Turbulence, Flexibility and Performance of the Long-lived Small Firm

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Abstract

This paper focuses on a new concern in the small firm's literature, namely what makes a small firm stay in business for a long time. It reflects a change in economic policy, away from an emphasis on *volume* of start-ups to an emphasis on *quality* of start-ups. The basic hypothesis is that flexibility enhances the long run prospects of the small firm. This is explored by examining precipitating causes of organisational change within the small firm, and the consequential adjustments. The study is fieldwork based and uses evidence from face-to-face interviews with 63 owner managers of mature small firms in Scotland. New measures of flexibility and turbulence are used to explain the performance of mature small firms. These depend on our unique body of evidence from interviews with owner managers. Performance is measured using a Likert scale over 28 distinct attributes.

Econometric estimates are reported on the relationship between flexibility, turbulence and performance. This is done in two forms. The first involves generalised least squares estimatation (with heteroskedastic adjustment) of the relationship between turbulence, four measures of flexibility, and performance. The second involves Heckman sample selection estimation, of this performance relationship. It is found that turbulence has a negative effect on performance. Further, this impact is relatively large. Next in importance are those flexibility factors which can be categorised as precipitating causes of organisational change (as opposed to consequential adjustments) within the mature small firm. Finally, trade-off relationships are found to exist between two of the measures of flexibility (viz. agility and speed). We believe that this trade-off relationship is worthy of further empirical investigation.

Keywords: **Flexibility, Turbulence, Performance, Small Firms**

JEL: **C42, D21, G33, L2, M13, M21**

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1. Summary

The paper explains the performance of long-lived small firms in terms of turbulence and flexibility. It introduces new measures of performance and flexibility. The latter reflect the agility and speed of long-lived small firms in responding to change. The evidence suggests that a trade-off exist between some dimensions of agility, and speed in responding to changes. Such trade-offs arise from the complex relationship between flexibility and performance. Thus the owner-manager of the small firm has to assess the implications for performance of committing resources to a particular strategic change today, as opposed to tomorrow. Our measure of firm specific turbulence had a negative effect on performance. This suggests that many long-lived small firms correct for past inflexibilities and poor performance in order to survive. Turbulence had a larger impact on performance than did firm flexibility, in adjusting to change. We found that the impact of precipitators of change was considerable, and partly counteracted the negative influence of turbulence on firm performance.

2. Introduction

In this paper we explore the relationship between turbulence, flexibility and performance. We do so using data collected in face-to-face interviews with 63 long-lived small firms in Scotland. We define long-lived small firms as businesses that have been trading for more than 10 years. They were classified as small firms at inception if they employed less than 100 people. In fact, the small firms in the study were much smaller, typically having 10 employees at inception. Today, our long-lived small firms had 13 employees, on average, indicating some, but not substantial growth since inception.

We reserve until Section 4 our account of the details of how we measured turbulence, flexibility and performance. Here we will put the matter more briefly. The *agility* of long-lived small firms was calibrated by the ratio of precipitators of organisational change to their consequential adjustments. *Speed* was measured by the time it took a firm to adjust to precipitators of organisational change. *Turbulence* was measured by a count of the number of changes undertaken over the lifetime of the long-lived small firm. *Performance* was measured using a self-appraised multidimensional scale. This incorporated aspects of: competitive environment; financial management; organisational structure; and business strategy. Such a measure is adopted because the flexibility of a firm is not always captured by increases in financial measures of performance. Organisational changes may be undertaken solely to maintain performance or in other words for sheer survival. A broader measure of performance is thus required to capture the relationship between flexibility and performance.

The flexibility of small firms explains their growth and viability, see Evans and Brock (1989), Piore and Sabel (1984) and Acs, Audretsch and Carlsson (1990). Thus small firms survive and prosper, alongside larger firms, because of their relative flexibility. For example, smaller firms are more flexible because they have proportionately fewer impediments to organisational change. To illustrate, they have lesser need to employ hierarchy to control their operation, Reid (1997). Another argument would be that small firms are relatively more flexible because they offer opportunities for the greater intensity of utilisation of variable factors of production. An illustration of this would be their tendency to the casualisation of labour to enhance performance, Reid (1999).

We would agree with Carlsson (1989) that the development of theoretical ideas about flexibility has been to the detriment of improving our knowledge about of its empirical dimensions. Carlsson (1989) identified three important aspects of flexibility in his empirical examination of larger firms. These were operational, tactical and strategic flexibility. Our approach differs from Carlsson in two respects: first we focus on small firm, rather than large firms; and second we focus on the aspect that he found most difficult to calibrate, strategic flexibility.

Earlier evidence on the relationship between flexibility and performance was provided by Smallbone, North & Leigh (1992). They found that firms which had been active in making adjustments were the most successful, in terms of employment change and survival. They used data from mature manufacturing firms in the UK. However, they did not examine the process, or speed, by which adjustments were made, nor did they look at performance implications of such adjustments. Our work aims to remedy these shortcomings of earlier work.

Briefly the development of our ideas is as follows. Section 3 examines the measurement of performance, flexibility and turbulence in the literature. Section 4 discusses the primary source data on which this study is based. Section 5 reports the results of a Heckman selection model, which estimates the effects which flexibility and turbulence have on performance. Finally, Section 6 summarises our principal results.

3. Flexibility, Turbulence and Performance

This section aims to achieve three things. First, it discusses concepts of flexibility and turbulence. Further, we describe how turbulence, agility and speed are to be measured. Second, we discuss conceptual problems of the measurement of performance, leaving to Section 4 the explicit consideration of how we calibrate performance. Third, we discuss briefly the effects we expect flexibility and turbulence to have on performance.

3.1 Measuring Flexibility and Turbulence

According to Stigler (1939) a firm's choice of cost structure determines its level of flexibility. The shape of the cost curve determines how responsive output decisions are to price changes. Flexibility is greater with flat-bottomed average cost curves, and flat or gently inclined marginal cost curves, in the context of U-shaped cost curves. Central to Stigler's notion of flexibility is the idea that expected profit will increase with greater flexibility. Thus, the more flexible a firm is, the higher its expected performance. The marginal gain is greater, the greater is environmental uncertainty. Thus greater flexibility is preferred to lesser flexibility, when the environment is uncertain.

Mills and Schumann (1985) associated the notion of greater flexibility with smaller, rather than larger firms. They argued that small firms achieved greater flexibility through their ability to alter variable factors of production more readily.[1] This source of flexibility enables small firms to thrive in uncertain environments. Mills and Schumann (1985) relied on Stigler's (1939) view that flexibility should be inversely related to the convexity of the cost function. This can be measured by the elasticity of supply at the mean price, where it is assumed that price equates supply and demand, when the environment is uncertain. Empirically, the Mills and Schumman (1985) measure of flexibility was approximated by an index of firm sales variability or employment variability.[2] Other measures adopted were those of Acs, Audretsch and Carlsson (1990). They explained increases in small firm presence, and decreases in mean plant size, using measures of change in production technology. Measures of flexible production technologies explain both the growth in small firms and decreases in the mean plant size. Examples of these measures include: the percentage share of the total number of machines accounted for by numerically controlled machines; the percentage share of the total number of machines accounted for by programmable robots; and the capital labour ratio. These measures of flexibility were found to be suitable approximations, given the availability of data.

In examining flexibility in the theory of the firm, Carlsson (1989) argued that flexibility is not necessarily inherent in small firms. Rather, it arises from the ability of small firms to use variable factors of production as their source of flexibility. This occurs because the existence of few organisational barriers allows small firms to mount a quick response to detected changes in their environment. Relevant to this perspective is Ghemawat's (1991) view on the source of flexibility. He would hold that flexibility arises from the expected added value which the firm can generate from revising its strategy. It does so by adopting alternative courses of action, as the outcomes of uncertain events unfold.

Although Ghemawat (1991) developed the idea in a corporate context, it is also entirely applicable to the small firms' case. Thus it is as true for small firms as for large firms that the value added created by flexibility arises in some sense from "the degree of preparedness". Specifically this refers to the ability of the firm to commit the necessary resources to pursuing different courses of action. Flexibility in this sense is not the optimisation of strategy, but rather the selection of strategies that can be adapted to a range of critical outcomes.

Ghemawat's (1991) conception of flexibility, adapted in our case to the small firm's context, has been influential in our formulation of dimensions of flexibility. In this paper we refer to them as *agility* and *speed*. Agility arises from the ability of the small firm to use variable factors of production to assist in achieving adaptations to its internal organisational structure. Thus the agile small firm is responsive to change or prepared for change. Speed is measured by the ability of the small firm to act expeditiously in the face of both precipitating influences (arising from its environment), and consequential adjustments (arising from its own organisational change). Thus the speedy small firm acts quickly before and after internal organizational change. The lower the reaction-time to detect changes in the environment, the more flexible the firm is.

As well as acting on precipitating influences and consequential adjustments, the small firm needs to be able to detect that circumstances have changed per se. To illustrate, Mata (1993) has found that detecting precipitating influences can be a source of flexibility in small firms, and this ability differs across owner mangers. He found that if owner managers within the small firms' sector were not alert to detecting environmental changes, the presence of small firms would not grow.

There is some deviation in our treatment of turbulence from that used in other parts of the literature of industrial organization. A common approach is that Beesley and Hamilton (1984) who approximated turbulence by accounting for flows in the birth and death of firms in particular industries. However their measure is industry specific rather than firm specific. Closer to our approach is the case study evidence of Markusen and Teitz (1985). In their work, which concerned the underlying dynamics of the competitive environment in which mature small firms operated, they found that the markets of such firms were turbulent. Thus, all firms in the sample were expecting some change, whether in the form of a crisis or of a growth opportunity. Our approach, following Markusen and Teitz (1985), as opposed to Beesley and Hamilton (1984), is to measure turbulence at the firm level. In this paper, *turbulence* is estimated by a count of the number of changes undertaken by the mature small firm, *qua* organisation, over its lifetime. Thus a relatively high number of changes signals that the mature small firm is operating in a turbulent environment.

3.2 Measuring Performance

Several approaches to measuring performance in small firms are possible. For example Reid and Smith (2000) identify three. In particular, they contrast an objective measure (e.g. quantitative measures like profitability and rate of return) with a subjective measure (e.g. a judgmental evaluation of performance, drawing on both quantitative and qualitative evidence). In this paper we adopt the latter approach. It is both more comprehensive, and more compatible with our evidence base. The requirement for a comprehensive measure of performance is consistent with the literature on entrepreneurship and management accounting as applied to the small firm e.g. Wickham, (2001, Ch. 20). Essentially it recognises that the proper control of the firm requires a comparison of current performance to a predetermined plan or objective. This approach would see there being an indissoluble link between the setting of performance standards and the control of the firm by the owner manager. The most commonly conceived performance standards relate to budgets. However there are many other forms including those relating to human factors, like responsibility, and technological ones, like hitting research milestones. As regards the compatibility of the evidence base, the subjective measure of performance evaluation allows us to undertake modelling which is currently not possible given our sample (see Endnote 3). Our sample is actually composed of three sub-samples. Each sub-sample typically has a different range of objective performance measures gathered at different points in time. There is therefore an intrinsic lack of comparability of these measures over the lifetimes of the firms. Resorting to a new performance measurement approach, which is common to the three sub-samples, allows us to proceed with empirical work on a common basis.

The firms examined in this study have, in a sense, passed the long run test of economic survival, and satisfied the aspirations of their founders. Thus owner-managers have before them a body of qualitative and quantitative evidence from which they can evaluate their performance. Naturally there are many dimensions to this performance. To illustrate, over time they have learned how best to combine their factors of production to exploit market opportunities, and they have responded to threats in a way that has improved their performance and enhanced their survival. Given that owner mangers comfortably juggle these various performance measures in their own minds, we consider it logical to explicitly measure the subjective processes by which this juggling act is sustained. To the extent that this measuring exercise is successful, it provides us with a new form of empirical evidence which is useful in econometric estimation.

3.3 Performance, Flexibility and Turbulence

This subsection examines the expected causal relationship between flexibility and turbulence (as independent variables) and performance (as dependent variable). In general greater flexibility is expected to have a positive effect on performance. This is true of approaches to flexibility as diverse as those of Stigler (1939) and Ghemawat (1991). Firm flexibility has been shown to explain relatively greater small firm presence in uncertain environments. This increased presence is therefore indicative of enhanced small firm performance.

As compared to the unambiguous effect of flexibility, the effect of turbulence on performance is less clear. In general, a higher number of organisational changes would reflect a greater degree of turbulence and visa versa however it does not automatically imply improved performance. Reid and Smith (2000b) found that both poorly performing (”stagnant”) firms and high performing (“adaptive”) firms have relatively active discretionary policies. Whereas stagnant firms frequently adopt organisational changes to counteract the consequences of inflexibility in terms of poor performance, adaptive firms frequently adopt organisational changes to facilitate greater growth and other aspects of improved performance.

In general the greater the number of consequential adjustments relative to the number of precipitating causes the less agile is the firm. Here we are interpreting agility as one aspect of performance. The greater the agility of the small firm the better its performance should be. If speed is measured by the time taken to respond to both precipitating influences and consequential adjustments, we should expect speed (in this sense) to influence performance negatively. As we shall see below, when we come to the econometric estimates, it may also be necessary to consider potential tradeoff relationships between agility and speed.

4. Data and Variables

This section presents information on the database and the variables used in econometric estimation. It also provides some amplification of the key hypotheses being addressed, and of the instrument design especially, as it relates to the measuring of performance.

4.1 Database

Briefly the data set that we used for econometric estimation was based on interview evidence obtained from owner managers of long-lived small firms in Scotland. Our sampling frame of 90 long-lived small firms was derived from three "parent" samples of Scottish small business enterprises[3]. These parent samples related to previous fieldwork studies undertaken in the 1980s and 1990s by one of the authors. The parent samples, from which these long-lived small firms were identified, may safely be viewed as random samples from the population of small firms in Scotland at the time of the initial interviews.[4] They provided a convenient set of known sources upon which further fieldwork could be built. Considerable benefit derived from previous contact with entrepreneurs in terms of access to the field. Generally owner managers were happy to be looked up again after long lapses of time.

This approach to identifying long-lived small firms was found to be superior to that offered by the use of independent sources, such as Dun and Bradstreet. There are two reasons for this. (1) Proceeding in our way, data are available on non-survivors, which would not be the case with Dun and Bradstreet. This allows us to analyse the consequences of different strategies adopted by survivors, compared to non-survivors. (2) Importantly, it allows us to correct for sample selection bias in estimating a performance equation.

Of the 90 owner mangers of firms contained in our sampling frame, 63 were willing to be interviewed face to face between October 2001 and February 2002 (a 70% response rate). The owner managers were interviewed using an administered questionnaire. This examined the characteristics of the long-lived small firm, changes in its scale and scope, an analysis of pivotal changes in the running of the firm since start-up, factors which fostered the survival of the firm and the level of innovation and technical change within the firm. General features of the database and the variables used in the course of this analysis are described immediately below.

The firms examined were mature (25 ½ years on average; median age of 22). Almost all sectors by SIC were represented in the sample from agriculture (01) to domestic services (99). The main sectors represented were: 32, mechanical engineering (4.8%); 43, textile industry (4.8%); 61, wholesale distribution (4.8%); 64, retail distribution (23%); 66, hotels and catering (4.8%), 67 repair of consumer goods and vehicles (6.3%); and 83 business services (9.5%). The modal firm was a retailer. The sample proportions between extractive/manufacturers (SIC 01-60) and services (SIC 61-

99) were 37% and 63% respectively. These proportions were similar across each of the 'parent' samples. Of the 267 firms in the three parent samples 101 (38%) were in manufacturing (SIC 01-60) and 166 (62%) were in services (SIC 61-99). Figures from the Department of Trade and Industry, for the UK as a whole, suggest that 27% were in manufacturing and 73% were in services. Thus there is a slight bias towards manufacturing firms in our sample. This partly explained by the slower progression of the Scottish economy to becoming service based, compared to the UK as a whole. It is also probably partly explained by the fact that the parent samples were drawn from the caseloads of Enterprise Trusts. These are business incubation units within Scotland, which in the early years may have had a tendency to favour manufacturing start-ups. The geographic scope of the sample was extensive. The following regions were represented: Aberdeen, Argyll, Aryshire, Banff, Caithneas, Cumnock, Dundee, Fife, Glasgow, Inverness, Isle of Skye, Lanarkshire, Lothian and Edinburgh, Midlothian, Moray, Orkney, Perth, Renfrewshire, Ross and Stirling.

Of the sample of 63 long-lived small firms, one (1.6%) was a sole trader operating from home, fifteen (23.8%) were sole traders operating from business premises, nineteen (30.2%) were partnerships and twenty-five (44.4%) were private limited companies. Eighteen (28.6%) firms changed their legal form during the life of the business. There is general evidence of changes in organisational form, from the sole proprietorship form, to the partnership and private limited company forms, over the lifetimes of the firms, *cf.* Reid (1997). The number of full-time equivalent (FTEs) employees, which is one indicator of the size of these small business enterprises, varied from 1 to 130 with the average and mode being 13.55 and 6 respectively. The average size of firms (and the corresponding standard deviation) in terms of full time equivalent employees were as follows: 5.94 (5.85), sole proprietorship; 7.91(4.08), partnership; and 22.19 (27.69), private company. Size, measured by turnover for the last trading year, also varied widely by business type. Average turnover (and its standard deviation) was: £219,813 (£143,025) for sole proprietorships; £557,526 (£455,994) for partnerships; and £1,372,821 (£1,885,391) for private companies (all figures in 2001 prices).

4.2 Variables

This subsection is concerned with summary statistics on the key variables used, detailed explanation of how they are defined, and an explanation of how the questionnaire design was used to generate variables. In Table I we indicate the key variables that we used in the econometric modeling reported on in Section 5 below.

Age and employees are fairly self-explanatory. Concerning age, it is very evident that we do indeed have a sample of long-lived firms. The average age is about 26 years, (roughly one generation) and no firm was younger than 10 years old. The maximum age in the sample was 90 years (roughly two generations). It should be mentioned that generational issues are of central importance, because many of these mature small firms are family businesses. After one generation, owner managers are frequently looking for exit strategies. A fairly obvious choice is family succession. Given generally favourable conditions in the labour market, and an increasing variety of job options, it turns out that family succession is by no means a foregone conclusion. For this reason the generational effect may have some impact on the lifecycle behaviour of the mature small firm. This is not something that we have explicitly examined but feel that it is worthy of examination in future work.

In terms of firm size (measured by full-time equivalent employees) these mature small firms are on average just above the size of the micro firm (10 employees or less). However the predominant firm type is still the micro-firm and the average size is somewhat raised by the existence of a few large firms in the sample. Essentially, the size distribution of these small firms is something like a Pareto distribution (that is one branch of an hyperbola in the first quadrant), with unity as the lower bound. The variables turbulence, agility and speed have already been discussed in a preliminary way, and are essentially components of our econometric modeling (see Section 5 below). The remaining variables in Table 1, and their construction, will be discussed in the remainder of this sub-section.

Table 1
Mean, standard deviation and range of each variable

Variable	Mean	Standard deviation	Min	Max
Age	25.54	15.73	10	90
Employees (FTEs)	13.55	19.89	1	130
Turbulence	7.90	3.8	2	16
Agility	.8737	.4070	.22	2.38
Speed	21.84	16.19	2.45	73.9
Prior	5.27	2.72	1	15.67
Adjust	7.31	3.33	1.67	16
PriorTime	75.60	62.28	0	260
AdjustTime	54.35	75.18	0	476.33
Perform	67.35	8.10	49.11	90.43

Turbulence was calculated using a frequency count of the number of key organisational changes to which long-lived firms were subject, over their lifetimes. Owner-managers were presented with a list of eighteen such changes. This list was diverse, including features like ownership, legal form, technical, location, cashflow, line of business, capacity, investment, product range, market positioning, diversification and management. The occurrence of key organisational changes (and the year in which they occurred) was recorded.[5] Owner managers were not limited to those listed. They were allowed to specify other main changes if they wished.

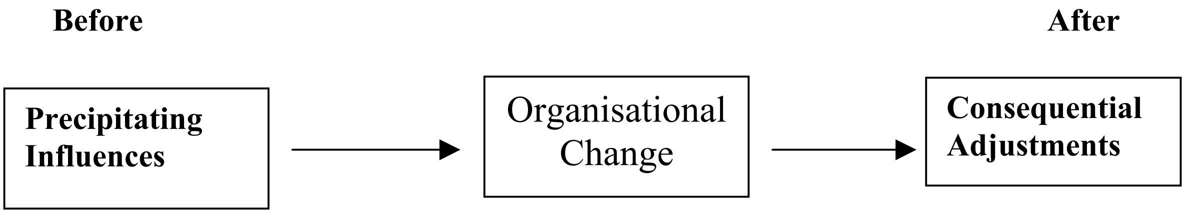
These key changes can be can be interpreted as critical decisions. Throughout the course of its life the mature small firm makes such decisions. Crucially, these critical decisions involve the commitment of resources (Ghemawat, 1991). Such changes can have positive or negative impact. When we refer to the performance variable, the implications of this will be drawn out. Essentially, our key changes are to be interpreted as ‘pivotal points’ or ‘crossroads’, rather than as crisis points. Typically they are strategic in nature, and at one remove from the more routinised decisions undertaken by the mature small firm on a day-to-day basis. Because of this, the consequences of these key changes are typically unpredictable: there is always a measure of uncertainty about the outcomes of such changes. They are treated below as contingent events, which are driven by environmental forces.

In a technical sense *Turbulence* was calculated as $\sum X_i$ where X_i is the occurrence of a change *i*. Emphasising the pivotal nature of key changes, we observe that they occur, on average, just eight times over the lifetime of the long-lived small firm (see Table 1). The range of key changes was fourteen and the maximum number of changes was just sixteen. Thus owner managers were clearly being very discriminating in interpreting any change in their operations as being a key change.

Measures of agility and speed were obtained as follows. For the key changes identified by each long-lived small firm, the owner-manager was asked to select those three which were most important to the running of their business, since inception. Just three changes were extracted for more detailed consideration, because pilot work had suggested that this was the best way of capturing salient information from the interviewing. A simple diagrammatic device (see Figure 1) was used in interviews with owner managers to explain our focus of interest. We explained that we wanted to know what had precipitated organisational change, and what adjustments had been made after it had been achieved. We used the term ‘precipitating influences’ to describe the forces, which led to organisational change. In a similar vein, we used the term ‘consequential adjustments’ to describe those adaptations which followed on from organisational change.

An advantage of the Figure that we used was that it made quite explicit the pattern of causal relationships. This, in turn, made it easier to get owner managers to estimate the intervals of time that occurred between precipitating influences and organisational change, and between organisational change and consequential adjustments.

Figure 1
Explanation of Causation



Owner managers were presented with a show-card on which they could identify precipitating causes and consequential adjustments. This show-card contained a comprehensive list of 30 potential categories of precipitating causes and consequential adjustments. An extract from this show card is given in Figure 2.[6] That Figure also indicates how responses were recorded. Figure 2 indicates some of the factors we were interested. Other ones included credit policy, finance, trade intelligence and cash-flow. These factors were liberally. For example, if a respondent checked demand as a precipitating or an adjustment factor, it could be as a result of either an increase or a decrease in demand. The important thing was that a change had occurred in this factor, which drove or followed the organisational change.

This line of inquiry was conducted for three organisational changes, over the mature firm's lifetime, that the owner manager had identified. Thus the sequence by which the data were elicited were as follows. First, the owner manager was asked to identify the precipitating influences from the list of 30 factors (in the format displayed, in an abbreviated way,) in Figure 2. Second, the owner manager was asked to identify the number of months (pt, which stands for '*PriorTime*') which elapsed between identifying the precipitating cause and the identifying the organisational change within the firm. Third, owner managers were asked to identify the consequential adjustments which followed the change in organisational form. Fourth the owner managers were asked to identify the number of months (at, which stands for '*AdjustTime*') which had elapsed between the occurring of the organisational change and the appearance of the consequential adjustment.

Figure 2
Response Format for Calibrating Change

Time	*Before*	*Factors*	*After*	Time
	□	**1. Headcount**	□	
	□	**2. Demand**	□	
	□	**3. New niches**	□	
	□	**4. Tax efficiency**	□	

Agility, is the ratio number of precipitating causes (P) to number of consequential adjustments (A). Agility was calculated for each of the three main changes identified by each respondent by counting the number of precipitatingfactors and adjustment factors for each change. A smaller ratio implies that the firm is more agile and thus more flexible. Formally agility is measured by the count of precipitating factors (P) divided by the count of adjustments (A) averaged over three main changes. Thus agility is calculated as

$$\frac{\sum_{c=1}^{m}\left(P_c / A_c\right)}{\sum_{c=1}^{3} m_c} \tag{1}$$

where $A=\sum a_{jm}$ where a_{jm} is the occurrence of adjustment j for each change m and $P = \sum p_{jm}$ where p_{jm} is the occurrence of precipitating factor j for each change m where $\sum_{c=1}^{3} m_c$. On average the firm's agility ratio is 0.8737. This ratio is less than 1, which implies that long-lived small firms are agile enough to alter more of the factors of production than drivers of organisational change. The average number of prior or precipitating causes is (*Prior*) is 5.27, whereas the average number of consequential adjustments (*Adjust*) is 7.31.[7]

The second measure the overall speed of adjustment is another important aspect of flexibility. Three measures of speed of adjustment can be obtained from the questionnaire structure, for each of the three main organisational changes identified by the owner manager. These are: the length of time from the emergence of precipitating factors to the organisational change; the length of time from the organisational change to changes in adjustment factors; and the summation of the two. The shorter are these time periods, the more flexible is the long-lived small firm. The overall speed of adjustment can be obtained by summing the average precipitating time and the average adjustment time. It is calculated here as

$$\frac{\sum_{c=1}^{3}\left(P_t + A_t\right)_c}{\sum_{c=1}^{3} m_c} \tag{2}$$

The average precipitating time is the sum of the number of months between detecting each precipitating factor (or 'driver') and making the organisational change, divided by the number of precipitating factors. Average precipitating time P_t is calculated as $\sum pt_{jm}/\sum p_{jm}$ where pt_{jm} is the length of time between each precipitating factor j and the occurrence of each main organisational change m. The average adjustment time is the sum of the number of months between making the organisational change and each consequential adjustment, divided by the number of adjustment factors. Average adjustment time A_t is calculated by $\sum at_{jm}/\sum a_{jm}$ where at_{jm} is the length of time between the occurrence of each main change m and each adjustment j. On average the firm's overall adjustment speed is 22 months. The less the time taken in adjustment, the more flexible is the small firm. The average total precipitating time (*PriorTime*) was 76 months whereas the average total adjustment time (*AdjustTime*) was 54 months.[8] As the average number of precipitating factors was less than the number of adjustments this suggests that small firms lingered until they were certain that change was required and then responded quickly.

A quantitative indicator of performance was obtained from a multidimensional scale with 28 items. These covered the strategic (9 items), financial (4 items), and organisational aspects (4 items) of the long-lived small, as well as environmental forces (11 items) affecting their performance.[9] We would hold that our approach has advantages over the using of conventional financial data. These are subject to accounting conventions (e.g. the reporting protocol) that make them difficult to interpret in sensible economic terms. This is especially true of accounting profit, as opposed to economic profit. Thus rate of return, or profitability, may both seem suitable quantitative indicators for assessing the performance of the mature small firm, but this fails to grapple with quite simple aspects of reality, like the fact that profit itself may be ill-defined in most small firms e.g. profit may not be well distinguished from income. We could, of course, have substituted a simple single question on self-appraisal of performance, for the more conventional type of question on rate of return. However, we would argue that our multidimensional approach has two main advantages over the single question approach. First, it produces detailed measurement across a wide spectrum performance-relevant variables, rather than a single variable. Second, by diluting variable specific effects, it produces a more comprehensive (and stable) of what is meant by performance, allowing common influences to come through (DeVellis, 1991).

The question put to owner managers was as follows: "*We'd like to know what has kept you in business down the years. Some things are good for business and some things are bad. What effect have the following had? "*. The owner managers were asked to rate[10] each item on a scale of 0 to 100 where 100 is good, and 0 is bad and 50 is neutral. They did so by placing a cross on the line, in this way calibrating the influence they judged this item to have had, based on actual experience of running the business. If an item was not applicable they were asked to say so. An extract of the scale is reproduced in Figure 3. We found that owner managers of our long-lived small firms could readily draw on their experience of running a business, to self-appraise the influence that each of these items had had on their performance. A self-assessment of each item's influence on the performance of the firm was thus obtained. Thereby a measure of overall performance, which summed these individual scores, was computed. An overall score for performance (*Perform*) was calculated for each firm, based on the summation of ratings for factors, normalised to take account of those items that were not applicable. Out of a maximum performance score of 100, the average long-lived small firms scored 67. In other words, for these long-lived small firms, many potential influences had a positive effect on performance.

Figure 3: Response Format for Performance Indicator

4.1 We'd like to know what has kept you in business down the years. Some things are good for business and some things are bad. What effect have the following had?

[Show with a cross whether the effect was good or bad.]

	N/A	Bad		Neutral		Good
Technology	☐	**0**	**25**	**50**	**75**	**100**
Rival's Innovation	☐	**0**	**25**	**50**	**75**	**100**
Regulation	☐	**0**	**25**	**50**	**75**	**100**

Table 2 examines our measures of turbulence, flexibility and performance, depending on firm type. We note that firm type is closely correlated with firm size. We have tested for differences between the mean values of these variables, across the sole proprietor, partnership and private company firm types, within our sample. We find that there *is* a significant difference in the mean sizes, whether measured by employment or sales. However, there are no significant differences in the means of our measures of turbulence, agility or speed, across firm types. This lends general support to Carlsson's (1989) theory that there are some aspects of flexibility, which are not related to size. There also find that there is no difference in the subjective measure of performance for different firm types (and therefore sizes). This is also true if we use a more 'objective' conventional measure of performance, like labour productivity (*LabProd*), here defined by sales divided by fulltime equivalent employees. The central concern of our paper is whether our dimensions of flexibility and turbulence are helpful in explaining long run differences in the performance of small firms, given that there are no significant differences in the performance and flexibility of these small firms by virtue of their type and size.

Table 2: Flexibility, Firm Size and Performance**

Variable	Sole Proprietor *(n=16)*	Partnership *(n=19)*	Private Company *(n=28)*
Sales*	219812	557526	1372821
	(143026)	(455994)	(1855391)
Employees (FTEs)*	5.94	7.24	22.18
	(5.85)	(4.15)	(27.18)
Turbulence	7.94	7.11	8.43
	(3.07)	(3.31)	(4.46)
Agility	.8896	.8781	.8617
	(.3431)	(.5316)	(.3554)
Speed	19.5478	20.6476	23.9555
	(13.1333)	(15.9629)	(18.0923)
Perform	69.1519	66.5217	66.8754
	(9.4962)	(8.2249)	(7.2764)
LabProd	55032	72339	64425
	(45063)	(3134)	(76271)

*Significant difference in means using ANOVA at α=.05 and $F_{(2\ 60)}$
**The standard errors are in parentheses.

5. Estimates

To examine the degree to which our different measures of flexibility and turbulence affected the performance of our long-lived small firms, we used Heckman's selection model (Lee 1982 and 1983; and Heckman 1976). This model assumes that there exists an underlying relationship between performance *Perform, Turbulence* and our measures of flexibility (e.g. *Adjust*, *AdjustTime*) of our long-lived small firm [11]

$$Perform = \beta_0 + \beta_1\, Turbulence + \beta_2 Precipitating + \beta_3 Adjust + \beta_4 PriorTime + \beta_5 AdjustTime + u_{1i}$$

where $u_1 \sim N(0, \sigma)$. Sample selection bias may exist, as the measures of performance turbulence and flexibility are only observed for long-lived small firms, and not for all firms, including non-survivors. Therefore a probit model of firm survival is estimated initially, using maximum likelihood estimation, to calculate the so-called inverse Mills ratio (lambda);

$S = X\beta + u_{2i}$

where S is a binary variable, which is set equal to unity if the firm has survived, but otherwise to zero. The matrix X contains observations on those factors thought to influence the long-run survival of small firms (e.g. number of full time and part-time employees, gearing and number of product groups), the vector β contains the estimated parameter coefficients and $u_2 \sim N(0, 1)$. The correlation between u_1 and u_2 is given by ρ. With the inverse Mills ratio as an additional regresssor in the general least squares estimation, Heckman's (1979) two-step procedure provides efficient estimates of the parameters, standard errors and covariance matrix.

Initially our model was run on a sample of 186 firms. A complete data set exists for the 63 long-lived small firms for the ordinary least squares regression. However, as the sample of long-lived small firms was gathered from 3 different 'parent' samples, complete data for the sample selection equation exists only for the industrial sector (*Sector*), start year (*StYear*), sales in early years of trading (*StSales*), full-time employees (*Ftemployees*) and part-time employees (*PtEmployees*). Data on *gearing* and number of product groups (*ProdGroup*) are just available for a sub-sample of 89 firms. As a result, only a rudimentary measure of survival is obtained. The results of the Heckman selection model with a sample size of 186 and 89 are presented in Tables 4 and 5 below.

Generalised least squares is applied to estimate the impact of our flexibility and turbulence measures on performance. As an initial inspection of the graph of the residuals from the ordinary least squares regression against the predicted values demonstrated, the residuals were increasing with values of the predictors. To correct for this, the ordinary least squares model was weighted by the reciprocal of *Sales*, as *Sales* were found to be proportional to the absolute value of the residuals, using the Glejser test for heteroskedasticity. This procedure was found to remove the heteroskedasticity. The generalised least squares model presented in Table 3 had an R^2 of 0.99 with probability value of 0.000. We focus discussion on the results of tables 4 and 5, as these estimates have been corrected for selectivity bias. It will be observed that the results in Tables 3, 4 and 5 are broadly similar, as may be expected, as ρ is close to zero, suggesting selectivity bias is not a major problem.

In the sample selection equation in Table 4 sales at start-up (*StSales*) is significant. That is, size at inception has a positive effect on long run survival. A 1% increase in mean sales at start-up increases the probability of survival by 0.2%. The number of product groups (*ProdGroup*) is significant at the 10% level in Table 5. Here, gearing, and the number of product groups are included in the estimation of the sample selection equation. A 1% increase in mean number of product groups early in the lifecycle increases the probability of survival by 0.52%. This is consistent with the results found by Reid (1991), with respect to product groups.

In examining the survival of small business firms start-ups Reid (1991) also found that gearing had a significant negative effect on small firm survival. Here gearing has a negative sign, but it is not a significant predictor of long run survival. If equity finance is a cheaper source of finance capital, Reid (2002) found that the optimal strategy for the highly geared small firm was to retire debt early in its lifecycle. However, later in its lifecycle many forms of finance capital could be appropriate to the long-run survival of a specific firm.

Being in manufacturing (the *Sector* variable equal to unity) has a negative influence on survival, as indicated by the evidence in Table 4 (sample size n = 186), but a positive influence in Table 5 (sample size n = 89). This conflicting result probably occurs because the sample of 89 firms has a greater representation of manufacturing firms. All manufacturing firms were subject to the pressures of de-industrialisation, but this effect is proportionally less in a sample containing more firms in manufactures. There is a lesser representation of manufacturing in the full sample, as discussed in Section 3 above. For this, approximately 60% of firms in the sample were services and 40% manufacturing. This closely reflects the population of small firms in the UK as discussed above.

The number of both fulltime (*FTEmployee*) and part-time employees (*PTEmployee*) has a negative effect on survival cf. Reid (1999). This suggests a larger headcount has a negative effect on long run survival, regardless of whether it is casual labour or fulltime employees. Long-lived small firms are slow to employ new staff due to strict employment laws. In addition, growth in services firms which have lower head-counts, and the decline in manufacturing, explain this result. However, here, their impact on survival is not statistically significant.

The year the firm was founded (*StYear*) was included as a proxy for age of survivors and non-survivors, as we do not have data on the year in which the vast majority of non-survivors in our sample ceased to trade. Care has to be taken in interpreting this variable as a result. It has a negative sign, which suggests the longer these small firms are in business, the more likely they are going to exit from the market. Thus it suggests that if the owner-manager is retiring, and there is no market for the small business, nor family member to take over the running of the business, the small firm is likely to cease trading. However, this effect is not statistically significant. We move now to consider the selection equation.

We find that *Turbulence* has a negative impact on performance. A 1% increase in the mean count of organisational changes reduces performance by 0.24%. This has a larger impact than all the other variables in the performance equation. There is an intuitive explanation for this, which supports the interpretation of Reid and Smith (2000b). It is that the relationship between turbulence and firm performance tends to be U shaped. Both poorly performing firms (or "stagnant" firms in their terminology) *and* highly performing firms (or "adaptive" firms in their terminology) tend to be relatively active in undertaking changes, compared to moderately performing firms. Thus, stagnant firms are active in making organisational changes to survive, whereas adaptive firms are active in making organisational changes to improve performance and promote growth. A larger proportion of these relatively "stagnant" firms in our sample are driving the negative relationship between *Turbulence* and *Performance*. Only a small proportion are experiencing positive dynamics. This suggests that there is another selection process here, besides the long-run test of economic survival: that is, whether or not the small firm grows to be a large firm - a "gazelle" as described by Birch (1996). Most of the long-lived small firms have succeeded in the first selection process but very few are triumphant in the second.[12]

A complex relationship exists between flexibility and performance according to the evidence presented in Tables 4 and 5. The number of precipitating or prior causes (*Prior*) has a significant and positive effect on performance. However, the longer it takes the mature small firm detect changes in its environment (*PriorTime*), the worse is the impact on its performance. A 1% increase in the mean count *Prior* increases performance by 0.15%. A 1% increase in the mean precipitating time (*PriorTime*) reduces performance by 0.07%. That is to say, given a larger number of detected drivers of a change, a firm has greater certainty that change is necessary to improve performance, including sheer survival. However, if a firm is slow to respond to detected drivers of change, it risks being too late to achieve improvements in performance from instigating the organisational change. That is, a trade-off exists. The longer the *PriorTime* the more *Priors* are detected. The more *Prior*s detected, the more there is certainty surrounding the performance implications of a change; but the longer it takes the firm to instigate the change (*PriorTime)* . That is, the mature small firm fails to capture some of the improvements in performance.

The number of Adjustments (*Adjust*) is not significant in Table 4 (sample size n = 186), but has a positive and significant effect on performance when we turn to the evidence in Table 5 (where n=89). There, a 1% increase in the mean count of adjustments (*Adjust*) increases performance by 0.10%. A reduced number of long-lived firms are examined in the latter model due to incomplete data on gearing (*Gearing)* and the number of product groups (*Pgroups)*. The number of uncensored observations is 30. *AdjustTime* has a positive and significant impact on performance. A higher number of adjustments (*Adjust*), following organisational change, increases the performance of the long-lived small firm. The more adjustments the firm makes, for a given level of drivers of change, the more agile the firm, and in this sense, the more flexible, the firm. A higher number of adjustments also signals commitment by the firm to organisational change. Furthermore, a greater commitment by these firms signals that the organisational change has significant implications for firm performance (including survival). The number of consequential adjustments (*Adjust*) has a much smaller impact on *Performance* than does the number of precipitating causes (*Prior*) (0.1% versus 0.2% respectively). This suggests that the certainty of the economic implications of an organisational change within the mature firm is more important than the number of adjustments made following the change. Misconstrued benefits of strategic changes impinge on firm performance.

A firm, which is slow to adjust, may have difficulty altering the factors of production, and thus is not agile. But in this instance *AdjustTime* seems to be reflecting a trade-off which exists between the number of adjustments *(Adjust),* and the adjustment time. A 1% increase in the mean adjustment time increases performance by 0.09%. By staging adjustments, a firm increases its option value to withdraw from a misdirected change and thereby increases its flexibility. However, it takes longer to receive payoffs from the organisational change. Thus increases in the option value of flexibility come at a cost. A longer adjustment time also reflects improved performance, in terms of sales growth and profitability, as the economic implications of organisational changes take longer to come to effect than other adjustments, such as changes in headcount or marketing.

The results in Tables 3, 4 and 5 are broadly similar except for the significance of adjustment (*Adjust*), which is only significant in Table 5. The elasticities calculated at the means are slightly higher in Table 5, which uses the broader sample selection equation. The fact that the results are similar in the estimation in Table 5, on slightly less than half the sample of long-lived small firms, indicates how robust the results are. ρ is close to 0.12 and 0.04 in Tables 4 and 5, respectively, suggesting that the correlation between the errors of the general least squares regression and the sample selection equation is very weak. We aim to undertake further research which will build on these estimates, using Box-Cox transformations to account of interaction effects. One of these is the interaction effect between *Prio*r and the time it takes the firm to adjust to detected priors or drivers (*PriorTime*). The other is the interaction effect between the number of adjustments (*Adjust*) and the time it takes for all adjustments to occur (*AdjustTime*).

Table 3 Generalised Least Squares *(n=186)*

Estimation	Coeff.	Std. Error	Prob.	Elasticities at mean
GLS				
Turbulence	-1.701831	0.2878478	0.000	-0.2525534
Prior	1.852652	0.5263581	0.001	0.151157
Adjust	0.2762535	0.4601972	0.551	0.0306325
PriorTime	-0.0819913	0.0435265	0.065	-0.0648971
AdjustTime	0.1163448	0.0189599	0.000	0.0940773
Constant	67.7238	3.10898	0.000	1.041584

Note: R^2 adjusted =0.99; $F_{(6, 56)}$=67.6 Prob.>F = 0.0000

Table 4 Heckman Sample Selection Model *(n=186)*

Estimation	Coeff.	Std. error	Prob.	Elasticities at mean
GLS				
Turbulence	-1.679331	0.1928492	0.000	-0.2470291
Prior	1.886974	0.3946002	0.000	0.1526074
Adjust	0.2794347	0.3605423	0.438	0.0307136
PriorTime	-0.0883651	0.0254937	0.001	-0.0693288
AdjustTime	0.1156801	0.0114233	0.000	0.0927197
Constant	67.18461	1.975877	0.000	1.02423
Selection Equation				
Sector	-0.0416648	0.2002715	0.835	-0.0727281
FTEmployee	-0.0040999	0.0120681	0.734	-0.0260707
PTEmployee	-0.013339	0.0171223	0.436	-0.0422587
StYear	-0.0030649	0.0111117	0.783	-0.2644557
StSales	5.00E-07	2.50E-07	0.045	0.1986496
Gearing				
ProdGroup				
Constant	-0.2515869	1.007342	0.803	
Mills-lambda	814015	1065096	0.445	
Rho	0.12243			
Sigma	6649056			
Wald chi2(6)	10035.63			
Prob>chi2	0.0000			

Table 5 Heckman Sample Selection Model *(n = 89)*

Estimation	Coeff.	Std. error	Prob.	Elasticities at mean
GLS				
Turbulence	-1.793477	0.215148	0.000	-0.2727101
Prior	2.405389	0.5098721	0.000	0.2010891
Adjust	0.945891	0.4272299	0.027	0.1074695
PriorTime	-0.1539495	0.0378933	0.000	-0.1248546
AdjustTime	0.1029675	0.0132173	0.000	0.08531140
Constant	63.40325	2.460651	0.000	0.9991559
Selection Equation				
Sector	0.2813531	0.319048	0.378	0.4416197
FTEmployee	-0.0038659	0.0208656	0.853	-0.0221049
PTEmployee	-0.0122082	0.01904	0.521	-0.0347784
StYear	-0.0160978	0.0272271	0.554	-1.249021
StSales	7.55E-07	4.43E-07	0.088	0.2697655
Gearing	-0.0002321	0.0005276	0.660	-0.0272064
ProdGroup	0.211399	0.1235461	0.087	0.5181847
Constant	-0.1704371	2.369223	0.943	
Mills - lambda	284672.3	1754376	0.887	
Rho	0.03646			
Sigma	6820567			
Wald chi2(5)	7483			
Prob>chi2	0.0000			

6. Conclusion

This paper examines the effects of flexibility (using our measures of agility and speed) and turbulence on an entrepreneur-appraised measure of performance for, the long lived small firm in Scotland. The performance measure incorporates aspects of its competitive environment, financial management, organisational structure and business strategy. We have described the features of our data, collected by field work methods, and used to create new measures of flexibility, turbulence and performance. A Heckman model with sample selection model was used to explain how differences in flexibility and turbulence affected the performance of the long-lived small firm. The estimates suggest that a complex relationship exists between the flexibility and performance, in this context.

We found that our firm-specific measure of turbulence (frequent organizational change within the mature small firm) had a negative effect on performance. Low performing small firms are perhaps driving the direction of this relationship between turbulence and performance. Such firms are 'chopping and changing', to counteract poor performance in the past. Only a small proportion are experiencing positive dynamics. Such firms may have passed the long-run test of economic survival, but they have not become superior performers. The number of consequential adjustments (following an organisational change within the firm) has a much smaller impact on its performance than the number of precipitating causes of change. The lesson that we draw form this is that the certainty of the economic implications of a change is important. The misguided use of resources can impinge negatively on the mature small firm's performance.

We conclude that there is an element of risk associated with undertaking organisational changes. Two trade-offs were shown to exist. First, the larger the number of detected drivers of a change, the more certain it is that the change is necessary to improve performance or survival. However, if a mature small firm does not respond in a timely manner to detected drivers of change, it risks being too late to generate all of the potential payoffs from instigating the organisational change. Second, by staging adjustments, a firm increases its option value to withdraw from a misdirected strategic change. This increases the flexibility of the firm. However, it takes longer to receive payoffs from the organisational change. These tradeoffs describe the complexity of the relationship between flexibility and performance, where the owner-managers of flexible small firms have to assess the risks to performance of committing resources sooner, rather than later, to a particular strategic change.

Appendix

Definition of variables used in main text

Age	Age of firm, in years.
Agility	Agility is the ratio of precipitating to adjustment factors averaged over three main changes.
Adjust	Count of adjustments averaged over three main changes = $\sum a_{jm}/3$ where a_{jm} is the occurrence of adjustment j for each main change m
AdjustTime	Total adjustment time averaged over three main changes $=\sum at_{jm}/3$ where at_{jm} is the length of time between the occurrence of each main change m and each adjustment j
Employees	Number of full-time equivalent employees in 2001
FtEmployee	Number of full-time employees at start-up
Gearing	=bank loan/personal injection
LabProd	= Sales/ Employees
Perform	$= \sum f_i/n$ where f_i is the self appraised score between 0-100 for each factor averaged overall factors 1 to n which were applicable.
Prior	Count of precipitating factors averaged over three main changes = $\sum p_{jm}/3$ where p_{jm} is the occurrence of precipitating factor j for each main change m
PriorTime	Total precipitating time averaged over three main changes $=\sum pt_{jm}/3$ where pt_{jm} is the length of time between each precipitating factor j and the occurrence of each main change m
ProdGroup	Number of product groups
PtEmployee	Number of part-time employees at start-up
Sales	Sales in 2001
Sector	=0 services (sic 61-99), 1 =manufacturing (sic 01-60)
Speed	The overall speed of adjustment can be obtained by summing the average precipitating time and the average adjustment time and dividing by the number of main changes $\sum_{c=1}^{3} m_c$
StSales	Sales at first interview (1985 for SBE, 1991 for telephone, 1994 for Leverhulme) at 2001 prices
StYear	Year the business was established
Survival	=1 survivor, 0 otherwise
Turbulence	Count of main changes over life of long-lived small firm $= \sum X_i$ where X_i is the occurrence of a change i

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Endnotes

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[1] Mills and Schumann (1985) developed a model where the existence of available technologies affords a tradeoff between static efficiency and flexibility so that in market environments with fluctuating demand it is possible for firms with higher minimum average cost also to survive if they are sufficiently flexible. Technologically diverse firms are able to compete with each other by relying on offsetting cost advantages as a result of this tradeoff. This technological diversity was associated with smaller sized firms because they use variable factors of production more rigorously than large firms.

[2] This was taken as the standard error of regressions adjusted for serial correlation where the natural logarithm of annual sales (or employment) from 1970 to 1980 was regressed onto a constant and a linear time trend. See Mills and Schumann (1985).

[3] Our sample is derived from three original samples. Data on the first parent sample of 86 small business enterprises (SBEs) in Scotland was collected between 1985 and 1988 using face-to-face interviews and examined in Jacobsen (1986), Reid and Jacobsen (1988), Reid and Jacobsen, Andersen (1993) and Reid (1993). This study examined factors effecting the survival, growth, performance and competitive strategy of these small firms in their early years. Of these 86 firms 25(29%) survived. The 25 long-lived survivors from this sample are pooled with long-lived survivors from the other two parent samples of small business enterprises in Scotland. Data on the second sample was collected by telephone in 1991. These 160 firms were more mature at the time and examined in Reid (1996). The administered questionnaire covered financial aspects of a very small firms existence, including funding shortages, forms of external finance, relations with banks and perceptions of the venture capital market. 50 out of the 160 firms are still in business (a survival rate of 31%). Thirdly 21 long lived small firms which were 10 years are more were also identified from a sample new business starts which were interviewed using face to face interviews

between 1994 –1997 on their finance, costs, business strategy, human capital, organisation and technical change. These firms were examined by Reid and Smith (2000a) Reid (1991) and Smith (1997) and Smith (1998). 15 out of 21 were still trading (a survival rate of 71%). According to figures produced by the Small Business Service (2001) in the Department of Industry and Trade between 1993 and 1996 the numbers registered for VAT had fallen by 40% which is a lot over a three year period (survival rate of 60%) in comparison with a survival rate of approximately 30% over a 16 year period. This demonstrates how difficult it is to trying to generate a large sample of long-lived survivors with such high failure rates.

[4] See Reid (1993), Reid and Andersen (1992), Reid (1996) and Smith (1997).

[5] This created a duration variable from the point of inception for each change that had occurred.

[6] This question structure and design format improves on innovative aspects of the data design used in Reid and Smith (2000b) to explain changes in the management accounting system of small business enterprises using contingency theory. Cause and effect is identified here.

[7] The average number of priors and the average number of adjustments are calculated by dividing

$\sum_{c=1}^{3} P_c / \sum_{c=1}^{3} m_c$ and $\sum_{c=1}^{3} A_c / \sum_{c=1}^{3} m_c$ respectively.

[8] The average total precipitatingtime and the average total adjustment time are calculated by dividing

$\sum_{c=1}^{3} A_c \Big/ \sum_{c=1}^{3} m_c$ and $\sum_{c=1}^{3} P_c \Big/ \sum_{c=1}^{3} m_c$ respectively.

[9] The factors were generated from theory and empirical evidence from studies examining differences in the performance of long-lived small firms.

[10] Rating factors along a continuum is a much easier task than ranking the list of factors from top to bottom especially for long lists of factors. The ranks can be tied when the factors are rated. The consistency which owner-managers rate factors on each scale item is also improved by defining the meaning respondents should assign to middle alternatives using adjectival labeling of points which is undertaken here.

[11] The regressors are included in their raw count form. Multicollinearity would exist in the model if the measure of agility and speed were included as speed is a linear function of agility.

[12] Another contributory factor is the standardisation of the measure of performance. If we do not standardise the measure of performance by dividing by the numbers of items on the multidimensional scale measuring performance applicable to each firm, a measure, which accounts for a the full 28 items underlying the performance of the firm can be calculated. This unstandardised measure of performance will account for greater variation in performance. As more items perhaps underlie the performance of adaptive firms and they should receive a higher score on this unstandardised measure of performance. As a greater number of items are perhaps applicable to adaptive firms the standardised measure of performance is biased downwards for adaptive firms. The standardised measure was calculated. Turbulence was positively correlated to this performance measure but as the residuals in the ordinary least squares regression were non normal the analysis of these models are not presented here.