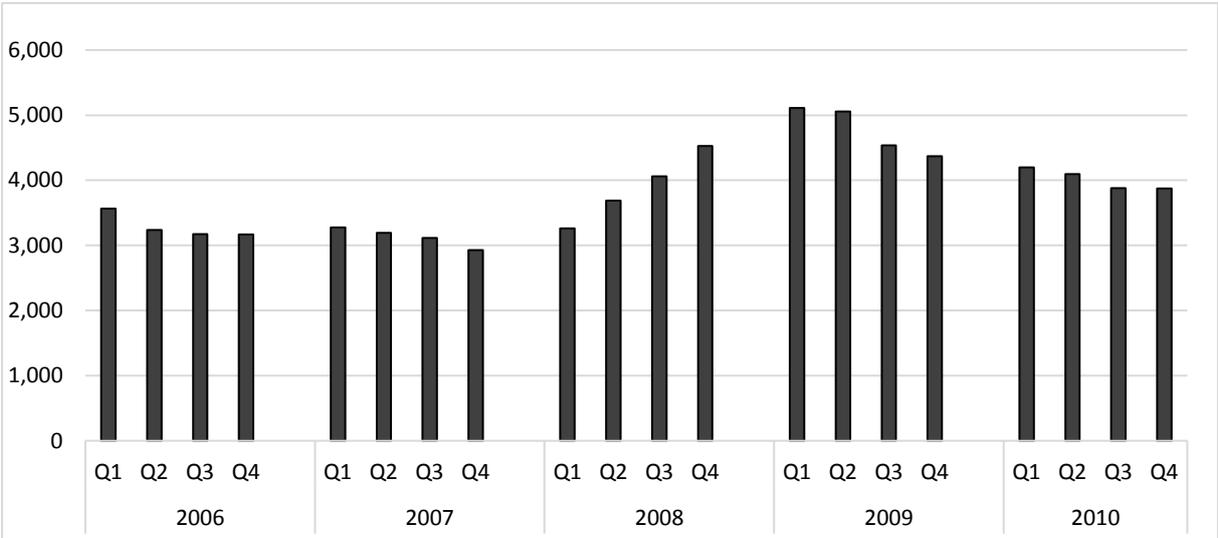


Figure 1: Total Company Liquidations – England and Wales

Source: Insolvency Service (2014)

Of course, firms struggle to remain solvent and they will typically endure a period of stress before closure. Consequently, many firms in late 2007, or in early 2008 (when the first survey was conducted), would have been already in difficulties. Furthermore, those firms facing severe problems would have been less likely to respond to our survey. These factors mean that (a) with hindsight the timing of our first survey was not perfect (it would have better to conduct it in 2007), and (b) deteriorating economic circumstances may account for some selection bias. We

⁸ The survey was mailed to the prime contact on the database for each company. In most cases, this was the managing director or chairman, and otherwise it was typically another senior manager.

fully acknowledge these limitations and we call for further empirical studies to confirm or disconfirm our general results.

However, at the time of conducting such a survey, it is impossible to know whether the timing is optimal or not: this can be determined only after some elapse of time after the empirical enquiry. We now know that our first survey was conducted very near to the peak in GDP in 2008, before the UK economic recession, and in advance of the big wave of company liquidations in early 2009. Our second survey was conducted after this surge of liquidations had abated.

Our questionnaire had four sections. The first assessed a range of demographics including questions about the percentage of revenues accounted for by the top 20% of customers and percent senior management team joined in the last 5 years. Respondents were asked to declare the age of their firm (years of active trading) and indicate its approximate level of pre-tax profits in the preceding year.

The second section measured adaptability in response to change across the four constituent areas using a 5 point Likert scale and included questions on frequency of copying good ideas and rate of success, ability to achieve structural change and disposition for technology take-up. (See the Appendix below for more details.) The third measured management style with staff, propensity to use consultants and attitude to risk in the senior management team. The final section addressed issues of dynamic and static competition, including customer loyalty and length of relationships, strength of price competition, competitive advantage, rate of new product introduction, response to the entry of a similar competitor and the customer response to an increase in prices.

The 2008 survey was pre-tested with semi-structured interviews with eight firms to ensure comprehension and clarity and tested on two samples from a similar database from another region.

The EEDA database contains few commercial firms with more than 250 employees. Such larger firms only account for less than 0.4% of total firms in the UK (Office of National Statistics, 2017). Also EEDA data collection procedures under-report firms in their first year of trading.⁹ After removing the large numbers of firms giving no permission to contact, the final mailing list was 16,545.

Following an initial mailing in April 2008, the survey was re-mailed a week later to those that had not responded. The overall response total was 1,545, a response rate of 9.3%, of which 909 were sufficiently complete for the analysis required. There were no statistically significant differences between the mean responses of the two mailings, though there may be some bias overall as those that give express permission to be contacted by mail are likely to be more open and outward looking than those refusing contact of this sort. The response rate is in line with EEDA's estimate of 10% typical response to their mailings to this audience.¹⁰

⁹ There is strong evidence from different industries and countries of an exponential age distribution of firms (e.g. Bottazzi et al. 2011). By this yardstick, the age distribution of firms in our sample has a deficit of firms younger than 3 years, and the shortfall is about 9% of that cohort. Theoretically, a constant survival probability for all firms (with constant rates of entry into the population) would eventually yield an exponential age distribution.

¹⁰ By number of employees, how representative of the actual population are the businesses in the survey sample? Comparing overall SME statistics for the EEDA region, our sample (a) under-represented the smallest firms of 4-9 employees (52.5% in EEDA region compared with 42.2% in our sample), (b) was a good fit on the proportion of firms of 10-49 employees (45.0% and 45.5% respectively), (c) over-represented firms with 50-99 employees

The 909 firms were highly varied in age: 54.1% of them being over 10 years old, 17.6% between 6 and 9 years, 21.8% between 3 and 5 years, and 6.4% of lesser age. By employees, 61.4% of the sample had less than 4, 16.3% had between 4 and 9, 12.8% had between 10 and 24, 4.8% had between 25 and 49, 2.6% between 50 and 99 and 2.1% between 100 and 250.

The sample also had a good representation of industries, with 42.5% in the broad band of business services and computing, 12.8% in manufacturing, 8.6% in wholesale/retail, 6% in construction, 5.2% in education, 5.1% in other social and personal services, 4.1% in transport, storage and communications and 3.2% in both financial intermediation and agriculture.

By revenues, 909 firms showed 78.7% at £1m or less, 10.2% with revenues between £1-£2.49m, 4.9% between £2.5-£4.9m, 2.1% between £5-£9.9m and between £10-£24.9m, 0.8% between £25-£49.9m and 1.1% more than £50m.

To obtain an overall measurement for the adaptability score as well as its subcomponents a reliability analysis was conducted using Cronbach's alpha statistic. A score of 0.70 or greater recommended by Nunnally (1978) indicates that the items that comprise the composite scores are an adequate measurement for these scores. In fact the reliability of the items that comprised the adaptability composite score was $\alpha = 0.89$ and all the items contributed to scale reliability. An overall measurement for the adaptability composite score was calculated as the average of the scores received for each one of the 20 items on the survey instrument for the four constituent areas of the firm. A composite formal procedures measure was also calculated as the average value for each of the formal procedures items on the survey instrument for the four constituent areas. The summary statistics for each of the composite scores are presented in Table 1.¹¹

Table 1 - Summary Statistics for Survey Instrument Composite Scores (N = 909)

Survey instrument	Min	Max	Mean	St Dev
Adaptability	1.00	3.80	2.4450	0.53119
Production	1.00	5.00	2.3635	0.65643
Sales	1.00	4.40	2.3419	0.65660
Administration	1.00	4.40	2.5510	0.62892
Strategy	1.00	4.20	2.5236	0.63811
Formal Procedures	1.00	5.00	3.0114	0.93362

(2.0% and 6.8% respectively), and (d) over-represented firms with 100-249 employees (0.5% and 5.4% respectively). Given that the SME statistics count those with five to nine employees, and the survey counted four to nine, the bottom end percentage match is a little low for the sample. One explanation of the over-representation of larger firms is that the nature of the survey appeals to larger firms that can more readily identify with the issues tackled within the survey questions. Weighting the data to make the size groups more in line with EEDA statistics would have little effect, because of the closer fit of our sample with the two smallest size groups (for 4-9 and 10-49 employees) that make up 97.5% of firms on the EEDA database.

¹¹ To test the normality of the variables, the Kolmogorov-Smirnov (K-S) test was conducted. The adaptability scores were not significantly different from a normal distribution ($Z = 0.682, p = 0.741$) but the formal procedures variable was ($Z = 1.587, p = 0.013$).

To investigate the relationship between adaptability with age, we divided the sample into two groups: those firms less than 10 years old and those aged 10 years or more. There was a significant difference in the adaptability of the firms for the years trading: $F(1, 850.79) = 14.64$, $p < 0.01$. The firms which were 10 years old or more had significantly higher adaptability scores than firms which were less than 10 years old. The average values for each trading group by years are shown in Table 2. These statistical correlations between mean age and mean adaptability are important and we discuss them more extensively below. We explain that this does not necessarily mean that individual firms increase their adaptability through time.

Table 2 - Mean Adaptability Scores of Firms Younger and Older than Ten Years

Firm age	N	Mean Adaptability	St Dev Adaptability
10 or more years old	492	2.4920	0.59066
Less than 10 years old	417	2.3335	0.64794

By contrast, our study found no significant correlation between mean adaptability and firm size, as measured by the number of employees. There was also no significant difference in the adaptability of the firm for the band of revenue. It might be expected that the more adaptive firms are more profitable. But surprisingly there was no significant relationship between the adaptability of the firm and the level of profits.

Consequently, while this pre-recession survey did not demonstrate that adaptability is irrelevant, it did not reveal any major effects upon performance. Survivability tests had to await the post-recession survey.

But at the same time the 2008 survey presented an enigma. Why was average adaptability higher in the older compared with the younger group of firms? Did this show that adaptability was important for survival after all? How did this square with prominent previous claims that adaptability in firms tends to decline through time? Our answers to these questions come after our report on the post-recession survey and our account of a computer simulation used to interpret the empirical outcomes.

5. Post-recession survey and analysis

The follow-up survey was conducted in October 2009 during the biggest UK economic downturn since the Second World War, after a significant shake-out of firms had occurred and when the recession was biting hard. From its peak in the first quarter of 2008 to its trough in 2009, the UK economy shrank by 7.2%. The severe economic downturn gave us an opportunity to test whether our adaptability score had any relation to survival, although we knew that failed firms would be difficult to contact after the event.

We used the opportunity of the recession to obtain data to refine the analysis of the relationship between survival, adaptability and other possible factors. We asked whether and in what form the firm had survived. The possible answers were: (a) survived more or less intact; (b) survived - but only just in the current line of business; (c) survived - but through an asset

sale or merger in the same or similar line of business; (d) survived by moving largely into a new line of business; (e) gone out of business altogether.¹² These answers were used to create groups (a) to (e) by survival criteria. We also requested a management estimate of revenue and profit changes over the period.¹³

The follow up survey was pre-tested on ten firms from the sample database used for the first test. Of the original 909 respondents, the 2009 survey yielded 418 useable responses for comparison. It was not possible to determine whether original respondents who failed to respond the second time had gone out of business or not. This raises the possibility of further selection bias. This needs to be born in mind when addressing our post-crash results.

Nevertheless, some basic tests detected no significant selection bias. Chi-square tests between the attrition rate (i.e. those who failed to respond to the second survey as a fraction of those who responded to both the first and second survey) showed no significant relationship between attrition and variables such as profits, revenues, size or adaptability, although there was a significant relationship between attrition and the length of trading.¹⁴

One-way ANOVA was conducted to determine if there was a significant difference between how well the participants survived and their 2008 adaptability scores. The results for survival groups are presented in Table 3. Based on the results of a one-way ANOVA, there was a significant difference between the groups of participants ($F(2, 144) = 4.63, p = 0.01$). This indicated that there was a significant difference between at least one of the survival groups and the other survival groups. This also indicated that the adaptability score correlates by a small but significant amount with survival outcomes.

Table 3 - ANOVA Results for Adaptability and Survival Groups

Source	SS	df	MS	F	p
Intercept	179.508	1	179.508	582.862	.000
Response	2.854	2	1.427	4.634	.011
Error	44.349	144	.308		

R-squared = 0.060. Adjusted R-squared = 0.047.

¹² Those who survived but through an asset sale or merger in the same or similar line of business and those who survived by moving largely into a new line of business and those who went out of business altogether had very few observations, perhaps because of the bias that those who changed business format or went out of business altogether were highly unlikely to have retained their contact e-mail. Those who survived but only just in the current line of business and those who survived but through an asset sale or merger in the same or similar line of business were combined, as were those who survived by moving largely into a new line of business and those who went out of business altogether.

¹³ An additional question asked for firm age, rather than age by band, as in the first survey.

¹⁴ A Kolmogorov-Smirnov test showed that the adaptability variable of those in the second survey was also normal.

To determine how the survival groups differed from one another in terms of their adaptability scores, a post hoc analysis was conducted, using both LSD and Bonferroni tests. There was a significant difference ($p < .01$) between those who survived more or less intact (group (a)) and those who survived by moving largely into a new line of business (group (d)) or went out of business altogether (group (e)). In fact, those who survived more or less intact scored 0.75 units higher on their adaptability scores, on average, when compared to those who survived by moving largely into a new line of business or went out of business altogether. There was a significant difference between those who survived but only just through their current line of business or through an asset sale or merger in the same or similar line of business, and those who survived by moving largely into a new line of business or went out of business altogether ($p < 0.01$). In fact, those who survived through the current line of business, or through an asset sale or merger in the same or similar line of business, scored 0.79 units higher on their adaptability scores, on average, when compared to those who survived by moving largely into a new line of business or went out of business altogether. There was not a statistically significant difference in the adaptability scores for those who survived through the current line of business or through an asset sale or merger in the same or similar line of business and those who survived more or less intact.

T-tests on components of the adaptability score, comparing 2009 survival outcomes with 2008 adaptability, showed that a significant difference was observed for adaptability in production and administration, but not for the other components. These findings provide some limited support for the notion that adaptability is important for survival. But this support derives more from the production and administration components of the adaptability score.

Although derived from a very different context where different capabilities mattered, the post-recession results indicate that some aspects of adaptability seem to bring a slight but important benefit for survival. They also suggests that the different criteria for survival can change in relative importance, especially as an economy moves from boom to recession.

6. Simulation and analysis of the results

We regard our empirical results as preliminary but suggestive. While they are insufficiently extensive or profound to draw highly general conclusions, they give important indications and suggest further lines of empirical enquiry. Our results augment the existing literature in various ways and suggest important additional questions.

It has been reported in the industrial organization literature that the chances of firm survival are positively correlated with age (e.g. Dunne et al. 1988, 1989). Our data show (at the population level) a positive correlation between average adaptability and average age. Can we conclude from this that the average adaptability found among the older firms may positively contribute to their survival? Why was average adaptability higher in the older compared with the younger group of firms? Did this show that adaptability was important for survival after all? How could greater adaptability be associated with older firms, when evidence in the literature associates age with greater ossification and inflexibility?

We have to consider the following, counter-intuitive possibility. *In principle, a positive correlation between average adaptability and average age in a population can be consistent with declining adaptability among individual firms, even with declining adaptability in every single firm.*

This would be an example of the well-known Simpson's Paradox, or the Yule-Simpson Effect, in which a pattern that is prevalent among groups of data is absent or reversed when all

the data are aggregated. A famous demonstration of this paradox came in 1973 when the University of California at Berkeley was sued for bias against women who had applied for admission to its graduate schools. The admission figures showed that men applying were significantly more likely than women to be admitted. But the evidence showed that no individual department was significantly biased against women, and most departments had a small but statistically significant bias in favor of women (Bickel et al. 1975). This paradox results from the fact that statistical properties of an aggregated population are not necessarily the same as those of subsets of that population.

How could this paradox be relevant in our case? Ostensibly, cohorts of young, new-entrant firms have a wider variation of adaptability. Among them, the less adaptive firms are not yet eliminated. Selection effects on adaptability are slow to operate. But as time goes by, many in these less-adaptable firms fail, which can lead to higher average adaptability in the older population. The paradox would emerge because the survival population was a more-adaptive subset of the original cohort.

Hence greater average adaptability in the survival (post-crash) population could result from the fact that many less-adaptive firms had been eliminated. Adaptability might then matter for survival after all. The positive correlation of adaptability with age would not result from the increasing adaptability of individual firms, but from the elimination of the less adaptive through time.

Our next task was to explore whether this counter-intuitive outcome was consistent with our survey results. To demonstrate this possibility, we tried to replicate something close to our 2008 results. The aim was not to build a predictive model, or even to obtain a close replication of reality, but to show that the counter-intuitive outcome was possible and consistent with the limited data available to us.

A computer simulation was performed with a population of 100 firms. At birth, the adaptability of the firms is normally distributed with mean 1.0 and standard deviation r . In each year the 10 firms with lowest adaptability were eliminated and they were replaced by newborn firms with their characteristics generated in the same way. The assumed annual 10% death and replacement rate is roughly in line with UK firm survival statistics. Our evidence does not show such a strong effect of selection on adaptability traits, but we wanted to use the simulation heuristically, without claiming that the assumptions in the model were all accurate.

We assumed that in each year the adaptability value of each firm alters by a fractional amount a . Negative values of a mean a fractional decrease. So each firm exhibited an exponential increase or decrease in its adaptability.

There were five target values that the simulation had to replicate, in order to be close to our empirical observations:

1. The correlation coefficient between adaptability and age for the sample (target 0.01).
2. The percentage of surviving firms with age 10 years or more (target 50%).
3. The mean population adaptability score for those of 10 years or more, divided by the mean population adaptability score for those younger than 10 years (target 1.068).
4. The adaptability standard deviation for those younger than 10 years, divided by the mean population adaptability score for those younger than 10 years (target 0.2531).
5. The adaptability standard deviation for those of 10 years or more, divided by the mean population adaptability score for those younger than 10 years (target 0.2777).

The two independent variables were r and a . These two values were fixed for each run of the simulation. The program searched the space of possibilities for these two variables and computed the five outcomes above for each point in that space, as well as the (equally weighted) summed mean squares of the deviations (as fractions of target values) from the target values. Several local optima were discovered, all of which had a negative value for a , all implying an exponential decrease in adaptability through time for each individual firm. The lowest discovered minimum of summed mean squares had $a = -0.01145$ and $r = 0.4130$.

The simulation results for the least-mean-squares run would mean that adaptability declined for each individual firm by about 1.1% per year. It is also important that the variation in adaptability was high (initially $r = 0.413$) and declined slightly, as the least adaptive firms were rejected. But, in line with Simpson's Paradox, the mean population adaptability score for those of 10 years or more was greater than for those younger than 10 years.

If selection were the only force in operation, and adaptability did not alter survival chances, then we would expect no change in the variation in adaptability through time. So selection is having an effect, or adaptability is increasing the chances of survival, or both.

In reality, increases in average adaptability in the population through time, and decreases in the variation in adaptability, would suggest that selection culls some of the less-adaptable firms. But the estimations in our simulation results indicate that these changes are slight, despite a large estimated variation in adaptability. This would imply that (in reality) adaptability is weakly selected as a trait; adaptability matters, but its survival premium is small. Both adaptability and selection matter, but adaptability does not guarantee survival.

Nevertheless, if these data and simulations are a guide, then adaptability matters, and insofar as it is possible for firms to improve their adaptability, then they can slightly reduce their chances of extinction. The writers on strategy are right to underline adaptability. But adaptability is far from everything and selection forces are strong, as organizational ecologists have insisted. Although we cannot draw firmer conclusions from our data and simulation, they both tell a consistent story.

This story may help to reconcile the 'adaptationist' and 'selectionist' views, by making them logically consistent, and by indicating which effects have to be measured to gauge the relative importance of adaptation and selection in forming population-level or industry-level outcomes.

7. Conclusions

The evidence and simulation presented here have theoretical and policy implications. On the theoretical side, our evidence undermines the old bifurcation between strategy theorists promoting an agenda of adaptation, on the one hand, and prominent economists and organizational ecologists asserting the supremacy of selection, on the other hand. In our sample, both selection and adaptation matter, but the former operates only weakly on the latter trait. Unfortunately, the misleading dichotomous terminology of 'Darwinian' selection versus 'Lamarckian' adaptation greatly exacerbates this false bifurcation (Usher and Evans 1996). As if Darwin said nothing about development and adaptation! This is clearly wrong (Mayr 1991). Elsewhere this false dichotomy has been criticized on theoretical and terminology grounds (Hodgson and Knudsen 2010, Hodgson 2013).

The study reported here provides data that is consistent with the operation of both adaptation and selection in firms and industries. Our analysis of these results shows that it is vital to

distinguish between firm-level and population-level effects, in order to appraise the relative impacts of adaptation and selection.

Development of the policy implications would require more extensive empirical studies. Our method of construction of adaptability indices needs to be further tested and tuned. But insofar as our observations have wider applicability we can already draw some implications for policy.

First, and perhaps most important, competition is a blunt and context-dependent instrument for the improvement of performance. Although competition clearly has major effects, and it may spur innovation and improve productivity, the evidence suggests that it has only weak outcomes in terms of promoting more-adaptive firms. Furthermore, when shifting from pre-recession to post-recession contexts, the viability of firms depends on a changing set of criteria, with different parametric weights.

Second, our study shows that adaptability is important, but it is hard to improve this capacity within any individual firm, and to counter the general tendency for declining adaptability in each individual firm. Even with success, improvements in adaptability bring limited benefits in terms of survival. On the other hand, a small improvement can give the edge over competitors. Firms need to try and improve adaptability, but not at any cost. Targets for improvement should be limited and realistic, as with the appraisal of potential benefits. Similarly, government policy should not be to promote fleet-footed flexibility and agile adaptability as sure-fire formulae for success. Policies need to take into account the costs and risks involved: adaptations often fail.

This topic is ripe for further empirical enquiry, armed by a theoretical framework that links rather than bifurcates adaptation and selection, and distinguishes between firm-level and population-level effects.

Appendix: The Measurement of Adaptability

The adaptability instrument used here was the sum of survey scores for reported (dispositions for) adaptability across the sales and marketing, production, administration and human resources, and corporate strategy functions. For the individual components of production, sales and marketing, admin/hr and strategy the following questions were asked:

When you carry out important changes (not just minor improvements) in each of these areas, how easy is it to do?

When you make less important changes in these areas, how easy is it to do?

What level of formal procedures does your company operate in these areas?

How frequently does senior management review what you do in these areas?

How adaptable are your employees to change in these areas?

Answer options were on a five-point Likert scale. As a number of specific adaptability factors were also recorded (such as adaptability of employees, ease of structural change, frequency of management reviews), two versions of the adaptability instrument were tested, one based on the shorter set of questions that only covered strategy, production, admin/HR and sales and marketing and one that included the larger set of more widely ranging adaptability questions. Examination of statistical relationships with other data using the two versions of adaptability produced surprisingly identical results. Factor analysis of the larger set also revealed one prime

factor that consisted entirely of the components of the shorter set, so the shorter was used as a matter of parsimony and for clarity of explanation.

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