Early Life-Cycle Behaviour of Micro-Firms in Scotland

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ABSTRACT. The paper reports on the behaviour of young (less than three years old) micro-firms (less than ten employees) in Scotland, with an emphasis on life-cycle effects. Two main tests were carried out. The first took Gibrat's Law (that growth is independent of size) as the null hypothesis, and a life-cycle effects model as the alternative. The Gibrat's Law model was rejected in favour of the life-cycle model. Smaller micro-firms grow faster than larger micro-firms. Robust non-linear variants of the life-cycle model were discussed and shown to display stable equilibrium characteristics which were consistent with the sample evidence. The second took a Classical simultaneous equations model as the null hypothesis, for which growth and profitability were mutually reinforcing. A Managerial model was set up as the alternative for which growth and profitability were in a trade-off relationship. The Classical model was rejected in favour of the Managerial. In the short-run, young micro-firms experience a trade-off between profitability and growth. The Managerial model was shown to imply a stable equilibrium, with characteristics consistent with sample evidence.

KEY WORDS. Growth-profit trade-off, life-cycle, Scotland, small firms

JEL Classification: L1, L2, M2

This paper reports on a larger body of original research concerned with how young small firms grow shortly after they have started up in business.[1] The *micro-firm* is the smallest type of firm, having an employment size which does not exceed ten, yet it is by far the most common. The size distribution of firms is (approximately) an inverse J-shape, implying a high frequency of small firms and a low frequency of large firms [see Daly and McCann (1992)]. This effect goes right down the scale in that very small firms are more numerous than small firms, which are more numerous than medium sized firms, and so on. Thus an interest in the micro-firm, despite its extreme neglect, even in the small firms literature itself, is no more or less than an interest in the typical or *modal* firm [see Hughes (1993)].

The reason why the micro-firm is neglected is quite simple: data are not readily available. The larger the firm, the more likely are its operations to be covered by legislation on public disclosure of operations. Further, the more likely are its activities to fall within one or more of various tax regimes, that as well as playing a fiscal role, also generate data of use to the small firms specialist. However, if your operations are too small to require public reporting, and for the same reason fall outside of various tax regimes (VAT, corporation tax *etc*), you as an owner-manager become a shadowy figure in national statistics. There are ways of trying to plumb our ignorance in this area, for example, by the use of membership lists of small business associations (*e.g.* Federation of Small Businesses, Forum of Private Business[2]). However, membership lists involve some measure of self-selection, and if the investigator wishes to avoid the potential bias that this implies s/he must engage in primary source data collection.

This is the course of action which has been taken in acquiring the body of evidence on micro-firms reported upon below. All data were gathered by directly interviewing owner-managers of young (on average, three years old) small entrepreneurial firms in Scotland.[3] The average size of these firms was eight employees, and data were gathered over the period 1985 to 1988. During this period, it is known that small firms such as these, lying in the category of 0–19 employees, accounted for 5%

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of gross output and 7% of total employment in Scotland. A sample of 73 micro-firms was obtained, acquiring very detailed data on each individual firm, sufficient indeed to construct 73 case studies, yet creating a sample big enough to appeal to large sample techniques of statistical inference and econometrics. In doing so, a middle course was followed between small sample case study methods, in which one learns 'a lot about a little' [*cf.* Samson (1990), Pratten (1991), Lazerson (1990)], and large sample econometric studies, in which one learns 'a little about a lot' [*cf.* Evans (1987), Brock and Evans (1986)]. Here, my aim has been to provide a rich characterisation of each firm, and to do so for a sufficiently large number of firms that mathematical modelling becomes possible. In this way, one finds that modelling is 'well grounded' in reality, and sufficient degrees of freedom exist to estimate statistically robust models. A representative sample was obtained from the client lists of a random sample of Enterprise Trusts in the Lothian, Fife and Strathclyde regions (EVENT, GET, LET, ASSET *etc*). The composition by *small business type* was: private companies (50%); partnerships (20%) and sole proprietorships (30%). This categorical variable (*viz.* small business type) plays an important role in the modelling reported upon below.

Here, I report on two aspects of the analysis of this sample. The first explores the relationship between size and growth, taking as the central hypothesis the Law of Proportionate Effect (or Gibrat's Law) according to which growth rates of firms are independent of size. The second explores the simultaneous, mutually causative relationship between growth and profitability. The classical view that growth and profitability go hand-in-hand is taken as the central hypothesis with the alternative hypothesis appealing to the growth-profitability trade-off implied by 'managerial theories' of the growth of the firm (of the Penrose-Marris-Richardson-Slater[4]) variety. From hereon, I shall refer to micro-firms as Small Business Enterprises, or SBEs, for short.

Suppose a market is expanding at the rate of 5% per year. Then Gibrat's Law says that all firms in the market will share in this expansion rate. Thus a firm with a turnover of £1m in 1985 would have a turnover of £1.05m in 1986; and a firm with a turnover of £0.5m in 1985 would have a turnover of £0.525m in 1986. This so-called Law is weakly confirmed for very large (typically corporate) enterprises, but in the small firms literature is treated more as a null hypothesis that is formulated with rejection in mind. It is therefore normally regarded as a special case of a more encompassing hypothesis which adds two elements: firstly, an endogenous size dependence, with growth dependent partly on base-period size; and secondly, an exogenous shock component, which says that the basic growth relationship is subject to an independent, multiplicative random shock each time period [*cf.* Hay and Morris (1991, Ch.15)].

This leads to an equation suitable for estimating growth effects which expresses size this year as a linear function of size last year, where the size variables are expressed in natural logarithms. Size may be measured by any of several economic variables such as sales, employment or assets. The coefficient of the lagged natural logarithm of the size variable (call it β) plays a special role. If $\beta = 1$ growth is independent of size; if $\beta > 1$ larger SBEs grow faster than smaller SBEs; and if $\beta < 1$ smaller SBEs grow faster than larger SBEs. Of these competing hypotheses, the third is the most plausible ($\beta < 1$) despite the elevation of the status of the first to that of a "Law". I say this because $\beta < 1$ implies a stability in the growth process, and indeed suggests a type of optimal or equilibrium size for the SBE.

The argument is illustrated by reference to Figure 1, which has (log) size in time period t on the horizontal axis and (log) size in time period t + 1 on the vertical, and a 45° line which can be used to identify a so-called 'fixed point' for the

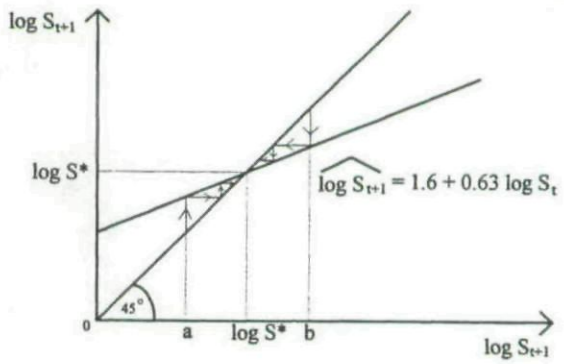

Fig. 1.

growth process implied by the fitted equation which is superimposed on it. This equation was fitted by least squares using (log) assets in 1988 (*i.e.* S_{t+1}) as the dependent variable and (log) assets in 1985 (*i.e.* S_t) as the independent variable.[5] It will be observed that it does indeed imply a stable growth process. On this Figure, log S* denotes the equilibrium size of SBE, in the sense of that (log) size to which SBEs will tend. Possible adjustment paths from (log) sizes a and b towards log S* are indicated.

When equilibrium is achieved, log S* = 1.6 + 0.63 log S* which implies log S* = 1.6/0.37 = 4.324 which implies S* = exp(4.324) = 75.49. This figure is close to the average nominal asset size within my sample in 1985 of £76.36 thousand. Because β is so unambiguously less than unity, Gibrat's Law ($\beta = 1$) is refuted, and a more general model is accepted with the property that smaller SBEs grow faster than larger SBEs. This is a model displaying the 'life-cycle' effect noted in the title to this paper: it is thereby established for this sample of young Scottish SBEs.

This argument is plausibly neat, but arguably simplistic. The 'mechanism' behind the process (a simple first-order difference equation) is too much in view, and one acquires from it no intuitive sense of why such a life-cycle effect might occur in practice. A convincing story [see Jovanovic (1982), Frank (1988)] makes appeal to an element of 'human capital' theory. Partly the success of an SBE is attributable to the experience of the owner-manager. His experience is accumulated by the practice of running a firm, and even he may initially be ignorant of his ability. Over time, his ability is revealed at the same time as his skill is acquired. This introduces a 'time dependence' into the growth relationship: the age of the SBE is also a determinant of its growth rate, as well as its size.

This dependence of growth on age and size can be assumed to take a quite complex non-linear form, for the purposes of generality. It can again be simplified to facilitate econometric estimation by being re-expressed in a log-linear form, which also incorporates quadratic age and size effects [*cf.* Evans (1987), Brock and Evans (1986)]. This flexible functional form can capture, or approximate to, many forms of non-linearity. When estimated on the data, using assets, sales or employment as the size variable, a consistent picture emerges. It is that growth is negatively related to size *and* to age.[6] Thus younger and smaller SBEs grow faster than older and larger SBEs. There *is* a life-cycle effect, and the rapidly-learning owner-manager running a young SBE which is close to financial inception is able to 'grow on' his firm more successfully than the owner-manager of an older SBE who has exhausted benefits of learning.

Although size and age have been identified as determinants of growth, and their effects have been found to operate in a relatively complex, non-linear fashion, the model specification is still sparse. One could invoke Occam's Razor and say "do not compound hypotheses unnecessarily", and leave the matter as it stands. However that would be to ignore a significant body of economic theory which would lay claims to providing a more complex explanation of the growth of the firm.

The initial hypotheses explored above were that growth depended on size, or on size and age. Now these parsimonious hypotheses will be extended to take account of market extent, market share, rivals' pricing policies, capital structure (*e.g.* gearing) and, above all, profitability. One expects a profitable firm to have a Darwinian advantage over an unprofitable or less profitable firm, and to enjoy superior growth opportunities. But more than this, one might expect growth itself to be a stimulus to profitability, for example, because of learning effects and the consequential dynamic economies of scale. I have developed this argument in some detail elsewhere in an industrial context.[7] It implies a model of 'cumulative causation', with growth fostering profitability, and profitability fostering growth. A necessary condition for this is the existence of increasing returns to scale. When I first approached hypothesis testing in this area, this was the kind of framework I had in mind, and evidence from fieldwork amongst SBEs provided fragments of evidence that seemed to support it. For example, profits were the major source of finance for expansion. Outside equity participation, either formally through venture capital, or informally, through 'business angels', was non-existent. External finance was invariably debt finance, and was often provided on a matching basis by banks to a

level that corresponded to the owner-manager's personal financial injections. Thus gearing ratios of around unity were common. On the supply side, evidence of scale economies was widespread, across a broad range of industrial activities, up to capacity operations [see also Pratten (1991)]. One therefore is led to construct a null hypothesis that says growth and profitability advance hand-in-hand.

As against this type of reasoning, which has its roots in Classical notions of competition, and has been updated by the likes of Kaldor, Currie and Thirlwall [*cf.* Reid (1989)], there is an alternative view. The theory is too extensive to bear detailed individual reference in a brief account of this sort, but suffice it to say that it is, generically speaking, of the 'managerial theory of the firm' variety [see Hay and Morris (1991, Chs. 9, 10), Reid (1987, Ch.9)]. Here, the key intellectual figures would be Penrose, Marris and Baumol, with important formalisations being due to Slater (1980) and Richardson (1964). According to this view, there are costs of growth of a managerial sort, which attenuate profitability. The firm must change, in an organisational sense, when it grows; and putting into place new 'organisational technology' involves resource costs. Penrose (1959) argued informally that new managers had to be drawn into the growing firm, and then trained and dovetailed into existing managerial arrangements. Training, and the re-positioning of personnel within the organisational form of the firm are in themselves expensive, and furthermore a diversion from direct production, both of which are detrimental to short-run profitability. Slater (1980) has formalised this argument to show that increases in marginal cost will arise from rapidly recruiting managers when the firm is expanding quickly. Richardson (1964), somewhat less formally, argued that the key constraint to growth was acquiring and assimilating suitable additions to the managerial team. These arguments are normally directed at the corporate enterprise. The novelty of this paper is to argue that the logic is no less applicable to the SBE. A firm which started from home as a sole proprietorship might rapidly become a partnership, and subsequently a private company, all within as little a time as three years. This involves major changes in managerial methods, and significant management recruitment as the SBE's form mutates [see Reid, Jacobsen and Anderson (1993)]. For example, it typically involves creating tiers of superior/subordinate relations, organised in a hierarchical fashion. This usually involves 'control loss' by the original owner-manager. As Samson (1990, Ch.5) points out, it sometimes involves 'organisational crisis'. A 'Business Type' variable is available for my sample to proxy such effects.

Developing an alternative hypothesis to the 'cumulative causation' view of growth and profitability, one comes up, following 'managerial' lines of reasoning as above, with a growth-profitability 'trade-off' view, sometimes known as the 'Penrose Effect'. Summarising, the null hypothesis is that growth and profitability advance hand-in-hand; the alternative hypothesis is that growth and profitability lie in a 'trade-off' relationship to one another.

These alternative hypotheses were tested using a simultaneous equations model of growth and profitability for the SBE. The equations estimated were:

$$\text{Growth Rate} = F[\text{Profitability } (-),\ \text{Main Market } (+),\ \text{Market Share } (+),\ \text{Rivals' Pricing } (-),\ \text{Degree of Product Differentiation } (-),\ \text{Gearing Ratio } (-)] \quad (1)$$

$$\text{Profitability} = f[\text{Growth Rate } (-),\ \text{Business Type } (-),\ \text{Rivals' Pricing } (+),\ \text{Gearing Ratio } (-)] \quad (2)$$

Under a variety of specifications and methods of estimation,[8] these variables were significant, and generally stable in the signs of their effects on the dependent variables, as indicated by the plus or minus signs in brackets. In equation (1) profitability has a negative effect on the growth rate; and in equation (2) the growth rate has a negative effect on profitability.[9] Thus the evidence refutes the null hypothesis of 'cumulative causation' and accepts the alternative hypothesis of a growth/profitability 'trade-off'. Such conclusions have been reached in other contexts by Cubbin and Leech (1986) and by Dobson and Gerrard (1989).

The new evidence reported upon here supports a managerial view of SBE growth. If a concave profitability-growth rate locus exists of the sort indicated in Figure 2 by the line GG′, and an

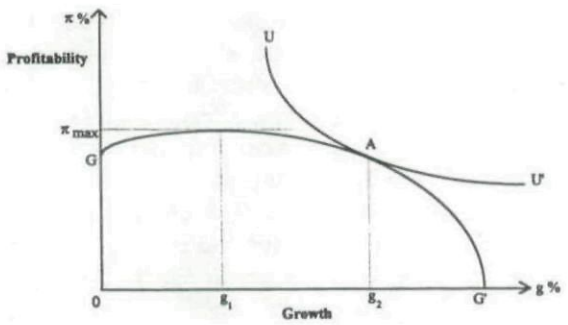

Fig. 2.

owner-manager's indifference curve is given by UU', equilibrium (and presumably *observed*) values for growth and profitability will be observed *on the trade-off section*[10] of the locus GG'. Rather than stop short at the growth rate g_1, which maximises profitability (π_{max}), the owner-manager pushes on growth to g_2. This may be quite rational. It could be that whenever the SBE gets a 'toehold' in a new market niche, its primary goal must be to invade that niche, even at the cost of sacrificing short-run profitability, in order that it pre-emptively occupies that niche ahead of rivals. Thus the alternative to rapid niche invasion, with some temporary sacrifice of profit, is no niche occupancy at all, and hence no profit. Once a niche is occupied, the SBE can devise various 'harvest' strategies aimed at maximising long-run profit.[11]

Apart from the 'trade-off' aspect of the model given by equations (1) and (2), other features are worthy of comment. In the growth rate equation (1), the extent of the main market, and the size of market share correlate positively, as one would expect, with growth. The next two variables have less obvious, perhaps even surprising, effects. Rivals' pricing is based on a dummy variable which is unity when rivals' prices are crucial to the SBE's own pricing. Essentially the more elastic is the conjectural cross-price coefficient ($\Delta P_i/P_i \div \Delta P_j/P_j$), the lower is the growth rate: alert, competitive, price-conscious rivals impede the SBE's growth. The Degree of Product Differentiation variable assumes greater values the less homogeneous (*i.e.* the more differentiated) is the good. Normally, one would think of product differentiation as defining the boundaries of an SBE's niche markets, and to a degree it should act as a barrier to entry. This market protection should foster rather than hinder growth, but apparently that does not occur on average for these SBEs. The reason is to be found, I think, in the rather extreme form that product differentiation often takes. SBEs frequently supply goods or services on a 'bespoke' basis *i.e.* custom-designed to a particular buyer's needs [*cf.* Reid, Jacobsen and Anderson (1993)]. This removes all substitutability in the marketplace. One buyer's version of the good will not even substitute for another buyer's, let alone meet the needs of a larger potential customer base. This excessive product differentiation will clearly severely curtail sales growth possibilities. High gearing, especially if it rises above unity, will increase the SBE's exposure to risk, and also impose a debt-servicing burden. Not surprisingly, this is to the detriment of growth.

Turning to the profitability equation (2), the gearing ratio is again as expected: high gearing damages profitability. The Business Type variable increases as the type goes from sole proprietorship to partnership, to private company *etc.* The negative sign on this variable precisely confirms the insights of managerial theorists like Penrose, Slater and Richardson. Increasing the organisational complexity of the SBE creates costs which erode profits. More surprising is the different effect that the Rivals' Pricing variable has on profitability, compared to growth. The interpretation I would put on this variable is that rivals act as good monitors of an SBE's profitability performance through their close interdependence in terms of pricing policies. In a sense, they provide a costless monitoring system which keeps the profit orientation lively amongst rivals.

A final interpretation of the model embodied in equations (1) and (2) is worthy of consideration. There are two endogenous (or jointly determined) variables in the model: profitability (π) and the growth rate (g). All the other variables are exogenous (or predetermined). The status of these variables has been confirmed by diagnostic testing.[12] To simplify the model, it may be written as just a single-argument profitability equation $\pi = f(g)$ and a single-argument growth rate equation $g = F(\pi)$. Suppose all exogenous variable are assigned to their mean values, then the linear regressions used to estimate equations (1) and (2) enable specific

functions to be given to f(.) and F(.). Using the estimated coefficients [see Footnotes] and mean values for exogenous variables, these functions are found to be (approximately) $\pi = f(g) = 21.9 - 0.04g$ for the profitability equation and $g = F(\pi) = 109.0 - 2.71\pi$ for the growth equation. It is informative to graph these equations, as in Figure 3. The equilibrium values for growth (g^*) and profitability (π^*) should mutually satisfy f(.) and F(.), that is: $g^* = F(\pi^*)$ and $\pi^* = f(g^*)$. Solving out using the expressions for these functions, one gets $g^* = 55.7\%$ which is close to the mean value of the annual real growth rate in the sample of 57.1%, and further $\pi^* = 19.67\%$ which likewise is close to the mean value of profitability in the sample of 19.43%. It is to be further noted that the equations indicate a stable equilibrium point[13] at (g^*,π^*) which is denoted E in Figure 3. Thus, starting from a growth rate of 109% on the horizontal axis, a convergent path to E can be traced; and likewise starting from a profitability of 21.9% on the vertical axis, one can trace another convergent path to E. These equilibrium values are close to mean values for growth and profitability in the sample, and the growth and profitability values generated in passages to equilibrium are also similar to those observed in the sample.

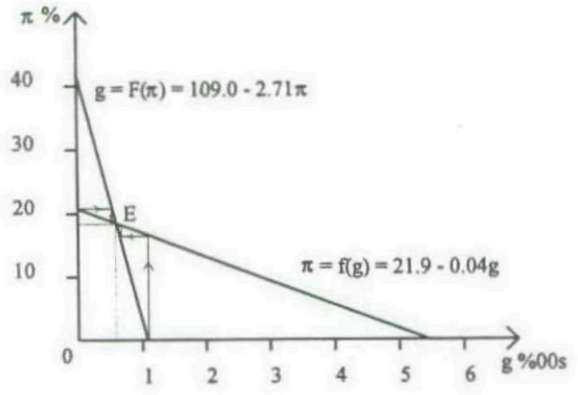

Fig. 3.

To conclude, the Scottish data on young SBEs which have been examined show a remarkable coherence, and display clear congruity with several major theories. Two main null hypotheses were set up, with the following consequences after testing:

(a) Gibrat's Law was tested and refuted. The alternative hypothesis, which was accepted, implies a 'life cycle' effect for the small firm in Scotland. This simple alternative model can be generalised to a more complex non-linear model, which also takes account of entrepreneurial experience. The main conclusion stands under this generalisation: small SBEs grow faster than larger SBEs. Further, this growth process is stable, and tends to an equilibrium value which is close to the mean value of size for SBEs in the sample.

(b) A more general simultaneous equations model of growth was formulated. Under the null hypothesis a 'cumulative causation' view was put to the test. It was rejected in favour of an alternative (managerial) hypothesis which implies a growth/profitability trade-off. This more general model was also shown to be stable, and to generate equilibrium values which were close to the mean values for growth and profitability in the sample.

Notes

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[1] See the preliminary treatment in Reid and Jacobsen (1988), the detailed treatment, appealing to case study, statistical and econometric evidence in Reid (1993), and the small business strategy approach in Reid, Jacobsen and Anderson (1993).

[2] See, for example, the work by Binks, Ennew and Reed (1988) using data supplied by the Forum of Private Business.

[3] The fieldwork design and instrumentation used are treated in some detail in Reid (1993).

[4] Space precludes a detailed individual treatment of authors. For an extensive and thorough survey, see Hay and Morris (1991, Ch.10).

[5] The equation estimated was:

$$\ln(\text{asset}_{t+1}) = 1.6 + \underset{(4.02)}{0.63}\ \ln(\text{asset}_t); \quad F = 25.87$$

Estimation was by least squares using White's heteroskedastic-consistent covariance matrix.

[6] An example of the typical model estimated is:

$$g = \underset{(2.02)}{0.37} - \underset{(-1.97)}{0.11S} + \underset{(0.64)}{0.003S^2} - \underset{(-0.78)}{0.06A} - \underset{(-0.14)}{0.001A^2} + \underset{(1.83)}{0.018S.A}$$

with $R^2 = 0.33$, $F = 7.5$, $n = 67$

Here, g is asset growth in real terms, S is the natural logarithm of real assets and A the natural logarithm of age. Estimation was by least squares, using White's heteroskedastic-consistent covariance matrix.

[7] See Reid (1989, Ch.4) where a dynamic model of price leadership is developed, in which the leader sustains an output and profitability advantage over time.

[8] Estimation was by ordinary least squares and by iterative three stage least squares.

[9] One iteration three stage least squares estimators for equations (1) and (2) respectively give coefficients and asymptotic t-ratios as follows, where coefficients are in the same order as indicated in the main text, starting with a constant:

(1)* 228, –2.7, 28.0, 18.3, –64.8, –72.9, –0.8
(–2.1) (1.7) (2.2) (–1.4) (–2.5) (–3.0)

(2)* 44.7, –0.04, –9.0, 13.0, –0.13
(–0.8) (–1.9) (1.3) (–2.52)

The system $R^2 = 0.52$. When higher iterations are used, the significance on the profitability and growth rate variables in (1)* and (2)* rises rapidly. For technical details, see Reid (1993, Ch.11).

[10] This would be true, for example, if SBEs shared the same profitability-growth locus, but differed by the owner-managers' tastes for growth versus profitability. Various 'identifiability' conditions need to be satisfied if the trade-off case is to be theoretically substantiated along managerial lines. These conditions are analysed in Hay and Morris (1991, Ch.10).

[11] It may be that in the long-run the growth-profitability 'cumulative causation' effect will assert itself, despite any short-run trade-off effects of the sort I have identified.

[12] That is by Hausman endogeneity tests.

[13] This stability condition may be expressed:

$$(d\pi/dg)_f = -0.04 > -0.369 = (d\pi/dg)_F.$$

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