

FIRM SIZE AND GROWTH IN THE UNITED KINGDOM LIFE INSURANCE INDUSTRY

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ABSTRACT

This study tests whether the organic growth rates of United Kingdom (UK) life insurance firms are independent of size, as predicted by Gibrat's (1931) Law of Proportionate Effects. Using data for 1987–1996 and the three subperiods, 1987–1990, 1990–1993, and 1993–1996, we find that smaller life insurance firms tended to grow faster than larger ones in the 1987–1990 period and that larger life insurers tended to grow faster than smaller ones in the 1990–1993 and 1993–1996 periods. But over the ten-year period, we find no significant difference between the growth rates of small and large firms, thus supporting Gibrat's Law as a long-run tendency in the UK life insurance industry. When we examine firm-specific determinants of asset growth, we find evidence in 1987–1996 and 1987–1990 that more diversified life insurance firms experienced higher growth rates on average than more specialized life insurers. We also find that the growth of life insurance firms was related to input costs during the 1990–1993 and 1993–1996 subperiods.

INTRODUCTION

Gibrat's (1931) proposition that the proportionate organic (or internal) growth rates of firms are independent of their size has been the subject of many cross-sectional and sector-specific studies published in the industrial economics literature over the last decade or so (e.g., Cabral, 1995; Chesher, 1979; Evans, 1987; Hall, 1987; Harhoff et al., 1998; Weiss, 1998). The overall conclusion arising from most of the prior research is that self-generated corporate growth rates tend to vary randomly across firms and over time, as predicted by Gibrat's Law of Proportionate Effects (Geroski et al., 1997). In other

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words, growth is independent of size, and other firm-specific factors, in single and multiperiod states. However, to our knowledge, prior research has not investigated whether corporate growth rates in insurance markets follow the Gibrat process. This is surprising given that insurance markets in developed economies such as the United Kingdom (UK) (see Carter, 1998; Richards and Colenutt, 1975) and the United States (US) (see Globerman, 1986) have long been characterized by rapid market change, dynamic rates of firm growth, and innovative product development. Of the 840 UK registered insurers in 1997, 177 firms were engaged solely in life insurance, while 65 of the largest operatives (composites) wrote both life and general insurance business (Association of British Insurers, 1998). Like other parts of the financial services sector, the life insurance industry has been operating in an increasingly competitive environment spurred on by the World Trade Organization's liberalization of international trade in services and the gradual arrival of the single European market in financial services (Carter, 1998). As a result, insights into the firm size-growth relation should be particularly relevant to the insurance industry, where new entrants have taken an increasing share of new business premiums (Swiss Re, 1999).

Our research is motivated in two further respects. First, the question of whether small life insurers grow as fast as (or faster than) large life insurers is an issue of some importance to policymakers, industry associations, and others. For example, insights into the relation between self-generated corporate growth and firm size could help policymakers frame rules that achieve desired objectives in policy areas, such as the licensing of new entrants to the market and employment and wealth creation. Second, the structure and evolution of the insurance industry will be of interest to the distributors and consumers of insurance products. For example, evidence suggesting a lack of empirical linkage between the past performance and future growth of life insurance firms is likely to influence the decision making behavior of brokers, policy holders, and investors. Therefore, we seek to address the dearth of empirical research by using 1987–1996 data from the UK life insurance industry to test whether the observed growth rates of life insurance firms follow the Gibrat process and, more generally, to investigate the determinants of the growth of life insurance firms.^{1,2}

The remainder of the article is structured in the following manner. The next section describes the Gibrat process and discusses other possible determinants of firm growth in the life insurance industry. The "Empirical Study" section outlines the nature of the empirical study, explains the variables and sources of data, and presents and discusses the results. The final section concludes the article.

¹ While some of the life insurance firms in our sample grew by means of a merger or acquisition, none of these were major. Most of the growth recorded over the ten years of our study, therefore, was organic growth.

² UK life insurers are taxed and accounted for on a different basis than are their counterparts in the general (property-liability) insurance industry. As a result, we consider that any improved statistical precision possibly emanating from the pooling of both life and general insurance firms would be offset by the problem of measurement bias in estimating the linkage between firm size and growth rate patterns. Indeed, this is one reason why most industrial economics-based studies from the insurance sector (e.g., Cummins et al., 1999; Hardwick, 1997) tend to treat life and general insurance as separate industries.

CORPORATE GROWTH

Drawing on a framework of empirical research in the natural sciences, Gibrat (1931) concluded that skewness in populations (such as those relating to size frequencies) reflects an underpinning Gaussian process according to which a large number of small but independent additive influences generate a normal distribution. Thus, an observed skewed distribution of variate x could be modeled by positing that an underlying function of x (say, the natural logarithm of x) is normally distributed (Sutton, 1997). Applying this stochastic model to cross-sectional/time-series firm-based data from the French manufacturing sector, Gibrat (1931) demonstrated empirically that proportionate organic (asset-based) growth was independent of firm size. This work led to the formulation of what has become generally known in the industrial economics literature as Gibrat's Law. Given the generality of Gibrat's Law, this prediction should apply to financial services firms such as those operating in the UK life insurance industry—a sector with a notably skewed (concentrated) firm size distribution (Carter, 1998).

A basic tenet of Gibrat's Law is that firms face the same probability distribution of self-generated growth rates, with each firm's observed growth pattern determined by a random sampling from that distribution (Weiss, 1998). In its basic form, the stochastic process can be expressed as:

$$(SIZE)_{it} / (SIZE)_{i,t-1} = \alpha (SIZE)_{i,t-1}^{\beta_1 - 1}, \quad (1)$$

where $(SIZE)_{it}$ is the (asset-based) size of firm i at time t and $(SIZE)_{i,t-1}$ is the size of firm i in some previous time period; ε_{it} is a disturbance term that is assumed to have a mean equal to 1 and a constant variance. The value of α may be interpreted as the constant market rate of growth, while the value of β_1 represents the effect of initial size on the subsequent rate of firm's growth. If $\beta_1 = 1$ firm growth is independent of initial size and Gibrat's Law holds (assuming that the disturbances, ε_{it} , are independently distributed over time, (Chesher, 1979)). If $\beta_1 > 1$, large firms tend to grow faster than smaller firms, and if $\beta_1 < 1$, small firms tend to grow faster than larger firms. The functional form in Equation (1) thus takes into account the dynamic relation between current period changes in firm size and recent past changes in firm size.

Previous empirical studies of Gibrat's Law (Dunne and Hughes, 1994; Hall, 1987) assume that the firm size-growth relation generates a lognormal distribution, albeit one with increasing variance over time. Therefore, taking natural logarithms and re-writing Equation (1) gives the following equation:

$$\ln S_{it} = \beta_0 + \beta_1 \ln S_{i,t-1} + \mu_{it} \quad (2)$$

where $\beta_0 = \ln \alpha$ and $\mu_{it} = \ln \varepsilon_{it}$. However, estimating Equation (2) by ordinary least squares (OLS) raises a number of possible problems. First, the disturbances will be heteroskedastic if the variance of growth rates is not equal for different sizes of firms, leading to inefficient estimates. Second, if serial correlation arises from growth persistence, the estimate of β_1 will be inconsistent (see Chesher, 1979). Third, it is possible that sample attrition (i.e., the loss of small, slower-growing firms from the sample) will bias the estimation results. All three problems are therefore tested for and (where necessary) dealt with in the regression analysis.

Recent empirical studies (Dunne and Hughes, 1994; Geroski et al., 1997; Weiss, 1998) have also tested the sensitivity of the Gibrat process to firm-specific inputs, such as the cost of capital and labor, and other variables, such as profitability. The reasoning is that such factors directly influence the output choices of managers in firms and thus may be important determinants of corporate growth rates and the structural evolution of markets. In this study, we also consider the relative influence of a number of firm-specific factors in the survival and growth of UK life insurance firms. These factors are input costs, profitability, output mix, company type, organizational form, and location. While a link between any of these factors and firm growth will not necessarily invalidate Gibrat's Law, the results will add to our understanding of the determinants of corporate growth in the life insurance industry. Consider each of the factors in turn.

Input Costs

A firm may have higher than average input costs per unit of output (i.e., be relatively cost-inefficient) for a number of reasons. For example, the concept of cost inefficiency can refer either to unexploited economies of scale or diseconomies of scale in an industry, or to the existence of technical or allocative inefficiency. A firm with unexploited economies of scale could reduce average cost by increasing the scale of its operations, but doing so may be difficult as scale inefficiency puts the firm at a competitive disadvantage that may hinder growth. Similarly, a firm facing diseconomies of scale could reduce average costs by contracting the scale of its operations. Thus, while the existence of economies of scale provides a clear incentive for the organic and acquisition-based growth of firms (Cummins et al., 1999), such growth may be difficult to achieve—for example, due to managerial inertia. Moreover, diseconomies of scale could provide an incentive for contraction or at least represent a barrier to any further growth.

Previous research (Hardwick, 1997) suggests in fact that many firms with unexploited economies of scale have operated for many years in life insurance and other financial services markets. If economies of scale exist, researchers should ask why these firms have not taken advantage of available unit cost savings yet have neither gone out of business nor been taken over. One possible explanation, alluded to by Fields (1988), is that insurance markets have not been sufficiently competitive and that absent price transparency plus a lack of knowledge about policy conditions and premiums on the part of consumers (i.e., asymmetric information) have allowed such scale-inefficient firms (and their management structures) to survive.

Technical and allocative cost inefficiencies refer to the deviation of a firm's actual cost of production from the minimum cost achievable by that size of firm. Technical inefficiency implies that the firm is producing less than the maximum possible output from the inputs it is employing, while allocative inefficiency implies that, given input prices, the firm is failing to employ the cost-minimizing combination of inputs. In this study, we use firms' input cost ratios as a proxy for cost inefficiency.³ Our prediction is that, other things being equal, life insurance firms with higher input costs per unit of

³ Input cost ratios are only a rough gauge of inefficiency. In fact, it is not impossible for a firm with a high cost ratio to be relatively efficient. See Berger et al. (1997) for a discussion of this point.

output (whether caused by scale, technical, or allocative inefficiencies) will perform less well than more cost-efficient firms and so will grow more slowly.

Profitability

Whittington (1980) and Geroski et al. (1997), among others, have suggested that although firm growth and size may approximately follow a random distribution over time, profitability could nonetheless be an important determinant of corporate growth and development. For instance, Whittington (1980, pp. 335-336) states that "... higher profits provide both the means (greater availability of finance from retained profits or from the capital market) and the incentive (a high rate of return) for new investment." However, the empirical evidence of the linkage between profitability and firm growth/size is somewhat ambiguous. For example, evidence collected by Whittington (1980) from UK manufacturing companies suggests that an inverse relation exists between average year-on-year profitability and firm size, as managers may trade current profits for future growth because, for example, they wish to "empire-build" and engage in excessive perquisite consumption (e.g., luxurious offices). By contrast, in their UK study, Geroski et al. (1997) do not find evidence of such a tradeoff between profit maximization and firm growth and conclude that a positive association between average-period profitability and firm growth over the long-term exists. With regard to the life insurance industry, Santomero and Babbel (1997) have observed that in the US, the managers of many life insurers have not accurately predicted economic shocks (e.g., adverse interest rate movements) and that this has adversely affected both corporate profitability and the pace of product-market development. This observation suggests that if future economic shocks are largely unpredictable, corporate growth rates in the life insurance industry are also likely to be unpredictable. Such a priori reasoning would thus be consistent with Gibrat's Law.

Output Mix

The life insurance companies included in our sample produce a mix of outputs, including life insurance and annuities, pensions, and permanent health insurance.⁴ A possible source of firm inefficiency is the selection of a nonoptimal output mix. If scope economies⁵ are within this range of products, we would expect firms with a more diversified output mix to operate more efficiently and therefore achieve higher average growth rates.

Company Type

A further possible source of (external) scope economies may be available to composite insurance companies that sell both long-term (i.e., life) and general (i.e., property-liability) insurance products. For example, such firms have the opportunity to cross-sell life insurance products to their property-liability policy holders. The existence of such scope economies would give composite insurance firms a competitive advantage over pure life insurance companies, and this may be reflected in higher growth rates.

⁴ Permanent health insurance provides benefits to cover the financial needs associated with long-term disability caused by accident or sickness.

⁵ See Berger and Humphrey (1997) for a survey of studies of scale and scope efficiencies in financial services. Also see Berger et al. (2000) who estimate economies of scope for US life and property-liability insurers.

Organizational Form

Corporate growth rates in insurance markets could also be influenced by whether an insurer is a policy holder-owned organization—in other words, a mutual company—or an organization owned by shareholders—a proprietary or stock company. Our reasoning is simply that organic growth rates are likely to be influenced by the availability of capital (Whittington, 1980) and thus more likely to favor the stock form of organization, which has access to capital markets. In contrast, mutuals are unlikely to have such easy access to funds to aid organic growth (see Adams, 1995). Other things being equal, we would therefore expect stock insurers to exhibit higher rates of growth than mutual insurers.

Location

It is not unreasonable to expect that UK based life insurers with their head offices or principal administrative offices located outside London will face different rates of growth than insurers based in London. This is because we anticipate that location in the London market provides increased opportunities for new business growth—for example, from international trade and the proximity to London's financial institutions. So regional variations may influence the economics of life insurance firms and thus the applicability of Gibrat's Law to the UK life insurance industry (e.g., see Hardwick, 1997).

THE EMPIRICAL STUDY

Samples and Data

To construct our samples, we started with the 231 firms that were actively engaged in life insurance business in the UK in 1987 and submitted returns to the Department of Trade and Industry (DTI), as reported in the Synthesys Life database (published by Thesys, 1998). These firms can be categorized into four main types: independent stock companies, independent mutual companies, bank assurers, and subsidiaries of stock or mutual organizations.

How to deal with the last group is a problem for a study of this kind. These are firms that retain their names and authorities to operate as life insurers, pension companies, or investment management companies. They operate in many respects independently of their parent companies, yet are owned by the shareholders of the parent companies and ultimately controlled by the parent companies' board of directors. When independent life insurers are taken over by a larger group but continue to operate as before, should the companies be regarded as survivors or nonsurvivors? In the empirical study, we regard such firms as survivors if they continue to report as separate entities under their former corporate names.⁶ Our target sample consists, therefore, of all life insurance firms listed in the Synthesys Life Database (regardless of parent).

In the empirical study, we investigated the ten-year period 1987–1996 and the three subperiods, 1987–1990 (boom), 1990–1993 (recession), and 1993–1996 (recovery), to test Gibrat's Law in the UK life insurance industry. The period 1987–1996 represented

⁶ For example, in the UK, Scottish Mutual and Clerical Medical continue to operate and report as separate entities even though they have been acquired by Abbey National plc and Halifax plc, respectively.

the earliest and latest years for which complete data were available from public sources. By focusing analysis on the three subperiods, we could also test whether the firm size-growth relation in the UK life insurance industry is influenced by macro-economic conditions (see, for example, Ward and Zurbruegg, 2000). Furthermore, to be included in the sample, the firms must have been operating in 1987 and survived at least until the end of 1996 under the same corporate name. There were 176 life insurance firms that met this condition, and these firms earned over 80 percent of total premiums generated in the life insurance industry during the period. In addition to firm size, we examined other possible determinants of the growth of life insurance firms, as discussed in the "Corporate Growth" section. These are input costs (*IC*), profitability (*PR*), output mix (*MIX*), company type (*COMP*), organizational form (*ORG*), and location (*LOC*). The cross-section growth model is:

$$\ln(\text{SIZE})_{it} = \beta_0 + \beta_1 \ln(\text{SIZE})_{i,t-1} + \beta_2 \ln(\text{IC})_{i,c} + \beta_3 \ln(\text{IC})_{i,p} + \beta_4 \ln(\text{PR})_{i,c} + \beta_5 \ln(\text{PR})_{i,p} + \beta_6 \ln(\text{MIX})_i + \beta_7 \text{COMP}_i + \beta_8 \text{ORG}_i + \beta_9 \text{LOC}_i + \mu_{it} \quad (3)$$

where $\text{IC}_{i,c}$ and $\text{IC}_{i,p}$ are average values of the expense ratio over the current and previous periods, respectively, and $\text{PR}_{i,c}$ and $\text{PR}_{i,p}$ are the average values of profitability over the current and previous periods, respectively.

The variables included in the study were measured according to the definitions given in Table 1. Data on asset sizes, input costs, profitability, and output mix for 1987–1996 were obtained from the Synthesys Life Database, while data on company type, organizational form, and location were extracted from the Insurance Post (1999). Table 1 also summarizes the full set of hypotheses to be tested.

Results

The sample means and standard deviations of the asset sizes, input cost ratios, profitability, output mix, company type, organizational form, and location are shown in the first part of Table 2 for the ten-year period and the three subperiods. The average asset size of the life insurance firms in our samples grew from an average of £1,236 million in 1987–1990 to £2,656 million in 1993–1996. The average input cost ratio increased steadily during the ten-year period from 0.38 in 1987–1990 to 0.42 in 1990–1993 and 0.62 in 1993–1996. At the same time, the average profitability ratio fell from 0.91 in 1987–1990 to 0.87 in 1990–1993 and 0.72 in 1993–1996, and output mix remained relatively stable. It is clear from the standard deviations that large degree of within-sample variation occurred in all variables. The second part of Table 2 shows the Pearson coefficients of correlation for the independent variables included in the regression equation for the ten-year period. These were all less than 0.5 in magnitude, so the possibility of inefficient estimates resulting from multicollinearity was very small. As a further check on the possibility of multicollinearity, variance-inflation factors (VIFs) were calculated for each independent variable for each period.⁷ None of these exceeded 1.5 (and similar results were obtained for the three subperiods), confirming that problems associated with multicollinearity are unlikely in this model.

⁷ As a rule-of-thumb, variables can be regarded as highly collinear if a VIF exceeds ten (see Gujarati, 1995, p. 339). The results were $\ln(\text{SIZE})_{t-1}$: 1.52; $\ln \text{IC}$: 1.49; $\ln \text{PR}$: 1.37; $\ln \text{MIX}$: 1.39; COMP : 1.14; ORG : 1.20 LOC : 1.12.

TABLE 1
Variable Definitions and Hypotheses

Variable names	Definitions
Company size (<i>SIZE</i>)	Annual total net assets.
Input cost ratio (<i>IC</i>)	Average period gross expense ratio (annual management expenses, including commissions, divided by total written premiums)
Profitability (<i>PR</i>)	Average period ratio of reported annual retained net profit (after tax) to total net written premiums ⁸
Output mix (<i>MIX</i>)	The sum of the squared ratios of annual premiums from each of the four main lines of business (life insurance and general annuities, pensions, permanent health insurance, and other business) to total premiums ⁹
Company type (<i>COMP</i>)	Composite insurer = 1, pure life insurer = 0
Organizational form (<i>ORG</i>)	Stock life insurer = 1, mutual life insurer = 0
Location (<i>LOC</i>)	Insurer located in London = 1, located outside London = 0

Hypotheses to be tested

- H1: (Gibrat's Law) Other things being equal, differences do not exist in the probability distributions of growth rates across size classes of UK life insurance firms.
- H2: Other things being equal, life insurers with higher input costs per unit of output will perform less well than more cost-efficient firms and so will grow more slowly.
- H3: Other things being equal, growth rates of life insurance firms are related to rates of profitability. According to prior studies, this relationship could be positive or negative.
- H4: Other things being equal, more diversified life insurers have higher growth rates than more specialized life insurers.
- H5: Other things being equal, composite insurance companies have higher growth rates than pure life insurers.
- H6: Other things being equal, stock life insurers have higher growth rates than mutual life insurers.
- H7: Other things being equal, life insurers in London grow faster than life insurers outside London.

⁸ Annual retained net profit (after tax) is the aggregate of the balance on the company's life insurance (technical) account after adjusting for actuarial transfers to reserves and the profit/loss on minor (nontechnical) activities outside the life fund but nonetheless related to new business generation (e.g., management charges). We experimented with other measures of profitability such as net operating income (before tax) to net premiums written and net operating income (before tax) to total assets. However, the results were not qualitatively different and so are not reported. Tests using the embedded value measure of future profit (i.e., the total of the present value of in-force business plus the value of shareholders' net assets held outside the life fund but available to generate life business) could not be conducted. This is because many life insurance companies (notably mutuals) do not routinely report embedded value profits.

⁹ For each line of business, we calculated total annual premiums on an "annual premium equivalent" basis (i.e., regular premiums plus one-tenth of single premiums).

TABLE 2

A Summary of Descriptive Statistics

	1987–1996	1987–1990	1990–1993	1993–1996		
Mean assets (£m)	1,903.9 (3,951)	1,236.3 (2,071)	1,805.8 (3,817)	2,655.9 (5,406)		
Input cost ratio	0.40 (1.26)	0.38 (0.76)	0.42 (1.27)	0.62 (2.68)		
Profitability ratio	0.80 (6.45)	0.91 (6.96)	0.87 (7.16)	0.72 (4.92)		
Output mix	0.79 (0.21)	0.80 (0.21)	0.79 (0.22)	0.78 (0.22)		
Company type	0.38 (0.49)	0.38 (0.49)	0.38 (0.49)	0.38 (0.49)		
Organizational form	0.68 (0.47)	0.68 (0.47)	0.68 (0.47)	0.68 (0.47)		
Location	0.39 (0.49)	0.39 (0.49)	0.39 (0.49)	0.39 (0.49)		
Correlation matrix (1987–1996)						
	$\ln(SIZE)_{t-1}$	$\ln IC$	$\ln PR$	$\ln MIX$	$COMP$	ORG
$\ln IC$	−0.34					
$\ln PR$	−0.08	0.46				
$\ln MIX$	−0.46	−0.09	−0.19			
$COMP$	−0.13	0.21	0.24	0.11		
ORG	−0.26	0.16	−0.08	0.18	0.21	
LOC	−0.05	0.06	−0.08	0.14	0.20	0.33

The first part of this table shows the means and standard deviations (in brackets) of the variables included in the regression analyses for the periods 1987–1996, 1987–1990, 1990–1993, and 1993–1996. The second part shows a correlation matrix for the independent variables included in the 1987–1996 regression equation.

Equation (3) was estimated first by OLS for the ten-year period and the three distinct economic subperiods, but (as expected) there was evidence of heteroskedastic disturbances in all four models.¹⁰ A number of reasons have been suggested in the literature for the existence of heteroskedasticity in the firm size-growth equation. For example, Harhoff et al. (1998) consider that smaller firms tend to have less diversified product ranges than larger firms and so may be subject to greater growth variability. Other researchers (Dunne and Hughes, 1994; Jovanovic, 1982) have suggested that the ages (life cycle effects) of the firms in the sample may be the key determinant of growth

¹⁰ Three diagnostic chi-squared statistics were calculated to test the hypothesis of homoskedastic disturbances: the Lagrange multiplier test, the White test, and the Breusch-Pagan test. All three calculated values allowed us to reject the hypothesis of homoskedasticity for all periods at the 5 percent level of significance, suggesting that the OLS estimates may be inefficient.

variability. For instance, smaller, younger firms with inexperienced managers (and usually less diversified product structures) may be less stable than larger, older firms. However, when we included age as a regressor in the life insurance firm size-growth equation, it proved to be insignificant and did not remove the heteroskedasticity.

An alternative way of dealing with heteroskedasticity is to calculate weighted least-squares (WLS) estimators by making an assumption about the pattern of heteroskedasticity and then transforming the data appropriately. After a number of experiments, we could eliminate heteroskedasticity by multiplying the square of $\ln(\text{SIZE})_{t-1}$ through Equation (3) and then applying OLS. Next, we tested for possible problems arising from serial correlation and sample attrition (or survivorship) bias.

Serial correlation. Chesher (1979) demonstrated that estimates of β_1 could be inconsistent if growth persistence is in the sample, i.e., if the factors that make a firm grow quickly (or slowly) in one period persist into future periods, so that "... growth encourages (or discourages) growth" (Chesher, 1979, p. 404). Under these circumstances, faster-growing firms will become larger over time so that estimates of β_1 will be biased upward in small samples. Thus, even if the estimates of β_1 are equal to one, Gibrat's Law may still not hold. To test whether serial correlation of this type existed in our model, we regressed the growth rates of life insurance firms over the period 1990–1993 on growth rates over the period 1987–1990, and we regressed growth rates over the period 1993–1996 on growth rates in 1990–1993.¹¹ The coefficient estimates were both negative, neither was significantly different from zero, and the R^2 values were very low (0.004 and 0.012, respectively). We concluded, therefore, that no evidence of growth persistence exists that is likely to bias our results.

Sample attrition (or survivorship) bias. A further possible problem in firm size-growth models arises from sample attrition, i.e., the greater probability that slower-growing small firms will be nonsurvivors compared with slower-growing larger firms. As non-surviving firms are excluded from the sample, the estimates of β_1 may be biased downward and so give the impression that smaller firms tend to grow faster than larger firms. To investigate sample attrition more closely, we calculated the average asset sizes and growth rates of the 34 life insurance firms that survived through the first half of our ten-year sample period, 1987–1991, but failed to survive through to 1996. We then compared these values with the average size and growth rate of the 176 firms that survived the entire ten-year period. These results are shown in Table 3, where it is clear that the nonsurviving life insurance firms were significantly smaller and had significantly lower median growth rates than the surviving life insurance firms.

¹¹ The results are shown below, where g_0 represents the 1987–1990 growth rates, g_1 represents the 1990–1993 growth rates, and g_2 represents the 1993–1996 growth rates:

$g_1 = 0.48 - 0.05g_0$	$g_2 = 0.17 - 0.10g_1$
(0.05) (0.06)	(0.05) (0.10)
$n = 176$	$n = 176$
$R^2 = 0.004$	$R^2 = 0.012$
$F = 0.68$	$F = 0.99$
(Standard errors in brackets)	

TABLE 3

Asset Size and Growth of Survivor and Nonsurvivor Firms

	Survivors 1987–1991 that did not survive to 1996	Survivors 1987–1996
Number of firms	34	176
Asset sizes 1987–1991 (£m)		
Mean (£m)	327	1,903
Standard deviation	535	3,951
Median	164	326
Asset growth 1987–1991 (%)		
Mean	168	179
Standard deviation	276	776
Median	36	47

Significance tests

 H_0 : The surviving and nonsurviving firms have the same mean asset sizes. H_A : The surviving and nonsurviving firms have different mean asset sizes. $t = 3.78$ (Reject H_0) H_0 : The surviving and nonsurviving firms have the same asset growth rates. H_A : The surviving and nonsurviving firms have different asset growth rates. $t = 1.26$ (Cannot reject H_0) H_0 : The nonsurviving firms have the same median asset size as the surviving firms. H_A : The nonsurviving firms have a lower median asset size than the surviving firms. $z = 2.23$ (Reject H_0) H_0 : The nonsurviving firms have the same median growth rate as the surviving firms. H_A : The nonsurviving firms have a lower median growth rate than the surviving firms. $z = 2.57$ (Reject H_0)

This table compares the average asset sizes and growth rates of those life insurance firms that survived through 1987–1991 but not to the end of 1996 with those that survived through the entire ten-year period.

Note: To compare the medians, a nonparametric signs test is used. The test-statistic is a z-value because the normal approximation to the binomial distribution is applied.

To allow for the possibility of bias from this source, we estimated the firm size-growth equation for each period in a sample-selection framework, using the Heckman two-stage method (Heckman, 1979) to deal with the problem of survivorship bias. First, we used a probit technique to estimate a quadratic survival selection equation.¹² Then we re-estimated Equation (3) for each period using WLS (to eliminate heteroskedastic disturbances) and the inverse Mills ratio function of the probit residuals as an additional independent variable over the selected sample.

¹² Quadratic sample selection equations have been used in previous studies such as Evans (1987) and Dunne and Hughes (1994).

TABLE 4
The Determinants of Firm Growth—Regression Results

Variable	Coefficient estimates and standard errors (in parentheses)			
	1987–1996	1987–1990	1990–1993	1993–1996
Constant	1.360 (1.22)	1.746 ^b (0.63)	−0.386 (0.60)	−1.069 ^b (0.53)
Initial company size	0.946 ^b (0.07)	0.896 ^{b,d} (0.04)	1.052 ^c (0.03)	1.076 ^{b,e} (0.03)
Input cost ratio (Current)	−0.146 (0.09)	−0.062 (0.04)	−0.347 ^b (0.07)	−0.070 (0.05)
Input cost ratio (Lagged)	–	–	−0.349 ^b (0.08)	0.099 ^c (0.05)
Profitability (Current)	−0.032 (0.04)	−0.006 (0.02)	−0.023 (0.02)	0.007 (0.02)
Profitability (Lagged)	–	–	−0.004 (0.02)	−0.010 (0.02)
Output mix	−0.523 ^b (0.24)	−0.229 ^c (0.12)	0.047 (0.12)	−0.027 (0.11)
Company type	−0.276 ^b (0.133)	−0.074 (0.07)	−0.107 ^c (0.06)	0.068 (0.07)
Organizational form	0.096 (0.14)	−0.005 (0.07)	0.024 (0.07)	−0.047 (0.06)
Location	−0.115 (0.13)	−0.010 (0.07)	−0.081 (0.06)	−0.043 (0.06)
Inverse mills ratio	0.095 (0.92)	−0.671 (0.48)	0.474 (0.44)	0.863 ^b (0.40)
<i>n</i>	176	176	176	176
Adjusted <i>R</i> ²	0.85	0.95	0.96	0.96
<i>F</i> statistic	116.4	438.9	413.2	454.4
LM Het Test ^a	0.09	0.09	0.07	0.25

This table shows the results of estimating Equation (3) using life insurance company data for the periods 1987–1996, 1987–1990, 1990–1993, and 1993–1996. WLS and the Heckman two-stage procedure are used throughout.

The adjusted *R*² values suggest a good fit in all periods. The *F* statistics are also highly significant, suggesting that the independent variables jointly have a statistically significant influence on the dependent variable. Furthermore, the LaGrange multiplier test statistics for heteroskedasticity in all periods do not allow us to reject the hypothesis of homoskedastic disturbances.

^a The critical value of the chi-squared statistic for the LM test is 3.84.

^b Significantly different from zero at the 5 percent level (two-tailed)

^c Significantly different from zero at the 10 percent level (two-tailed)

^d Significantly less one at the 5 percent level (two-tailed)

^e Significantly greater than one at the 5 percent level (two-tailed).

The results of estimating Equation (3) separately for 1987–1996 and the three sub-periods are shown in Table 4. The lagged values of $\ln IC$ and $\ln PR$ were not available for the 1987–1996 and 1987–1990 regressions and so were excluded in those periods. We now consider the results in the light of the seven hypotheses listed in Table 1.

Hypothesis H1: The estimate of β_1 for 1987–1996 was not significantly different from one in a two-tailed test, but the 1987–1990 estimate was significantly less than one, while the 1990–1993 and 1993–1996 estimates were both significantly greater than one (at least at the 10 percent level in two-tailed tests). We conclude that H1 is supported over the longer term, but not over the shorter subperiods that correspond to different phases of the business cycle.

Our finding that the firm size-growth relation of life insurers varies over time is consistent with the findings of a number of previous studies. For example, investigations using data before 1960, usually for manufacturing firms only, generally found estimates of β_1 to be greater than one (see Prais, 1976; Singh and Whittington, 1975). Studies using data after 1960 have often found estimates of β_1 to be less than one (Storey et al., 1987). Dunne and Hughes (1994) also included the financial sector in their cross-sectional study and found estimates of β_1 equal to 0.98 for the period 1975–1980 and 0.89 for 1980–1985; however, these coefficients were not statistically significant.

The state of the business cycle is therefore a possible explanation for the time-varying firm size-growth relation. For example, small firms may tend to grow faster than larger firms during an economic boom (as experienced by the UK at the end of the 1980s) in response to greater consumer confidence and higher spending. However, larger firms may be better equipped than smaller entities to survive and maintain their asset sizes during an economic recession (as in the UK in the early 1990s). Our results tend to support this reasoning. We found that smaller life insurance firms grew faster than larger ones in the boom years of 1987–1990, while the larger firms grew faster during the recession of 1990–1993 and continued to do so during the recovery years of 1993–1996. Care should be exercised in interpreting these results, as we have only examined variations over the course of a single business cycle, which of course could be idiosyncratic. Nevertheless, our observations suggest that the possible link between the firm size-growth relation, consumer behavior, and the state of the macroeconomy would be an interesting topic for further research.¹³

Hypothesis H2: The estimates of β_2 and β_3 (the coefficients on the current and lagged values of the input cost variable, $\ln IC$) were mixed. Over the entire ten-year period and in 1987–1990, the estimates of β_2 were not significantly different from zero. In 1990–1993, the estimate of β_2 was negative and significant, while the estimate of β_3 was positive and significant. A similar result was found for 1993–1996, although in this period, only the estimate of β_3 was significant (at the 10 percent level). These results suggest that while high input costs in the current period may impede growth, high input costs in the recent past may lead to higher growth. This latter relationship may be because greater financial inducements to staff and increased expenditure on training and information technology only lead to higher growth in the future, or it

¹³ See O'Brien (2001) for some recent evidence of new entrant performance in the UK life insurance industry in the late 1990s (a period of relative macroeconomic prosperity).

may be because of the high first-year acquisition expenses associated with the launch of new life insurance products.

Hypothesis H3: With regard to the importance of profitability as a predictor of a life insurance firm's asset growth, the estimates of β_4 and β_5 were insignificant in all periods. Thus, we found no support for the view that higher levels of profitability (in either the current or previous periods) encourage (or discourage) growth in the life insurance industry.

Hypothesis H4: The estimates of β_6 (the coefficient on the output mix variable) were negative and significant in the ten-year period, 1987–1996, and in 1987–1990, but were insignificant in 1990–1993 and 1993–1996. This suggests that in the longer term and during the boom years of the late 1980s, more diversified life insurers enjoyed higher growth rates on average than more specialized life insurers, possibly reflecting the effects of economies of scope in the life insurance industry. So we have limited support for H4.¹⁴

Hypothesis H5: The estimates of β_7 (the coefficient of company type) were also negative and significant in the ten-year period, 1987–1996, and in 1990–1993, but insignificant in 1987–1990 and 1993–1996. This implies that over the longer term and in the recession of the early 1990s, pure life insurers enjoyed higher growth rates than those life insurers with property-liability affiliates, contrary to our expectations. The reasons for this are not clear, but the possibility of diseconomies of scope between life and property-liability insurance is worthy of further investigation.

Hypothesis H6: The estimates of β_8 (the coefficient on the organizational form dummy variable) were insignificant in all periods, suggesting that stock companies' access to market capital is not an important factor in determining growth potential. Thus, H6 is not supported by our results.

Hypothesis H7: The estimates of β_9 (the coefficient on the location dummy variable) were also insignificant in all periods. So we have found no supporting evidence that regional variations influence the growth rates of life insurance firms.

CONCLUSIONS

Using 1987–1996 data, this study empirically tested the predictions of Gibrat's Law of Proportionate Effects in the UK life insurance industry and investigated the influences of other possible firm-specific determinants of corporate growth.

¹⁴ We also included three control variables for "mix of business" in the regression equation: life insurance and general annuity premiums divided by total premiums (L), pensions premiums divided by total premiums (P), and permanent health insurance premiums divided by total premiums (H). In these ratios, total premiums included premiums from a fourth category of business, described in the accounts as "other long-term business," thus ensuring that the regression equation could be estimated. The estimated coefficients of L and P were both positive, while the estimated coefficient of H was negative, but all three were statistically insignificant in all periods. So we found no evidence that insurers specializing in different products tend to grow at different rates.

Taking the ten-year period as a whole, we have found no significant difference between the growth rates of small and large life insurance firms, a result that clearly supports Gibrat's Law as a long-run tendency in the UK's life insurance sector. We have also found no significant influence on growth from input costs, profitability, organizational form, or location. Interestingly, though, our results for 1987–1996 suggest that more diversified life insurance firms have higher growth rates than more specialized life insurers, but life insurers that are part of composite insurance companies (and so have property-liability affiliates) tend to have lower growth rates than pure life insurers. This implies that, while there may be economies of scope *within* the life insurance industry, there may be *diseconomies* of scope between life and property-liability insurance.

During the boom years of 1987–1990, our results suggest that smaller firms were growing faster than larger firms, but growth had no significant influence from input costs, profitability, company type, organizational form, or location. Only the output mix variable appears to have had any influence, with more diversified life insurance firms experiencing higher growth rates than more specialized firms. During the recession years of 1990–1993, larger life insurance firms grew faster than smaller ones, and our evidence further suggests that firms with higher input costs grew more slowly, while those that incurred higher input costs in the previous period (1987–1990) grew more quickly. Finally, in the years of recovery, 1993–1996, larger companies continued to grow faster than smaller ones, but the only firm-specific variable that exerted any significant influence on asset growth during this period was the lagged input cost variable; that is, higher input costs in 1990–1993 led to faster growth in 1993–1996.

Overall, these results suggest that while short-term fluctuations in business cycles can influence the relation between firm size and growth rate patterns, over the longer term the linkage becomes indeterminate, as predicted by Gibrat's Law. Therefore, from a policy perspective the size of life insurance firms does not appear to be an important consideration in determining long-term growth (and hence survival) potential. This finding does not favor a differential new entrant licensing policy based on firm size.

We acknowledge that the interpretation of our results should be tempered by recognition of the limitations of our study, such as the relatively small number of firm-year observations in the samples. Nonetheless, our results are robust to a battery of diagnostic tests. Finally, there seems to be scope for more research into the determinants of the growth of insurers and other financial services firms. An investigation into the effects on the growth of small and large firms of changes in macroeconomic conditions would be of particular interest, as would further research into economies of scope between life and property-liability insurance.

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