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

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Abstract. The hypothesis that flexibility enhances the long run prospects of the small firm is explored by examining precipitating causes of organizational change within it, and consequential adjustments. The study is fieldwork based and uses evidence gathered directly from entrepreneurs. New measures of flexibility and firm-specific turbulence are used to explain long-run performance, measured over 28 distinct attributes. Econometric estimates (using GLS and Heckman selectivity correction) are reported, on the relationship between flexibility, firm-specific turbulence and performance. Firm-specific turbulence is shown to have a negative effect on performance, but the latter is enhanced by increasing the flexibility of the small firm.

Key words: Flexibility, firm-specific turbulence, performance, small firms.

JEL Classifications: C42, D21, G33, L2, M13, M21.

I. Introduction

The paper explains the performance of long-lived small firms in terms of firm-specific turbulence and flexibility. The evidence suggests that (a) a trade-off exists between agility and speed (our measures of flexibility) in responding to changes; and (b) that firm-specific turbulence has a negative effect on performance. We explore below the relationship between firm-specific turbulence, flexibility and performance 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.

The flexibility of small firms explains their growth and viability, (see Piore and Sabel, 1984; Brock and Evans, 1989; Acs et al., 1990). Thus

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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, 1998). 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 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 firms, 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 et al. (1992). They found that firms which had been active in making adjustments were the most successful, in terms of growth in real turnover, 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 II examines the measurement of performance, flexibility and firm-specific turbulence in the literature. Section III discusses the primary source data on which this study is based. Section IV reports upon the results of a Heckman selection model, which estimates the effects which flexibility and firm-specific turbulence have on performance. Finally, Section V summarises our principal results.

II. Flexibility, Firm-Specific Turbulence and Performance

This section aims to achieve three things. First, we discuss concepts of flexibility and firm-specific turbulence. Second, we discuss conceptual problems of the measurement of performance, leaving to Section III the explicit consideration of how we calibrate performance. Third, we discuss briefly the effects we expect flexibility, and firm-specific turbulence, to have on performance.

1. Measuring Flexibility and Firm-Specific Turbulence

According to Stigler (1939), a firm's choice of cost structure determines its degree 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 Schumann (1985) measure of flexibility was approximated by an index of firm sales variability or employment variability.[2] Other measures adopted include those of Acs et al. (1990). They explained increases in small firm presence, and decreases in mean plant size, using measures of change in production technology.

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 organizational 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

[1] Mills and Schumann (1985) developed a model where the existence of available technologies engenders 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).

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 optimization 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 organizational 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 organizational 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. Thus, the specific interpretation of *speed* we use throughout this article is that of "elapsed time". The shorter is elapsed time, the greater is "speed" in the conventional sense. Our elapsed time interpretation of *speed* should be kept in mind throughout this article.

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 firm-specific turbulence from that used in other parts of the literature of industrial organization. A common approach is that of Beesley and Hamilton (1984) who approximated firm-specific 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, firm-specific turbulence (*FSTurbulence*) is estimated by a count of the number of changes undertaken by the mature small firm, *qua* organization, over its lifetime. Thus, a relatively high number of changes signals that the mature small firm is operating in a turbulent environment.

2. Measuring Performance

Several approaches to measuring performance in small firms are possible. For example, Reid and Smith (2000a) 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. 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 footnote 3). In adopting a subjective performance measure, it may be noted that so-called objective performance measures also have subjective elements to them, not the least being that the data were recorded and manipulated by human subjects who are prone to error and exercise judgment. In the small firms context, such weaknesses in so-called objective measures arise particularly from failure to value intangible assets, difficulty in distinguishing profit from income, and poor reliability of accounting records when ownership and control are not separated, (see Sapienza et al., 1988; Keasey and Watson, 1991; Reid, 1993). 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 our 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-managers comfortably juggle these various performance measures in their own minds, we consider it logical to measure explicitly 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. Performance, Flexibility and Firm-Specific Turbulence

This subsection examines the expected causal relationship between flexibility and firm-specific turbulence (as independent variables) and performance (as dependent variable). In general greater flexibility is expected to have a positive effect on performance, (Stigler, 1939; 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.

The effect of firm-specific turbulence on performance is less clear. In general, a higher number of organizational changes would reflect a greater degree of firm-specific turbulence and *vice 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 organizational changes to counteract the consequences of inflexibility in terms of poor performance, adaptive firms frequently adopt organizational 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.

III. Data and Variables

This section presents information on the database and the variables used in econometric estimation, amplifies the key hypotheses, and explains the instrument design.

1. Database

The data set was based on interviews with owner-managers of long-lived small firms in Scotland. Our sampling frame of 86 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 are random samples from the population of small firms in Scotland at the time of the initial interviews.[4]

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 analyze 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 86 owner-managers of firms contained in our sampling frame, 63 were willing to be interviewed face-to-face between October 2001 and February 2002 (a 73% 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.

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[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 (1998), Reid et al. (1993) and Reid (1993). This study examined factors affecting 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 113 firms were more mature at the time and examined in Reid (1996). The administered questionnaire covered financial aspects of a very small firm's existence, including funding shortages, forms of external finance, relations with banks and perceptions of the venture capital market. 46 out of the 113 firms are still in business (a survival rate of 41%). Thirdly, 20 long lived small firms which were 10 years old are more were also identified from a sample of new business starts which were interviewed using face to face interviews between 1994 and 1997 on their finance, costs, business strategy, human capital, organization and technical change. These firms were examined by Reid and Smith (2000a), Reid (1991) and Smith (1997, 1998). 15 out of 20 were still trading (a survival rate of 75%).

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

The firms examined were mature (25.5 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 the "parent" samples. Of the 219 firms in the three parent samples, 84 (38%) were in manufacturing (SIC 01-60) and 135 (62%) were in services (SIC 61-99). Figures from the Department of Trade and Industry, for all UK small firms, suggest that 27% were in manufacturing and 73% were in services. The following regions were represented: Aberdeen, Argyll, Aryshire, Banff, Caithness, Cumnock, Dundee, Fife, Glasgow, Inverness, Isle of Skye, Lanarkshire, Lothian and Edinburgh, Midlothian, Moray, Orkney, Perth, Renfrewshire, Ross and Stirling.

Concerning age, 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). Of the sample of 63 long-lived small firms, 1 (1.6%) was a sole trader operating from home, 15 (23.8%) were sole traders operating from business premises, 19 (30.2%) were partnerships and 25 (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 organizational form, from the sole proprietorship form, to the partnership and private limited company forms, over the lifetimes of the firms (cf. Reid, 1998). 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: \$317,278 (\$206,442) for sole proprietorships; \$804,733 (\$658,182) for partnerships; and \$1,981,530 (\$2,721,373) for private companies (all figures in 2001 prices).

2. Variables

This subsection provides statistics of key variables, their definitions, and explains the questionnaire design. In Table I we indicate the key variables that we used in the econometric modeling reported in Section IV.

Table I. 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
FSTurbulence	7.90	3.8	2	16
Agility	0.8737	0.4070	0.22	2.38
Speed	21.84	16.19	2.45	73.9
Precipitator	5.27	2.72	1	15.67
Adjust	7.31	3.33	1.67	16
PrecipitatorTime	75.60	62.28	0	260
AdjustTime	54.35	75.18	0	476.33
Perform	67.35	8.10	49.11	90.43

Firm-specific turbulence was calculated using a frequency count of the number of key organisational changes to which long-lived small firms were subject, over their lifetimes. Owner-managers were presented with a list of 18 such changes. This list was diverse, including features like ownership, legal form, technology, 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 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 a 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 routinized 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, firm-specific turbulence (*FSTurbulence* was calculated as $\sum X_i$ where X_i is the occurrence of change i. Emphasising the pivotal nature of key changes, we observe that they occur, on average, just

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

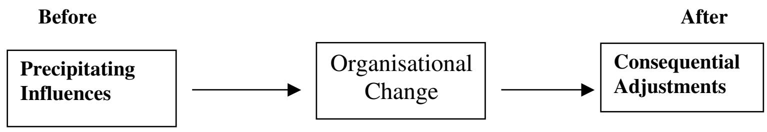

Figure 1. Explanation of causation.

eight times over the lifetime of the long-lived small firm (see Table I). The range of key changes was 14 and the maximum number of changes was just 16. 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 organizational 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 organizational change. In a similar vein, we used the term "consequential adjustments" to describe those adaptations which followed on from organizational 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 organizational change, and between organizational change and consequential adjustments. 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] This figure also indicates how responses were recorded. Figure 2 indicates some of the factors we were interested in. Other ones included credit policy, finance, trade intelligence and cash-flow.

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 was as follows. First,

[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.

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

Figure 2. Response format for calibrating change (extract from).

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 '*PrecipitatorTime*') which elapsed between identifying the precipitating cause and the undertaking of 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.

Agility is the ratio of the 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 precipitating factors and adjustment factors for each change. A larger 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 (m_c). Thus, agility is calculated as

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

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. On average, the firm's agility ratio is 0.8737. This ratio is less than 1, which implies that long-lived small firms find it difficult to limit the amount of trimming (the number of adjustments) they make as a consequence of organisational change. The average number of precipitating causes (*Precipitator*) is 5.27, whereas the average number of consequential adjustments (*Adjust*) is 7.31.[7]

[7] The average number of precipitators and the average number of adjustments are calculated by: $\sum_{c=1}^{3} P_c / \sum_{c=1}^{3} m_c$ and $\sum_{c=1}^{3} A_c / \sum_{c=1}^{3} m_c$ respectively.

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

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

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 time taken in adjustment, the more flexible is the small firm. The average total precipitating time (*PrecipitatorTime*) 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 index measure of overall performance was created based on qualitative data. The data for creating this index came from the responses by owner-managers to questions about 28 dimensions of their firms' performance: strategy (9 questions); finance (4 questions); organization (4 questions); and business environment (11 questions).[9] This approach is based on modern methods of performance appraisal in small

[8] The average total precipitating time and the average total adjustment time are calculated by $\sum_{m=1}^{3} pt_{jm} / \sum_{c=1}^{3} m_c$ and $\sum_{m=1}^{3} at_{jm} / \sum_{c=1}^{3} m_c$ respectively.

[9] The dimensions were generated from theory and empirical evidence from studies examining differences in the performance of long-lived small firms (see Power, 2004).

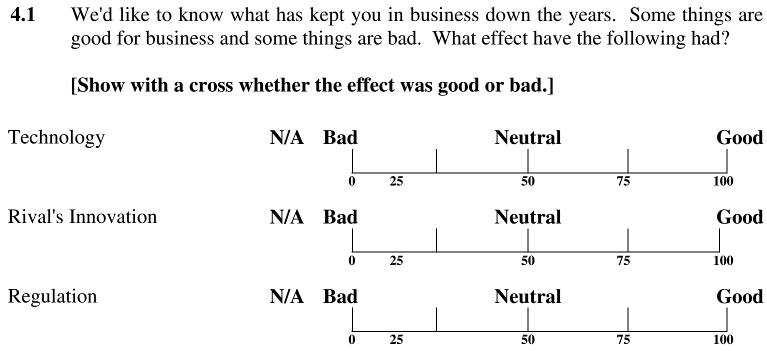

Figure 3. Response format for performance indicator (extract from).

entrepreneurial firms (Wickham, 2001), and the utilization of scorecarding methods for performance appraisal, monitoring and control (cf. Epstein and Manzoni, 2002) and, more generally, works emphasizing the importance of multidimensional performance measures in the context of new and growing ventures, (Sandberg and Hofer, 1987; Chrisman et al., 1998).

To judge how owner-managers evaluated their firm's ability to survive over the long haul, owner-managers were asked the following question: "*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?*" Based on actual experience of running the business, they were asked to rate a wide range of dimensions of performance: suppliers, growth, competition, buyer's willingness to pay, customer loyalty, access to buyers, substitutes, new entrants, technology, rival's innovation, regulation, cashflow, debt, credit policy, capital requirements, market positioning, cost control, quality, market research, differentiation, advertising, product mix, diversification, operational efficiency, skills, filling product gaps. Each dimension was scored by placing a cross on a continuum[10] ranging from 0 to 100, for its impact, bad or good, on performance, see the three examples (technology, rival's innovation, regulation) in Figure 3. If an item was not applicable, owner-managers were asked to say so. A score of zero denoted a very negative impact, 100 a very positive impact, and 50 a neutral impact on performance of a given dimension (e.g. quality, cashflow, operational efficiency).

The overall performance index was then created by summing the scores assigned to each performance dimension and normalising the aggregate figure obtained thereby, by the number of performance dimensions relevant

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[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 with 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.

to a given owner-manager's firm (i.e. the total score was divided by the number of items rated). Out of a maximum performance score of 100, the average long-lived small firm scored 67; the measure ranged from 49 to 90. Low performers had a performance rating between 49 and 62 (i.e. the lower quartile) and high performers had a performance rating of 73–90 (i.e. the upper quartile). We hold that our multidimensional approach has two main advantages over a 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) measure of what we refer to as performance, allowing common influences to come through (DeVellis, 1991).

The reliability and validity of this new performance index were investigated by Power (2004) using methods proposed by Gerbing and Andersen (1998) and Hair et al. (1995). Reliability analysis assesses the internally consistency of the measure of performance (i.e. whether there are common features across these small firms which could have contributed to their becoming long-lived) whereas an analysis of correlations with objective measures of performance investigates its predictive validity (i.e. offers evidence in support of the utility of this index as a measure of the fitness of the small firm to survive over the long haul). We found considerable agreement in the sample on those factors that contribute most to performance.

Cronbach's (1951) alpha coefficient was used to test for the reliability of the inclusions of influences in the performance index. Guidelines by Nunnally (1978) suggest a value of at least 0.7 is required to infer internal consistency. For our 28 influences on performance, Cronbach's alpha = 0.78, exceeding the recommended level of 0.7. High inter-item correlations also suggest that there are common features across these small firms which could have contributed to their becoming long-lived. Examples of relatively significant inter-item correlations include cost control and operational efficiency (0.584), credit policy and buyers willingness to pay (0.521), monitoring and skills (0.497), capital requirements and market positioning (0.444), credit policy and customer loyalty (0.434), quality and product mix (0.414), and skills and operational efficiency (0.413). All of these were found to be significant at p-value < 0.0001. Confirmatory factor analysis indicated that the data fitted well to our hypothesized multidimensional measurement model, using approaches proposed by Sandberg and Hofer (1987) and Chrisman et al. (1998) [$\chi^2(16) = 9.9762$; $p = 0.868$], (see Power, 2004). The former described new venture performance as a function of entrepreneurial attributes, strategy and industrial structure whereas in the latter it was extended to include resources and organizational structure.

The long run performance indicator is weakly positively correlated with net profits in 2001 (Pearson's $R = -0.165$, Prob. Value < 0.1). It is also negatively correlated with the level of indebtedness of the firm (Pearson's $R = -0.208$, Prob. Value < 0.05). Thus, in these cases, the long run performance indicator is behaving as expected. For small firms we do expect, based on available evidence, a negative relationship between growth and performance. This is, indeed, part and parcel of why small firms (with the exception of a very small percentage of "gazelles") typically stay small. There is evidence of this growth/performance trade-off here, which is something we treat in great detail in a simultaneous equations framework, in Power and Reid (2003). For the purposes of this article, this acts as a kind of predictive validity check. For example, we note that asset growth and our performance indicator are negatively correlated (Pearson's $R = -0.298$, Prob. Value < 0.05). In this, it parallels the relationship between accounting profit and asset growth (Pearson's $R = -0.747$, Prob. Value < 0.0001). This finding is robust with respect to the size measure used. Thus, both our performance index and headcount are negatively correlated (Pearson's $R = -0.210$, Prob. Value < 0.1). In general, there is indeed a negative correlation between our index of long run performance and size, further confirming the confidence we have in our performance measure.

As regards what our index means, in terms of the diversity of views across entrepreneurs, the following data are revealing. Taking a mean rating of greater than 75% as denoting good performance, the key influences on performance are judged to be quality (88%, 12), customer loyalty (82%, 15.8), product mix (81%, 12.8), skills (80%, 16.7), operational efficiency (78%, 15.5) and diversification (76%, 16.5) where the standard deviation is given after the mean percentage score. The high mean scores and low standard deviations suggest agreement amongst owner-managers on factors which foster long-run survival. Consider, by contrast, factors which are less important, or even detrimental, to long-run survival, like competition (54%, 23.3), substitutes (50%, 22.9), debt (48%, 26.3), regulation (47%, 22.7), rivals' innovations (45%, 23.2), and new entrants (43%, 21.5). These low mean score influences have higher standard deviations, indicating less agreement amongst owner-managers about their consequences for long run survival. This is not surprising, for these low mean score influences, relate to aspects of the small firm's environment (e.g. regulatory, competitive) over which it has little control, as compared to influences like quality, product differentiation, skills and operational efficiency, over which it has considerable control.

Although arguably not as familiar as an objective measure, we therefore would argue that our subjective measure both acts as a reasonably good surrogate for objective measures of performance, and extends the compass, in revealing ways, of what we understand by 'performance'. Thus, it seems that entrepreneurs "act" on their own evaluations.

Table II. Flexibility, firm size and performance[a]

Variable	Sole proprietor ($n=16$)	Partnership ($n=19$)	Private company ($n=28$)
Sales[b]	219812 (143026)	557526 (455994)	1372821 (1855391)
Employees (FTEs)[b]	5.94 (5.85)	7.24 (4.15)	22.18 (27.18)
FSTurbulence	7.94 (3.07)	7.11 (3.31)	8.43 (4.46)
Agility	0.8896 (0.3431)	0.8781 (0.5316)	0.8617 (0.3554)
Speed	19.5478 (13.1333)	20.6476 (15.9629)	23.9555 (18.0923)
Perform	69.1519 (9.4962)	66.5217 (8.2249)	66.8754 (7.2764)
LabProd	55032 (45063)	72339 (3134)	64425 (76271)

[a]The standard errors are in parentheses.
[b]Significant difference in means using ANOVA at $\alpha=0.05$ and $F_{(2,60)}$.

Table II examines our measures of firm-specific turbulence, flexibility and performance, depending on firm type. We note that firm type is highly 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 firm-specific 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. We 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 as sales divided by fulltime equivalent employees.[11] The central concern of our paper is whether our dimensions of flexibility and firm-specific 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.

IV. Estimates

1. Introduction

To examine the degree to which our different measures of flexibility and firm-specific turbulence affected the performance of our long-lived small

[11] Our measure of Labor productivity would probably be different if value added, rather than sales, were used. Alas, we lack value added figures, and our statistic has simplicity to recommend it. We doubt it would affect the results of the analysis.

firms, we used Heckman's selection model (Heckman, 1976; Lee, 1982, 1983; Davidson and MacKinnon, 1993). We chose to decompose our agility and speed measure into its component parts to assist interpretation. Our model assumes that there exists an underlying relationship between our performance variable (*Perform*) and our measure of firm-specific turbulence (*FSTurbulence*), along with our measures of flexibility (e.g. *Adjust*, *AdjustTime*) for our sample of long-lived small firms.[12] This may be expressed:

$$Perform = \beta_0 + \beta_1\, FSTurbulence + \beta_2\, Precipitating + \beta_3\, Adjust \\ + \beta_4\, PrecipitatorTime + \beta_5\, AdjustTime + u_{1i}, \qquad (3)$$

where $u_1 \sim N(0, \sigma)$. We may expect sample selection bias to exist, as the measures of performance, firm-specific turbulence and flexibility are only observed for long-lived small firms, and not for all firms, including non-survivors. The first step of this procedure is to estimate a binary probit model of the survival of long-lived small firms.
This may be written:

$$S = X\beta + u_{2i}, \qquad (4)$$

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. From the binary probit estimation we can calculate the so-called inverse Mills ratio (lambda). This inverse Mills ratio is then used as an additional regressor in the generalized least squares estimation of our performance Equation (3) above. Heckman's (1979) two-step procedure provides consistent estimators, under certain regularity conditions.

Initially our model was run on a sample of 186 firms, which included sub-samples from each of the three parent samples (see Table IV). This includes the 63 surviving long-lived small firms for which we have complete data to estimate the performance relationship (3), as well as the 123 non-surviving firms for which we have parsimonious data, but enough to estimate the selection relationship (4). In Heckman two-step estimation for this sample of 186 firms, the selection equation (4) (containing largely size measures) was estimated using common data across these three sub-samples:

[12] The regressors are included in their raw count form. Existence of multi-collinearity would influence (or even destroy) the estimation of the performance equation, if the measures of agility and speed were both included as regressors in the equation, as speed is a linear function of agility.

Table III. Generalized least squares ($n = 63$)

Estimation	Coeff.	Std. error	Prob.	Elasticities at mean
GLS				
FSTurbulence	−1.701831	0.2878478	0.000	−0.2525534
Precipitator	1.852652	0.5263581	0.001	0.151157
Adjust	0.2762535	0.4601972	0.551	0.0306325
PrecipitatorTime	−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

Notes: R^2 adjusted = 0.99; $F_{(6,57)} = 67.6$ Prob. > $F = 0.0000$.

industrial sector (*Sector*); start year (*StYear*); sales in early years of trading (*StSales*); full-time employees (*Ftemployees*); and part-time employees (*PtEmployees*). Overall, this estimation represents our attempt to use the available data in the most comprehensive fashion.

For comparative purposes, Table III presents generalized least squares estimators for the performance relationship (3) without sample selection. Here our goal is to estimate, in a preliminary way, the impact of our flexibility and firm-specific turbulence measures on performance. An inspection of the graph of the residuals from an exploratory ordinary least squares regression, plotted against the predicted values, suggested that 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, Davidson and MacKinnon (1993, Ch. 11). This procedure was found to remove the heteroskedasticity. The generalized least squares model presented in Table III had an R^2 of 0.99 with probability value of 0.000. Although this is highly significant, we focus our discussion on the results of Tables IV and V, because these estimates have been corrected for selectivity bias. We do so on a precautionary basis, although it will be observed that the results in Tables IV and V, which use sample selection methods are broadly similar to those in Table III. We find that ρ, the correlation between the disturbances in the performance and selection equations is close to zero, suggesting selectivity bias is not a major problem. Therefore, what is true of our analysis in Tables IV and V would be true also of an analysis of Table III.

2. Selection Equations

Our discussion turns first, therefore, to the selection equation of Table IV. This is computed with the largest sample size possible ($n = 186$), using data

Table IV. Heckman sample selection model ($n = 186$)

Estimation	Coeff.	Std. error	Prob.	Elasticities at mean
GLS				
FSTurbulence	−1.679331	0.1928492	0.000	−0.2470291
Precipitator	1.886974	0.3946002	0.000	0.1526074
Adjust	0.2794347	0.3605423	0.438	0.0307136
PrecipitatorTime	−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
Constant	−0.2515869	1.007342	0.803	
Mills-lambda	814015	1065096	0.445	
Rho	0.12243			
Sigma	6649056			
Wald χ^2 (6)	10035.63			
Prob > χ^2	0.0000			

from all three of the parent samples. We observe that sales at first interview (*StSales*) is significant. That is, size early in the lifecycle has a positive effect on long run survival. This is the kind of effect one would expect to observe, in terms of fundamental modelling of the small firm's growth process. For example, if the time series of sales from inception is a random walk, terminating when the process hits the absorbing barrier of zero sales, the mean passage time to exit is higher, the greater are first period sales. The effect of size has quite a high positive elasticity (using elasticities computed at the means): a 1% increase in mean sales at start-up increases the probability of survival by 0.2%.

Turning now to the sample selection equation in Table V, it is to be noted that the sample size is now smaller ($n = 89$) and additional variables are included, on the gearing ratio (*Gearing*) and the number of product groups (*ProdGroup*). Here, we have gained additional variables for the selection equation, but at the cost of having access to only two of the three parent samples. We note that the number of product groups (*ProdGroup*) is significant at the 10% level in Table V. This variable also has a very high elasticity (0.52). The importance of product group size has

Table V. Heckman Sample selection model ($n = 89$)

Estimation	Coeff.	Std. error	Prob.	Elasticities at mean
GLS				
FSTurbulence	−1.793477	0.215148	0.000	−0.2727101
Precipitator	2.405389	0.5098721	0.000	0.2010891
Adjust	0.945891	0.4272299	0.027	0.1074695
PrecipitatorTime	−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 χ^2 (6)	7483			
Prob. $> \chi^2$	0.0000			

been emphasised by others, including Reid (1993, Ch. 9). The work of Ungern-Sternberg (1990) provides an explanation of this effect in terms of diversification of the product portfolio, as an accommodation to fluctuating demand for individual products. In general, the selection equations of Tables IV and V should be regarded as being statistical devices for guarding against sample selection bias, in the context of a Heckman two-step adjustment procedure, rather than as sophisticated models of small firm survival. Our main focus is, of course, on the performance equation.

3. Performance Equations

Performance is examined using three estimators. First, generalized least squares estimators, without sample selection, using a sample size of $n = 63$ (see Table III). Second, Heckman sample selection estimation, using a sample size of $n = 186$ (see Table IV). Here, the selection equation uses all available sample data, but is restricted in the number of variables that can be used. Third, Heckman sample selection estimation, using a sample size of $n = 89$ (see Table V). In this case, a smaller sample size is used (accessing just two out of the three parent samples), but a wider range of variables (e.g. including gearing). The focus in the discussion to follow will be on the estimates with sample selection of Tables IV and V.

By reference first to Table IV, we find that firm-specific turbulence (*FSTurbulence*) has a negative impact on our count measure of qualitative performance (*Perform*). Judged by elasticities at the means, this variable has a larger impact than any other does on performance. Indeed, a 1% increase in the mean count of organisational changes, have the effect of reducing performance by as much as 0.24%. A similar effect, with an even higher elasticity, is found in Table V. Excessive organisational change seems to be to the detriment of the long-lived small firm's performance. As a business journalist commented on an earlier draft of our paper "*many a meddle may make a muddle of the business*" (Jamieson, 2002). There is an intuitive explanation for this, which supports the interpretation of Reid and Smith (2000b). It is that the relationship between firm-specific 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 relatively active in making organisational changes, just to survive, whereas adaptive firms are very active in making organisational changes, to improve performance and promote growth. It may be that the presence of a number of these relatively "stagnant" firms in our sample, doing really badly (sometimes called the "living dead") is driving the negative relationship between *FSTurbulence* and *Performance*. If so, this suggests that there is another selection process here, besides the long-run test of economic survival. It may take the form of deciding whether or not the small firm grows to be a large firm – a "gazelle" as described by Birch (1996). Part of the reason for the existence of gazelles may be that they are intrinsically designed to be of a relatively large scale, and that they very rapidly grow towards this target size after inception. Many of the small firms in the sample have succeeded in the first selection process but very few are triumphant in the second.

A complex relationship exists between flexibility (as measured by our *Precipitator*, *Adjust*, *PrecipitatorTime* and *AdjustTime*) and performance, according to the evidence presented in both Tables IV and V. We observe first that the number of factors which the owner-manager can identify as precipitating organisational change (*Precipitator*) has a highly significant and positive effect upon performance, and this effect is large, judged by the elasticity at the mean. Being aware of factors impinging on the small firm, by effective scanning of the business environment (e.g.

Wickham, 2001 p. 324) is an aspect of entrepreneurial alertness which should be reflected in the count variable *Precipitator*. We believe that it is this capacity to identify precipitating factors that are potential drivers of performance enhancing change which is important. That is, the owner-manager for whom the count variable *Precipitator* is high, is not just passively noting changes in the environment. Rather, he is actively seeking signs of environmental change, to which the business could be better adapted. In terms of options reasoning, the greater the array of factors embraced in the variable *Precipitator*, the higher the potential option value generated (see McGrath, 1999 Proposition 1). Furthermore, the *PrecipitatorTime* variable in Table IV has a highly significant negative coefficient and a moderately large elasticity. This suggests that the more rapidly the mature small firm takes action, typically in the shape of organisational change, in the face of critical changes in its environment, the better is its performance.

From Table IV, we note that a 1% increase in the *Precipitator* variable increases performance by 0.15%; and a 1% increase in the mean precipitating time (*PrecipitatorTime*) reduces performance by 0.07%. In real option terms, this says that, for a larger number of detected drivers of a change, a firm has greater certainty that change is necessary to improving 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, implying a trade-off. The longer is the *PrecipitatorTime*, the more the *Precipitators* that are detected. The more *Precipitators*, the greater the certainty surrounding the performance implications of the change. But the longer the *PrecipitatorTime* the greater the risk that the mature small firm will fail to capture some of the benefits of improved performance. Comparing the *Precipitator* and *PrecipitatorTime* variables of Table IV with Table V one finds a set of results that is captured by the discussion above. The significance level goes up, as do the magnitudes of both the elasticities, in the case of Table V ($n = 89$), therefore the analysis above applies all the more so.

Organisational change makes small firms subject to adjustments on headcount, stock levels, credit policy, etc. Note differences between Tables IV and V in the behaviour of the variable *Adjust* which measures these effects. Specifically, the coefficient of *Adjust* is not significant in Table IV (sample size $n = 186$), but has a positive and significant effect on performance (see *Perform*) when we turn to the evidence in Table V (where $n = 89$) and a higher elasticity. In the latter case, a 1% increase in the mean count of adjustments (*Adjust*) increases performance by 0.10%. Turning now to *AdjustTime*, this has a positive and significant impact on performance in both Tables, but a relatively small elasticity.

This suggested that the higher the number of adjustments (*Adjust*), other things being equal, following organisational change, the greater is the performance. A higher absolute number of adjustments also signals greater commitment by the firm to organisational change. Furthermore, a greater commitment by these firms indicates that the organisational change has significant implications for firm performance (including survival) (Ghemawat, 1991).

In Table V, the number of consequential adjustments (*Adjust*) has a smaller impact on *Performance* than does the number of precipitating causes (*Precipitator*) (0.1% versus 0.2% respectively). Real options reasoning 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. Faulty evaluations of the potential benefits of strategic change can impact negatively on small firm performance (McGrath, 1999).

The variable *AdjustTime* refers to the lag between organisational change (instigated by some precipitating factors) and consequential adjustments e.g. of headcount, of stock level, etc. A detailed definition is given in Appendix A. The statistical import of the variable *AdjustTime* is similar across Tables III, IV and V. The coefficient of *AdjustTime* is positive and highly statistically significant and has a moderate elasticity. A 1% increase in the mean adjustment time increases performance by 0.09%. Although a mature small firm which is slow to adjust may be having difficulty in altering its factors of production (e.g. headcount), and in this sense lacks agility, the interpretation we prefer runs in terms of real options analysis (Bowman and Hurry, 1993; Luehrman, 1998 and McGrath, 1999).[13] We would hold that the statistical behaviour of the *AdjustTime* variable seems to suggest the following argument. Extending *AdjustTime* can attenuate potential downsides by limiting fixed costs and irreversible investments. This should

[13] Just as an option in the theory of finance confers the right (but does not impose not the obligation) to purchase a specified asset at a pre-specified price on a specified date, so a real option confers the right (but does not impose the obligation) to invest (or further invest) in an asset within the firm. The ability to delay the decision about whether to invest in a real asset increases flexibility in the face of risk, Copeland and Keenan (1998). By adopting a 'wait and see' strategy, uncertainties regarding the true value of the asset may be resolved. The existence of a positive net present value, NPV (i.e. being "in the money") alone should not necessarily lead to investment, if business conditions are poor. Only if conditions are favorable, should investment or further investment be made (exercising the option). Such an approach builds on good, or mitigates against bad, fortune. As in financial options theory, real options rise in value with uncertainty, because greater variability raises the potential gains without raising the cost of accessing them. From a real options standpoint, entrepreneurs should hold a portfolio of options and adopt an incremental approach to investment (i.e. making small investments initially followed by large investments) to limit downside risks, see Bowman and Hurry (1993). In effect, the "alert" entrepreneur takes out real options which are not obvious to others, and are therefore undervalued (see McGrath, 1999).

raise the bundled value of the portfolio of adjustments, typically investments, that might be labelled the mature small firm's 'strategy' in the light of organisational change, (Luehrman, 1998; McGrath, 1999). By staging adjustments, a firm increases its option value to withdraw from change, or to continue to invest, having resolved uncertainties, thereby increasing its flexibility. However, the staging of adjustments may imply that it takes longer to receive payoffs from the organisational change. Thus, increases in the option value deriving from flexibility may come at a cost.

A brief case study illustrates this, see Judge (2002). The firm from our sample was a corporate design and communications company. Its activities had a high creative content, and involved producing images and various forms of documentary reporting relating to its clients' business. The industry as a whole was subject to the impact of a major precipitating factor, namely the emergence of digital technology. The organisational change that was undertaken involved researching the market and determining the consequential needs, suppliers and trading partners. The entrepreneur who ran the firm was aware of the potential for failing successfully to adopt the new technology. He invested in a pilot project for digital software, and then on the back of its success, a further investment was made in terms of employing a new team of people 'to deal specifically with that side of the business'. The entrepreneur in question said

> *We forged close links with other companies, such as programming firms and internet service providers, so we could be sure that, if we went cold on the digital technology, those of our clients that were interested could still be serviced by someone else.*

Here we see the entrepreneur taking actions, like staging commitments, and planning routes back from failed experiments, which are consistent with our real options interpretation.

The results in Tables III, IV and V are broadly similar. Of these, Table V is arguably the most satisfactory in terms of overall significance, individual coefficient significance, magnitudes of elasticities, and specification of the selection equation. Regarding the latter, we sacrificed sample size in order to put market (*ProdGroup*) and financial variables (*Gearing*) into the selection equation. This seems to have paid off, statistically speaking, in that we can say more, even with a smaller sample size. For this reason Table V contains our preferred specification.

If parsimony were our only goal, the results of Table III, on the smallest sample size ($n = 63$) would be recommended. However, they lack significance for the coefficient on *Adjust*, and leave one uneasy about possible consequences of sample selection bias being neglected. In fact, when one looks at the diagnostics relating to the Heckman two-step adjustment procedure in Tables IV and V, the Mills Lambda is not statistically significant in either case and the correlation between disturbances on the performance and selection equations is low. We nevertheless prefer the results of Table V because they are careful about sample selection, and because, at the margin, any adjustment for it might have a marginal impact upon the performance equation (which seems to have been the case with the *Adjust* variable).

V. Conclusion

This paper examines the effects of firm-specific turbulence, and various dimensions of flexibility, on the performance of the long-lived small firm in Scotland. It identifies the main factors that influence the performance of long-lived small businesses positively. First, they must be alert. They must be good at recognizing drivers of change. Second, they must be speedy. They should be quick to adapt their organization in the light of these forces of change. Third, once organizational change has been implemented, the entrepreneur should follow through on *all* necessary adjustments. However, this should not be done impulsively. Such adjustments typically involve investments which are in the nature of exercising an option. Fourth, delay on adjustment may have beneficial consequences for performance, if it reduces uncertainty and diminishes irreversibility. Acting in these ways, entrepreneurs can have a positive influence on performance. On the other hand, as we explore below, firm-specific turbulence has a negative effect on performance.

Performance is regarded as a multidimensional variable. Here it is constructed from interview evidence with entrepreneurs, covering competitive environment, financial management, organisational structure and business strategy. All evidence was collected by fieldwork methods. Our measures of performance, firm-specific turbulence and flexibility are all novel. Several performance models were estimated, using generalized least squares estimation (with heteroskedastic adjustment) with or without sample selection. When adjustment for sample selection bias was undertaken, two different specifications of selection equations were used, and the Heckman two-step procedure was adopted.

Whilst flexibility had a positive effect upon performance, this was not true of our firm-specific measure of turbulence (*FSTurbulence*). This is a count variable of the frequency of organizational change. It had a highly significant and strong negative effect on performance. This firm-specific turbulence refers to the total amount of "trimming" of its activities that the firm undertakes. We find that too much "trimming" reduces performance. For example, it wastes resources, and suggests false or imprudent moves, which then require correction. The smart approach is to stage the commitment of resources to a new strategy. This allows you to pull back if things do not pan out as you expected. Technically, it increases the "option value" of the small firm.

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Appendix A. 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
FSTurbulence	count of main changes over life of long-lived small firm $= \sum X_i$ where X_i is the occurrence of a change i
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 and 100 for each factor averaged overall factors 1 to n which were applicable
Precipitator	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

Appendix A. Continued

PrecipitatorTime	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_c
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

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