Dynamics of growth and profitability in banking

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ABSTRACT

This paper unifies the growth and profit strands in the empirical banking literature. A model allowing for bi-directional causality between growth and profit is used to test for the law of proportionate effect (LPE) and persistence of profit (POP), using 1990s European banking data. Larger commercial banks grew faster than smaller ones. The LPE describes the growth of savings and co-operative banks adequately. POP estimates are highest for co-operative banks, perhaps because entry is not profit-driven. Current profit boosts future growth, but in line with the managerial hypothesis there is also some evidence that current growth dampens future profit.

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1. Introduction

Previous studies of the determinants of concentration have put forward various explanations as to why some firms grow and attain large size. These include economies of scale or scope, efficiency gains attained through achieving large size, the adoption of entry-deterring strategies or the exercise of other forms of market power. Industrial sectors may tend to become increasingly concentrated over time, however, even if large firms do not enjoy such advantages. It is well known that empirical firm size distributions in many industries and countries can be approximated by certain theoretical skewed distributions including the lognormal. These in turn can be simulated using a stochastic model in which the (logarithmic) size of each firm is subject to a chronological sequence of purely random growth shocks. The implications for concentration of this type of stochastic growth process were first investigated by Gibrat (1931), whose formulation has become known as the Law of Proportionate Effect (LPE). In banking, researchers including Alhadeff and Alhadeff (1964), Yeats et al. (1975) and Tschoegl (1983) have reached differing conclusions (using different data sets) as to whether growth patterns in banking are in accordance with the LPE. Recent studies by Cyree et al. (2000) and Goddard, McKillop et al. (2001) present multivariate analyses of the growth of financial institutions.

Empirical research concerning the dynamics of company profitability is based on an account of the determinants of profit that is an alternative to the essentially static Structure-Conduct-Performance (SCP) paradigm (Mason, 1939; Bain, 1951, 1956). According to Brozen (1971), while the relevant micro theory identifies SCP relationships applicable when markets are in equilibrium, there is no certainty that a profit figure observed at any point in time actually represents an equilibrium value. The hypotheses tested in the persistence of profit (POP) literature are that entry and exit are sufficiently free to eliminate any abnormal profit quickly, and that all firms' profit rates tend to converge to the same long-run average value. The alternative is that some firms possess special knowledge or other advantages that enable them to prevent imitation or block entry. If so, abnormal profit may tend to persist from year to year, and differences in average profit rates may be sustained indefinitely. Empirical tests of the POP hypothesis in banking are few in number. Recently, however, Berger et al. (2000) have presented extensive evidence of persistence using a US banking data set spanning the 1970s, 80s and 90s.

Previous programmes of research into the dynamics of growth on the one hand, and profit on the other, have in the main developed separately, and followed contrasting empirical methodologies. Nevertheless, there are strong arguments that these two performance indicators are in fact closely related. According to the well-known managerial theories of the firm, for example, if the managers of large firms are motivated by salaries, power, non-pecuniary benefits and prestige (all of which are perhaps associated more with firm size than profit), and if managers have discretion to pursue their own objectives, growth as well as profit may enter the firm's objective function.[1] Growth in the demand for any firm's products is constrained by limits to the size of markets (Downie, 1958; Penrose, 1959; Marris, 1964). This constraint can be overcome via diversification, but the capabilities of the firm's management team restrict the rate at which successful diversification can be achieved without damaging profitability. To some extent growth and profit are competing objectives, and are interdependent.

This paper investigates the dynamics of firm growth and profitability, using a data set comprising 625 banks located in seven major European countries, with a range of ownership characteristics. Growth and profit rates are observed annually, over the period 1992 to 1998. Both assets- and equity-based size, growth and profit measures are used. The focus is solely on internally generated growth and profit among surviving banks. Banks that entered, exited or were taken over are excluded from the sample. The inclusion of commercial, savings and co-operative banks permits investigation of the hypothesis that the size-growth-profit relationships embodied in the model vary systematically between banks of different ownership characteristics. For example, while market forces impose disciplines necessitating cost minimising (or profit maximising) behaviour on the part of mangers of private commercial banks, it is by no means clear that managers of mutual and public banks follow similar objectives (Evans et al., 2001).

Methodologically, this paper attempts to unify the growth and profit strands in the previous empirical banking and industrial organization literature. It reports tests of the LPE and of the POP hypothesis that are embedded within a two-equation reduced form vector autoregressive (VAR) model. The two-equation VAR model seeks to capture the bi-directional relationship between growth and profit described above, in a simple and intuitive manner. It also nests the separate single-equation models that have been used extensively elsewhere. No attempt is made to develop a multivariate ‘structural’ model of the determinants of growth and profitability. Instead the empirical model is ‘reduced form’, and the main emphasis is on the dynamics of the growth and profit variables. As in the LPE and POP literatures, a model of this kind carries implications for future trends in concentration and the size distribution of banks; and for the impact of competition on profitability in banking.

The rest of the paper is organised as follows. Section 2 reviews the theoretical and empirical literature on the dynamics of growth and profitability. Section 3 describes the specification of the bivariate VAR model for bank growth and profit, and discusses the relationship between the present model and specifications used elsewhere in the literature. Section 4 discusses estimation methods. Section 5 describes the European banking data set and presents the estimation results. Section 6 concludes.

2. The dynamics of growth and profit: previous literature

The results of previous empirical tests of the LPE have been varied. A number of early studies using manufacturing data find either no relationship or a positive relationship between firm sizes and growth rates (Mansfield, 1962; Utton, 1972; Singh and Whittington, 1975). In contrast, Hart and Prais (1956) identify an inverse size-growth relationship for some time periods, and therefore reject the LPE. Consistently, studies based on more recent manufacturing data find that the size-growth relationship, at either firm- or plant-level, is negative (Hall, 1987; Evans, 1987; Dunne and Hughes, 1994; Hart and Oulton, 1996, 1999; Blonigen and Tomlin, 2001).

Although many empirical tests of the LPE are based on industrial or manufacturing data, a number of researchers have analysed banking or other financial sector data sets.[2] Alhadeff and Alhadeff (1964) find that between 1930 and 1960, smaller US banks grew faster than larger ones. In studies based on data for the 1960s and early-1970s, Rhoades and Yeats (1974) and Yeats et al. (1975) also find that US bank growth varied systematically with size. Recent European studies by Wilson and Williams (2000) using 1990-96 data, and Scholtens (2000) using 1988-98 data, find little or no evidence of mean-reversion in bank sizes. Using international data, Tschoegl (1983) also reports no evidence of mean reversion for 1969-77. Saunders and Walter (1994), however, do find an inverse size-growth relationship at international level for 1982-87. Vander Vennet (1999) reports a similar finding for 1985-89, but no size-growth relationship for 1990-94.

Two recent cross-sectional studies present multivariate analyses of the determinants of growth for financial institutions. Cyree et al. (2000) use a 1983-94 US banking data set to develop a two-stage discrete choice model of the decision whether to grow ‘externally’ by acquisition, diversification or branch expansion; and for banks that do so, the selection of the principal growth strategy from among these three alternatives. Size is one of several factors influencing the decision whether to grow (larger banks are more likely to do so); others include the bank’s charter (federal or state); income growth in the bank’s home state; and labour costs. Goddard, McKillop et al. (2001) analyse the growth of US credit unions over 1990-99. Univariate tests of the LPE indicate that larger credit unions grew faster. Multivariate estimations suggest, however, that if larger credit unions grow faster, they do so for specific reasons: because their charters are less restrictive; because they are more efficient; or because their financial structure is conducive to growth.

Recently, several researchers have made renewed efforts to provide theoretical explanations for the results reported in the empirical literature; in particular, the inverse size-growth relationship which seems to prevail throughout manufacturing. Trau (1996) provides an extensive review of theoretical growth models, while Hart (2000) draws links between theory and the empirical literature. Sutton (1997, 1998) argues the need for integrated theories to explain variations in the shape of the firm size distribution between industries. Product characteristics and technology, which influence whether an industry tends to fragment into separate sub-sectors or remain homogeneous, influences changes in concentration. At an empirical level, Geroski (1995) suggests that in many studies, an inverse size-growth relationship is a manifestation of a form of survivorship bias. Small firms are less likely to survive than large firms, but fast-growing small firms are more likely to survive than slow-growing ones. Consequently a negative size-growth relationship is often observed.[3]

The origins of the POP literature can be traced back to Mueller's (1977) article, in which deterministic time series regressions are used to demonstrate convergence in profit rates. Mueller (1986) develops a stochastic, autoregressive model to describe the same phenomenon. Subsequent industry-level studies confirm that profits tend to converge slowly, over periods of several years' duration. Significant correlations between past and present profit rates are therefore observed (Levy, 1987; Coate, 1989; Bourlakis, 1997). Firm-level studies suggest differences between firms in long-run equilibrium profit rates, and differences in the speed of convergence (Geroski and Jacquemin, 1988; Cubbin and Geroski, 1990; Bhargava, 1994; Waring, 1996; Geroski, 1998; Goddard and Wilson, 1999; McGahan and Porter, 1999). Research on US banking suggests profit converges to its long run average value more slowly than in manufacturing, and market power plays a significant role in enabling abnormal profit to persist (Levonian, 1993; Berger et al., 2000).

In Marris's (1964) growth model and in much of the subsequent literature on managerial theories of the firm,[4] diversification constitutes the main link between growth and profitability. Assuming long run average cost curves are L-shaped and not U-shaped, in theory "the limit on the growth of a firm is determined by the demand for its particular product rather than by cost conditions ... [but in practice] this constraint does not limit the growth of a firm because it can always introduce another product line" (Hart, 2000, p233). If diversification is the principal engine of growth in the long run, the nature of the growth-profit relationship depends on the impact of diversification on profit. Most of the empirical evidence cited in Montgomery's (1994) review article suggests diversified firms are less profitable. In some cases, however, diversification closely related to the firm's 'core' product leads to increased profits (Rumelt, 1982; Teece et al., 1994). Lang and Stulz (1994) find Tobin's q is higher for specialised than for diversified firms. By comparing the individual business units of a conglomerate with specialised firms in the same industry, Berger and Ofek (1995) estimate a 'diversification discount' of around 15% of the share price. Daley et al. (1997) find a tendency for the share price of firms that divest non-core activities to increase.

In banking, there is evidence that the rate of diversification is positively related to bank size. In theory, increased diversification allows banks to offer a wider range of services and spread risk across a larger number of asset categories (Diamond, 1984). Hughes et al. (1999) find that while growth through product and geographic diversification reduces bank risk, efficiency tends to improve as a result of geographic diversification. Demsetz and Strahan (1997) suggest, however, that large diversified banks tend to hold lower capital reserves, and tend to be more active in high-risk lines of business, such as derivatives. Klein and Saidenberg (1997) find diversified banks are less profitable than their specialised counterparts.

Few researchers have tested for empirical relationships between growth and profit directly. An exception is Geroski et al. (1997), who use a manufacturing panel data set to estimate a growth model including backward- and forward-looking components. The former represent the completion of responses to past profitability shocks, captured by terms in lagged growth. The latter represent partial adjustments to expected future changes in profitability, proxied by changes in the firm’s stock market valuation. This variable produces a positive and significant coefficient in the growth equation. According to this formulation the unpredictability of future profit shocks explains the random (or near-random) nature of growth in the empirical LPE literature. Geroski et al. note that their estimations yield no evidence of an inverse growth-profit relationship, as might have been expected according to the managerial literature. There is no attempt, however, to test such a relationship directly by estimating a profit equation.

3. The dynamics of growth and profit: empirical model

Most empirical tests of the LPE are based on cross-sectional regressions, in which logarithmic growth over some period is regressed on log size at the start of the period. In some studies, lagged growth (to allow for persistence of growth), firm age (to allow for the effect of dynamic economies in the form of learning-by-doing) and size-age interactions are included as additional explanatory variables. Although cross-sectional regression is normally used in these tests, the structure of the empirical model is similar to that of the auxiliary regression used in Augmented Dickey Fuller non-stationarity tests in time series econometrics. In the terminology of this literature, the LPE is satisfied if the log sizes of individual firms are integrated, and is violated otherwise. Gibrat's original formulation and typical textbook presentations of the LPE emphasise the long-term implications of the LPE for industry concentration. It therefore seems anomalous, though perhaps understandable in view of the limited availability of firm-level data over long time periods, that cross-sectional estimation dominates the empirical literature (Goddard, Wilson et al., 2001).

Previously, POP has been investigated using either parametric or non-parametric methods on firm- or industry-level data. This paper adopts a parametric approach. Parametric methods usually involve examination of the coefficients of a first-order autoregressive (AR(1)) model for normalised profit rates (see below). These coefficients provide evidence concerning both short run persistence (the speed at which abnormal profit above or below the norm tends to dissipate) and long run persistence (the rate towards which each firm or industry's profit tends to converge in the long run).

In this study, the following specification of the reduced-form VAR model for growth and profit is used:

$$\Delta s_{it} = \alpha_{1i} + \beta_{11}s_{it-1} + \beta_{12}\Delta s_{it-1} + \beta_{13}\pi_{it-1} + u_{1it} \qquad [1]$$

$$\pi_{it} = \alpha_{2i} + \beta_{21}\pi_{it-1} + \beta_{22}\Delta s_{it-1} + u_{2it} \qquad [2]$$

where s_{it} = logarithmic size (assets or equity) of bank i in year t, for i=1...N, t=1...T; $\Delta s_{it} = s_{it} - s_{it-1}$ = logarithmic growth of bank i between years t-1 and t; π_{it} = profit rate (return on assets or return on equity) of bank i in year t; α_{1i} and α_{2i} are individual (bank) effects; and $\alpha_{1i}=0$ for all i if $\beta_{11}=0$. In order to eliminate cyclical effects that impact on all banks similarly in each year, Δs_{it} and π_{it} are normalised by subtracting their cross-sectional means (in each year) from each observation.

Equation [1] is the growth equation, in which β_{11} reflects the direction of the size-growth relationship. It is expected β_{11} is either zero, or close to zero on either side. $\beta_{11}=0$ implies there is no size-growth relationship, in accordance with the LPE; $\beta_{11}>0$ implies large firms grow faster than small firms; and $\beta_{11}<0$ implies the opposite. The term in Δs_{it-1} allows for persistence of growth; previous studies have reported both positive and negative estimates of their counterparts of the parameter β_{12}.[5] Finally, the inclusion of π_{it-1} in the growth equation either captures the notion that profitable firms grow faster because they have more finance available, or allows for any other link between current profit and future growth. A restricted version of [1], with $\beta_{13}=0$ imposed and the individual effects α_{1i} incorporated into the error term, is the panel equivalent of the univariate cross-sectional equation commonly used elsewhere to test the LPE.[6]

Equation [2] is the profit equation, in which the term in π_{it-1} allows for short run persistence of profit. β_{21} reflects the speed at which abnormal profit tends to converge to the long run average. $\beta_{21}=0$ implies zero persistence, and suggests that competition is sufficiently fierce to ensure that an abnormal profit earned in one year does not persist at all into the following year. $\beta_{21}>0$ implies abnormal profit does persist: competition is less fierce because entry barriers are effective to some extent. The inclusion of the lagged growth term in Δs_{it-1} in [2] is justified by reference to the managerial theories of the firm, and by the more recent literature on the implications of growth (mainly through diversification) for profitability (see section 2). Among a group of firms with objective functions including both growth and profit arguments a negative growth-profit gradient, or $\beta_{22}<0$ in [2], is expected. To avoid including integrated and non-integrated variables in the same equation, profit (assumed to be non-integrated) is assumed to depend on growth (also non-integrated), but not upon bank size (assumed to be integrated or near-integrated). While the specification of [2] precludes a link between variations in size and profit over time, it does allow for a possible individual size effect on profit, through α_{2i}. A version of [2] with the restriction $\beta_{22}=0$ imposed and the pooled lagged dependent variable coefficient (β_{21}) replaced by a set of individual coefficients (β_{21i}), is the univariate profit equation commonly used elsewhere to test the POP hypothesis.

Section 3 concludes with some further comments on the relationship between the empirical methodologies employed in this paper, and elsewhere in the LPE and POP literature. It is useful to think of the present methodology as occupying middle ground between the cross-sectional approach often used to test the LPE, and the time series orientation of the POP literature. The present data set takes the form of a panel with large N and small T. The empirical model allows for common slope coefficients for all banks, together with individual bank effects. Implicitly, the standard cross-sectional test of the LPE assumes common ‘slope’ coefficients and no individual effects. Goddard, Wilson et al. (2001) show the cross sectional test suffers from a loss of power, and therefore has difficulty in rejecting the LPE, if there are individual effects (and therefore heterogeneous equilibria towards which firm sizes are mean-reverting) under the alternative hypothesis that the LPE is false. By including individual effects, the test employed in this paper is therefore less restrictive than the standard cross-sectional test.

In contrast, the time series methodology usually employed to test the POP hypothesis allows the estimation of a full set of individual effects and 'slope' coefficients, though invariably with relatively small T (between 15 and 30 observations in most studies) for each firm. The reliability of the individual estimates is therefore questionable. Accordingly, in many firm-level studies researchers use second-stage estimations to 'explain' variation in the estimated persistence coefficients, according to observable firm characteristics such as size or industry classification. In a recent industry-level study, Aiginger and Pfaffermayr (1997) use panel data, estimating 'slope' coefficients that are pooled (across 97 three-digit industries), while allowing for the presence of, but not estimating, individual (industry) effects. This paper adopts the same method to estimate the profit equation in the VAR model, allowing for pooled 'slope' coefficients (β_{21} and β_{22} in [2]) and individual (bank) effects (α_{2i}). The latter, which allow for variation between banks in long run persistence, are not estimated. The estimation focuses instead on short run persistence (measured by β_{21}), and the term 'persistence' is deployed in this sense in the following discussion.

To summarise, the unrestricted reduced form VAR comprising equations [1] and [2] allows for the following causal links. Entry barriers (via β_{21} in [2]) impact on profitability as described in the POP literature. Profit in turn influences growth (via β_{13} in [1]) subject to a time lag. Growth is also a function of firm size (via β_{11}) and is subject to persistence effects (via β_{12}), as described in the LPE literature. And growth influences profit (via β_{22} in [2]) with a time lag, in accordance with the managerial hypothesis.

4. Estimation methods

Section 4 describes the estimation of the growth and profit equations, [1] and [2]. Since both equations allow for individual bank effects, estimation using panel data with a large cross-sectional but a limited time series dimension (large N, small T) raises a number of important technical issues. In either case, the inclusion of both individual effects and a lagged dependent variable precludes the use of ordinary least squares (OLS) or fixed effects estimation.

In the growth equation [1], the prior that β_{11} are close to zero implies s_{it} is either integrated or near-integrated. In the literature on testing for unit roots using panel data, Breitung and Meyer (1994) suggest using the following transformed version of [1]:

$$\Delta s_{it} = \beta_{11}(s_{it-1} - s_{i0}) + \beta_{12}\Delta s_{it-1} + \beta_{13}\pi_{it-1} + \xi_{1it}, \quad \text{where } \xi_{1it}=u_{1it} + \alpha_{1i} + \beta_{11}s_{i0} \text{ and } \alpha_{1i} = \beta_{11}\delta_{1i} \qquad [3]$$

In [3], $\beta_{11}s_{i0}$ is deducted from the right hand side of [1], and added back into the error term together with the individual effects. The latter are further constrained to equal zero when $\beta_{11}=0$, through the restriction $\alpha_{1i} = \beta_{11}\delta_{1i}$.[7] The resulting Breitung-Meyer panel estimator of β_{11}, obtained by applying OLS to [3], is unbiased when $\beta_{11}=0$, and biased (towards zero) by an amount that depends only on β_{11} (and can easily be corrected) when $\beta_{11}\neq 0$.[8]

In the profit equation [2], it is expected that β_{21} is either zero or positive but considerably smaller than one. π_{it} is non-integrated, and the generalised method of moments (GMM) estimator described by Hansen (1982) and employed by Arellano and Bond (1991) for dynamic panel estimation is appropriate. This involves transforming all variables in [2] so as to remove the individual effects, and then instrumenting the lagged dependent variable on its own second and higher-order lags and on the first and higher-order lags of the independent variable. Arellano and Bover (1995) suggest transforming variables by subtracting from each observation the mean of the remaining future observations, and then applying a weighting to equalise the variances. Accordingly, the expression for the transformed dependent and independent variables in [2] is:

$$\overline{x}_{it} = \sqrt{\frac{T-t}{T-t+1}}\{x_{it} - (x_{it+1} + \ldots + x_{iT})/(T-t)\}, \quad \text{for } t=1\ldots T\text{–}1 \text{ and } x_{it} = \pi_{it}, \pi_{it-1}, \Delta s_{it-1} \qquad [4]$$

The resulting efficient two-step GMM estimator is of the form:

$$\hat{\beta} = (\overline{X}'ZA_N Z'\overline{X})^{-1}\overline{X}'ZA_N Z'\overline{Y} \qquad [5]$$

where $\hat{\beta}$ contains GMM estimates of β_{21} and β_{22} in [2]; $\overline{X}$ contains transformations of π_{it-1} and Δs_{it-1} as in [4]; $\overline{Y}$ contains transformations of π_{it} as in [4]; Z contains the lagged values of π_{it-1} and Δs_{it-1} used as instruments; and A_N is a weighting matrix. Different A_N are used at the first and second steps of the estimation.

The construction of Z and A_N is described by Arellano and Bond (1991). Monte Carlo studies have shown the asymptotic standard errors obtained from the two-step estimator are severely downward biased in small samples, but the first-step standard errors are virtually unbiased (Windmeijer, 2000; Bond et al., 2001). In accordance with common practice, section 5 reports the efficient two-step coefficient estimates, together with the one-step standard errors. When interpreting the results, it should be noted that the GMM estimation is based on asymptotic theory. Coefficient estimates and standard errors are unreliable for samples with a small cross-sectional dimension. The limited time series dimension of the present data set also precludes the investigation of more elaborate dynamic structures in the growth and profit equations. The specification of [1] and [2] therefore rests on an assumption that Δs_{it} and π_{it} are subject to first order autoregressive effects only. This assumption is standard in most of the previous empirical LPE and POP literature.[9]

5. Data and estimation results

Accounts data for 625 European banks were obtained from the ‘Bankscope’ database, compiled by International Bank Credit Analysis (IBCA) of London. The sample includes all domestic commercial, savings and co-operative banks operating in seven countries (Denmark, France, Germany, Italy, Netherlands, Spain and the UK) for which complete annual data were available for all years from 1992 to 1998 (inclusive).[10] The exclusion from the sample of banks that entered, exited or were taken over creates the possibility that various kinds of sample selection effect are present. Such effects are endemic in most empirical LPE and POP studies, and seem unavoidable since estimation requires data that is complete over a specified period. While the sample is unlikely to be perfectly representative of the population in respect of all relevant bank characteristics (size, growth, profitability, ownership and so on), it does represent a heterogeneous cross-section of banks. There is no obvious sign of selection bias favouring, for example, large banks over small or *vice versa*.

Following Tschoegl (1983) assets and equity size and profit measures were obtained for each bank. Tables 1 and 2 show sample descriptive statistics for all years from 1993 to 1998, for both sets of measures. The estimation results are presented in Tables 3 to 6. All estimations are based on panel data for N banks (as shown in the tables) and T=4 time series observations.[11] Separate estimations are reported for the assets and equity measures. All estimations are carried out over all sample banks; for all (private) commercial, (mutual) savings and co-operative banks; and for each ownership type within each of the seven countries.[12] Estimated coefficients significantly different from zero at the 1%, 5% and 10% levels are identified in the tables. In the following discussion, the 5% level is used to classify estimated coefficients as significant or insignificant.

Univariate estimations

Table 3 reports estimations of the univariate growth and profit equations based on the assets size, growth and profit measures, with the restrictions $\beta_{13}=0$ and $\beta_{22}=0$ imposed on [1] and [2] respectively. Table 4 reports the corresponding estimations based on the equity measures. In the growth equations estimated over all banks, positive coefficients on s_{it-1} are obtained using both sets of measures. The coefficient is significant in the assets equation, but not quite significant in the equity equation. Overall, the results suggest that large banks grew slightly faster on average than their smaller counterparts. Both coefficients on Δs_{it-1} are positive and significant, indicating positive persistence of growth: a tendency for above- (or below-) average growth performance in one year to be repeated the following year.

In the growth equations estimated separately over commercial, savings and co-operative banks, positive and significant coefficients on s_{it-1} are obtained for commercial banks on both sets of measures. For savings banks the coefficients are positive but insignificant, and for co-operative banks they are negative and insignificant. The pattern of faster growth for the larger banks in the commercial sector is therefore not repeated elsewhere. As shown in Table 1, the commercial banks are considerably larger on average than those in the other two categories. Co-operative banks in particular tend to have a much more restricted business mix, dealing mainly with retail customers and small businesses. The statutes of many co-operative banks impose geographical or other restrictions on expansion. All of these factors may be relevant in explaining the differences in the size-growth relationship between the three sectors. The persistence of growth coefficients on Δs_{it-1}, however, are all positive and significant in these equations.

The assets growth equations disaggregated by ownership type and country identify German, Dutch and UK commercial banks; Spanish and UK savings banks; and Italian co-operative banks as sectors in which large banks out-grew small banks significantly. This pattern was reversed in the German and Italian savings bank sectors, where small banks out-grew large banks. Similar patterns are found in the corresponding equity growth estimations, though insignificant coefficients on s_{it-1} are recorded for two of these sectors: German commercial and Italian co-operative banks. In both sets of growth equations, the persistence of growth coefficients on Δs_{it-1} are predominantly (but not exclusively) positive.

Overall, the growth equations produce no consistent evidence of mean-reversion in bank sizes. Either growth is independent of size; or in some cases (commercial banks especially) the size-growth relationship is positive. The size-growth relationship is negative and significant in only two cases (both involving savings banks). These findings are consistent with other recent European banking studies (Wilson and Williams, 2000; Scholtens, 2000). They are at odds, however, with much of the recent evidence for manufacturing or other industries reviewed in section 2, in which an inverse size-growth relationship typically prevails.

One simple interpretation of this inconsistency is that banking may be qualitatively different from manufacturing. Technological advantages deriving from economies of scale, or opportunities for the exercise of market power, give large banks a slight edge over their rivals, which is reflected in their superior growth performance. The same does not apply in manufacturing. Section 2 showed that recently, some theorists have interpreted an inverse empirical size-growth relationship as an artefact of survivorship or other types of sample selection bias. This suggests an alternative explanation for the differences found between manufacturing and banking. Partly due to the highly regulated nature of the industry, banking entry and exit rates are considerably lower than in manufacturing. The potential for selection bias to influence the present results should therefore be lower than in manufacturing studies that are unable to control for such effects.

The fact that an inverse size-growth relationship is often found for manufacturing, but not for banking, is consistent with the hypothesis that selection effects may be driving some of the manufacturing results.

In the profit equations estimated over all banks, positive coefficients on π_{it-1} are obtained using both profit measures. The assets persistence estimate, however, is markedly lower than the equity estimate. This could reflect an increasing tendency for banks to manage their equity to attain benchmark shareholder value targets, rather than returns on assets (ROA). In contrast, Berger et al. (2000) find between 1970 and 1997, US banks' ROA and return on equity (ROE) "tend to rise and fall together" (p1214). Both persistence estimates are lower than those reported in a number of other POP studies.

The tendency for the assets persistence estimates to be lower than the equity estimates is repeated in the profit equations for commercial, savings and co-operative banks. On both profit measures, the persistence estimates for co-operative banks are markedly higher than those for the other ownership categories. If profit is not an important motivating factor for co-operative banks, high (or low) profitability may not be viewed as a meaningful signal that will attract or encourage entry to (or exit from) the co-operative sector. Consequently high (or low) profit may be more likely to persist; the competitive mechanisms that would otherwise be triggered, causing abnormal profit to disappear rapidly, are ineffective or inoperative in this case. The fact that the savings banks' persistence estimates are the smallest among the three ownership types may reflect a recent tendency for competition in this sector to intensify.

Finally, the profit equations disaggregated by ownership type and country produce considerable variation in the coefficients on π_{it-1} and their standard errors. In part, this reflects the small-sample limitations of the Arellano-Bond estimator (see section 4). Nevertheless, some patterns are discernible. Although few coefficients are significant, both sets of estimations produce 11 positive and only two negative persistence estimates. Using assets measures, the only significant coefficients are for German and Italian co-operative banks, reflecting the relatively high persistence in this sector, as discussed above. Using equity measures, five persistence coefficients are significant. As before, this suggests higher persistence in ROE than in ROA.

Bivariate estimations

Table 5 reports estimations of the bivariate growth and profit equations based on assets measures, with the restrictions β_{13}=0 and β_{22}=0 relaxed in [1] and [2] respectively. Table 6 reports the equivalent estimations based on equity measures. In the bivariate growth equations estimated over all banks, the coefficients on s_{it-1} are smaller than their counterparts in the univariate model. Both are insignificant. The coefficients on Δs_{it-1}, however, are both positive and significant, as are the coefficients on π_{it-1}. In the individual growth equations for commercial, savings and co-operative banks, a range of estimated coefficients on s_{it-1} is obtained. All coefficients on Δs_{it-1} and π_{it-1} are positive, and most are significant. Similar patterns are found in the growth equations disaggregated by ownership type and country. Looking at these results as a whole, there is still some evidence of a positive size-growth relationship in the commercial sector, but no consistent evidence that growth is anything other than independent of size in the savings and co-operative sectors. There is, however, consistent evidence of a positive persistence of growth effect and a positive link between current profit and future growth.

A comparison between the coefficient estimates on s_{it-1} in the univariate and bivariate growth equations suggests that the univariate estimators may tend to over-estimate the magnitude of the size-growth relationship, due to the omission from the univariate model of the profit variable. Part of the positive size-growth relationship detected in the univariate estimation is in fact attributable to the upward pull of current profit on future growth. When the profit variable is included in the bivariate growth model, the estimated size-growth relationship weakens. The earlier conclusion that the size-growth relationship (measured in isolation) is predominantly positive still holds, but in part this relationship derives from the link between current profit and future growth. This link might be explained by the use of profit as a source of finance for growth (Marris, 1964); or by delayed growth adjustments to profit shocks (Geroski et al., 1997).

In the bivariate profit equations for all banks, the inclusion of the term in Δs_{it-1} increases the coefficient estimates on π_{it-1} markedly using assets measures, and marginally using equity measures, in comparison with the corresponding coefficients in the univariate equations. The coefficients on Δs_{it-1} are both negative but insignificant. In the individual profit equations for commercial, savings and co-operative banks, the coefficients on π_{it-1} are all higher than their counterparts in the univariate model. As before, these estimates are markedly higher for co-operative banks than for the other two ownership types. Five of the six coefficients on Δs_{it-1} are negative, but none is significant. In the profit equations disaggregated by ownership type and country, all but one of the coefficients on π_{it-1} are positive. The coefficients on Δs_{it-1} are predominantly negative but insignificant, presumably due to the small sample sizes as before. The regular occurrence of positive coefficients on π_{it-1} and negative coefficients on Δs_{it-1} does, however, constitute weak evidence that these estimations may be detecting genuine relationships.

The magnitudes of the persistence estimates in the univariate and bivariate profit equations suggest that the univariate estimates may be downward biased, due to the omission from the univariate model of the growth variable. Low estimated persistence in the univariate model actually reflects the downward pull of current growth on future profit. When the growth variable is included in the bivariate model, estimated persistence becomes stronger. The POP literature tends to attribute rapid convergence to surmountable barriers to entry and exit and effective competition. The present findings, however, suggest an alternative mechanism: high profit stimulates growth, which in turn tends to reduce future profit. The predominantly negative effect running from current growth to future profit is at least consistent with the managerial hypothesis, that managers face trade-offs between profit and growth objectives, causing banks to operate along a negative profit-growth gradient. The absence of significant coefficient estimates, however, implies that the statistical evidence for such a relationship is weak.

The finding of a negative link running from current growth to future profit in the empirical profit equations is also consistent theoretically with the positive link between current profit and future growth in the growth equations. In the Marris model, for example, current growth determines future profit through the effect of the managerial constraint on the scope for successful (profitable) diversification. Diversify too rapidly and profit declines (high Δs_{it-1} leads to low π_{it}). But this is only part of the story; current profit is also needed to finance future growth (high π_{it-1} is a precursor to high Δs_{it}), as the present results indicate.

6. Conclusion

Previous programmes of empirical research into the dynamics of company growth and profitability have for the most part developed separately, and used different empirical methodologies. This paper has attempted to unify the growth and profit strands in the empirical industrial organization literature, using a recent European banking data set. It reports tests of the Law of Proportionate Effect (LPE) and the persistence of profit (POP) hypothesis based on a two-equation model, which attempts to capture two-way causality between growth and profit. On the one hand, current profit is an important pre-requisite for future growth, because profit is the ultimate source of finance for expansion. But on the other hand, excessive current growth can have damaging implications for future profit, due to a managerial constraint on the rate at which diversification can take place without damaging profitability.

The data set comprises annual size and profit observations over the period 1992-98 for 625 European banks with a range of ownership characteristics. Dynamic panel estimation methods are used to estimate growth and profit equations with common slope coefficients across all banks, and allowing for (but not estimating) individual bank effects. The dimensions of the data set are ‘large N, small T’. Accordingly the empirical methodology occupies middle ground between the cross-sectional approach that has typically been used to test the LPE elsewhere, and the time series orientation of the POP literature.

The growth equations suggest that the larger commercial banks grew faster on average than their smaller counterparts. This pattern is not repeated, however, among the savings and co-operative sectors. There is also widespread evidence of positive persistence of growth: a tendency for above- (or below-) average growth in one year to be repeated the following year. The estimated coefficients on the lagged profit term in the growth equations lend support to the notion that current profit is an important precursor to future growth. They are also consistent with the notion that growth responds gradually to actual or expected profit shocks.

With a small number of specific exceptions, the growth equations reveal little or no evidence of mean-reversion in bank sizes. While such growth patterns continue, concentration in the European banking sector will exhibit a natural tendency to increase. This finding is in marked contrast to most of the recent manufacturing evidence, which indicates a widespread tendency for mean-reversion in firm sizes. This inconsistency might reflect straightforward technological differences between manufacturing and banking. Alternatively, it might reflect the differential impact of certain types of selection bias on statistical analyses of manufacturing and banking data sets.

In the profit equations, positive short run persistence estimates are obtained for both assets and equity profit measures. The equity persistence estimates are markedly higher, possibly because banks are actively managing and smoothing their equity performance measures. On both sets of measures, the persistence estimates are higher for co-operative banks than for the other two ownership categories. If profit does not enter the objective function of the typical co-operative, the competitive mechanism through which high (low) profit sends signals encouraging entry (exit), in turn causing rapid convergence towards long run average profit, is likely to be inoperative in this sector.

The inclusion of a lagged growth term in the profit equation tends to increase the numerical short run persistence estimates. The persistence estimates in the equations that exclude growth therefore appear to be downward biased: low estimated ‘persistence’ may actually reflect (to some extent) the downward pull of current growth on future profit, rather than a highly effective competitive mechanism creating rapid profit convergence through processes of entry and exit. The limited time series dimension of the present data set precludes statistically robust estimation of the link between current growth and future profit. Nevertheless, the results are consistent with the managerial hypothesis that banks encounter trade-offs between growth and profit objectives.

Table 1 Measures of centrality, sample banks: annual mean size, growth and profitability, assets and equity measures, 1993-1998

Country	Bank type	No. of banks	Average assets, 1998	Average equity, 1998	Average growth p.a., assets, 1993-8	Average growth p.a., equity, 1993-8	Average ROA, 1993-8	Average ROE, 1993-8
All	All	625	8451324	468410	7.33	8.56	0.53	8.32
	Comm	224	19018270	1040715	7.08	7.95	0.78	10.08
	Savings	279	2916878	175365	7.18	8.29	0.42	7.76
	Co-op	122	1706359	87784	8.14	10.32	0.33	6.40
Denmark	Comm	28	5252175	289264	5.87	8.31	1.09	9.73
France	Comm	43	34264840	1294295	3.92	6.22	0.45	6.66
Germany	Comm	30	5380527	190153	7.63	8.41	0.58	9.08
	Savings	177	2387363	103098	6.94	7.64	0.29	6.80
	Co-op	103	1262836	47195	8.12	10.43	0.29	6.46
Italy	Comm	18	13685160	809044	7.01	5.02	0.40	4.75
	Savings	36	2829203	250550	4.52	5.25	0.47	5.02
	Co-op	19	4110721	307816	8.22	9.70	0.54	6.05
Neth’lands	Comm	9	88869170	3409370	11.96	15.49	0.58	11.22
Spain	Comm	31	18016700	1146557	8.65	7.34	0.97	11.49
	Savings	25	8791964	557320	10.47	13.55	0.92	14.84
UK	Comm	65	13439300	1274941	8.03	8.78	0.99	13.60
	Savings	41	1697444	188429	8.55	10.54	0.63	9.98

Note:

Assets and Equity are in euros, current prices. All conversions are at 1/1/1999 exchange rates. Growth rates (assets and equity), ROA and ROE are in percentages.

Table 2 Measures of dispersion, sample banks: size quartiles, standard deviations of growth and profitability, assets and equity measures, 1993-1998

	No. of banks	Bank size, 1998			St.deviation growth p.a. , 1993-98	St.deviation profit, 1993-98
		1st quartile	2nd quartile	3rd quartile		
(a) Assets size, growth and profit measures						
All banks	625	463280	1297200	3455300	9.61	0.54
Commercial	224	528700	2457500	6979994	12.97	0.75
Savings	279	717600	1444410	2904400	6.12	0.31
Co-operative	122	283300	512850	1197800	8.82	0.30
(b) Equity size, growth and profit measures						
All banks	625	32000	78709	216900	10.05	7.02
Commercial	224	51000	181989	533356	12.40	9.78
Savings	279	39777	79800	176200	6.73	4.75
Co-operative	122	13600	23400	62000	11.30	3.88

See notes to Table 1.

Table 3 Univariate estimations: assets size, growth and profit measures

Country	Bank type	N= No. of banks	Growth eq’n: Dep var = Δs_{it}		Profit eq’n: Dep var = π_{it}
			Covariates:		Covariate:
			s_{it-1}	Δs_{it-1}	π_{it-1}
All	All	625	0.0248*** (0.0056)	0.1766*** (0.0209)	0.0996 (0.0824)
	Commercial	224	0.0712*** (0.0133)	0.1215*** (0.0376)	0.0828 (0.1532)
	Savings	279	0.0024 (0.0053)	0.2244*** (0.0284)	0.0360 (0.2557)
	Co-operative	122	-0.0006 (0.0096)	0.1115** (0.0477)	0.2768 (0.2353)
Denmark	Commercial	28	0.0376 (0.0238)	0.2723*** (0.0752)	0.2875 (0.3479)
France	Commercial	43	0.0672* (0.0409)	0.1670* (0.0873)	0.4929 (0.4907)
Germany	Commercial	30	0.1023*** (0.0328)	0.1699 (0.1061)	0.3061 (0.7251)
	Savings	177	-0.0184*** (0.0053)	0.2470*** (0.0336)	-0.0670 (0.3959)
	Co-operative	103	-0.0086 (0.0101)	0.1253** (0.0521)	0.3779*** (0.1562)
Italy	Commercial	18	0.0220 (0.0448)	0.1325 (0.1552)	0.4804 (0.6259)
	Savings	36	-0.0865*** (0.0236)	0.2569*** (0.0789)	0.6297 (0.8446)
	Co-operative	19	0.0626** (0.0305)	-0.0277 (0.1226)	0.5443*** (0.2224)
Netherlands	Commercial	9	0.1603*** (0.0612)	0.1730 (0.2284)	0.1002 (1.6158)
Spain	Commercial	31	0.0270 (0.0341)	-0.0336 (0.0924)	0.4089 (0.3731)
	Savings	25	0.0923*** (0.0204)	-0.1443 (0.0968)	0.1419 (0.8954)
UK	Commercial	65	0.0825*** (0.0253)	0.0937 (0.0738)	-0.1718 (0.6624)
	Savings	41	0.0755*** 0.0140	0.1635** (0.0788)	0.6706*** (0.1187)

Note:

Standard errors are shown in parentheses.

*** denotes coefficient significantly different from zero at the 1% level; ** denotes 5% level; * denotes 10% level.

Two-tail tests are used in the growth equation [1], where there is no prior concerning the signs of β_{11}, β_{12} and β_{13}. One-tail tests are used in the profit equation [2], where the priors are $\beta_{21}>0$, $\beta_{22}>0$.

Table 4 Univariate estimations: equity size, growth and profit measures

Country	Bank type	N= No. of banks	Growth eq'n: Dep var = Δs_{it}		Profit eq'n: Dep var = π_{it}
			Covariates:		Covariate:
			s_{it-1}	Δs_{it-1}	π_{it-1}
All	All	625	0.0083^{*} (0.0046)	0.1559^{***} (0.0191)	0.3339^{***} (0.0707)
	Commercial	224	0.0204^{**} (0.0100)	0.0948^{***} (0.0316)	0.3431^{***} (0.1212)
	Savings	279	0.0060 (0.0047)	0.2944^{***} (0.0272)	0.2112 (0.3053)
	Co-operative	122	-0.0043 (0.0098)	0.1817^{***} (0.0476)	0.4425^{***} (0.1313)
Denmark	Commercial	28	0.0232 (0.0157)	-0.0705 (0.0516)	0.4253^{**} (0.2489)
France	Commercial	43	0.0032 (0.0316)	0.1774^{**} (0.0783)	0.5049 (0.4483)
Germany	Commercial	30	-0.0425^{*} (0.0256)	0.0983 (0.0862)	0.1465 (0.8879)
	Savings	177	-0.0100^{**} (0.0047)	0.3084^{***} (0.0337)	0.0132 (0.5544)
	Co-operative	103	-0.0066 (0.0093)	0.2058^{***} (0.0502)	0.2086 (0.2867)
Italy	Commercial	18	-0.0147 (0.0348)	0.1885^{**} (0.0789)	0.5110^{**} (0.2685)
	Savings	36	-0.0896^{***} (0.0268)	0.1692^{**} (0.0726)	0.7211 (0.7259)
	Co-operative	19	0.0071 (0.0421)	0.1219 (0.1310)	0.5665^{***} (0.1901)
Netherlands	Commercial	9	0.1801^{***} (0.0654)	-0.2544 (0.2144)	0.4183 (0.6156)
Spain	Commercial	31	0.0439 (0.0267)	-0.0391 (0.0811)	0.4705^{***} (0.1247)
	Savings	25	0.1058^{***} (0.0187)	0.0606 (0.1169)	-0.0652 (1.0842)
UK	Commercial	65	0.0365^{**} (0.0172)	0.1583^{**} (0.0693)	-0.0309 (0.7616)
	Savings	41	0.0232^{***} (0.0070)	0.4567^{***} (0.0646)	0.6064^{***} (0.1997)

See notes to Table 3.

Table 5 Bivariate estimations: assets size, growth and profit measures

Country	Bank type	N= No. of banks	Growth eq’n: Dep var = Δs_{it}			Profit eq’n: Dep var = π_{it}	
			Covariates:			Covariates:	
			s_{it-1}	Δs_{it-1}	π_{it-1}	π_{it-1}	Δs_{it-1}
All	All	625	0.0032 (0.0073)	0.1844^{***} (0.0209)	0.0009^{***} (0.0002)	0.2049^{***} (0.0731)	-0.1317 (0.1591)
	Commercial	224	0.0495^{***} (0.0162)	0.1344^{***} (0.0380)	0.0008^{**} (0.0003)	0.2015^{*} (0.1352)	-0.2451 (0.3818)
	Savings	279	-0.0234^{***} (0.0082)	0.2243^{***} (0.0282)	0.0011^{***} (0.0003)	0.1166 (0.2428)	-0.1768 (0.4047)
	Co-operative	122	-0.0019 (0.0142)	0.1120^{**} (0.0479)	0.0001 (0.0007)	0.3998^{***} (0.1356)	0.3457 (0.3320)
Denmark	Commercial	28	0.0166 (0.0269)	0.2945^{***} (0.0759)	0.0009 (0.0005)	0.4741^{*} (0.3599)	-2.0901 (3.7876)
France	Commercial	43	0.0715 (0.0475)	0.1639^{*} (0.0892)	-0.0002 (0.0010)	0.4864 (0.5188)	-0.2487 (1.6307)
Germany	Commercial	30	0.1130^{**} (0.0474)	0.1533 (0.1191)	-0.0004 (0.0012)	0.5097 (0.5466)	-0.2863 (2.1922)
	Savings	177	-0.0274^{***} (0.0080)	0.2455^{***} (0.0336)	0.0004 (0.0003)	-0.0928 (0.4989)	0.7246 (1.1487)
	Co-operative	103	-0.0188 (0.0173)	0.1291^{**} (0.0524)	0.0007 (0.0009)	0.2936^{*} (0.2070)	0.5572^{**} (0.3329)
Italy	Commercial	18	-0.0128 (0.0467)	0.0336 (0.1585)	0.0024^{**} (0.0011)	0.4502 (0.7205)	0.1875 (4.1656)
	Savings	36	-0.0633^{**} (0.0318)	0.2380^{***} (0.0807)	-0.0015 (0.0014)	0.6813 (0.8093)	-0.8560 (1.7511)
	Co-operative	19	0.0717^{**} (0.0348)	-0.0306 (0.1233)	-0.0006 (0.0010)	0.5415^{***} (0.2071)	0.7219 (5.9271)
Neth’lands	Commercial	9	0.0583 (0.0921)	0.2400 (0.2293)	0.0037 (0.0025)	0.6561 (0.8555)	-0.4459 (1.6860)
Spain	Commercial	31	0.0074 (0.0498)	-0.0229 (0.0947)	0.0007 (0.0012)	0.4443 (0.3905)	-0.0412 (1.3771)
	Savings	25	0.0536 (0.0410)	-0.1293 (0.0977)	0.0011 (0.0010)	0.4783 (0.6035)	-0.3548 (0.9001)
UK	Commercial	65	0.0485 (0.0309)	0.1084 (0.0738)	0.0011^{*} (0.0006)	0.2905 (0.7824)	-0.5457 (1.2625)
	Savings	41	0.0532^{**} (0.0225)	0.1811^{**} (0.0799)	0.0008 (0.0006)	0.6456^{***} (0.1306)	-0.3489 (0.7009)

See notes to Table 3.

Table 6 Bivariate estimations: equity size, growth and profit measures

Country	Bank type	N= No. of banks	Growth eq’n: Dep var = Δs_{it}			Profit eq’n: Dep var = π_{it}	
			Covariates:			Covariates:	
			s_{it-1}	Δs_{it-1}	π_{it-1}	π_{it-1}	Δs_{it-1}
All	All	625	0.0075^{*} (0.0045)	0.0742^{***} (0.0204)	0.0024^{***} (0.0002)	0.3589^{***} (0.0802)	-1.180 (3.639)
	Commercial	224	0.0068 (0.0103)	0.0418 (0.0329)	0.0018^{***} (0.0004)	0.3583^{***} (0.1252)	-4.445 (4.978)
	Savings	279	0.0121^{***} (0.0044)	0.0870^{***} (0.0293)	0.0046^{***} (0.0003)	0.2645 (0.3090)	-1.076 (17.839)
	Co-operative	122	0.0081 (0.0113)	0.1221^{**} (0.0548)	0.0023^{**} (0.0011)	0.6161^{***} (0.1231)	-3.416 (13.014)
Denmark	Commercial	28	0.0170 (0.0163)	-0.1508^{*} (0.0784)	0.0014 (0.0011)	0.4571^{*} (0.3552)	-9.673 (31.510)
France	Commercial	43	-0.0114 (0.0306)	0.0908 (0.0785)	0.0039^{***} (0.0010)	0.4386 (0.5101)	-12.174 (24.483)
Germany	Commercial	30	-0.0438^{*} (0.0259)	0.0868 (0.0917)	0.0006 (0.0015)	0.5796 (0.4993)	-4.1586 (20.473)
	Savings	177	0.0003 (0.0047)	0.1609^{***} (0.0389)	0.0024^{***} (0.0003)	0.0515 (0.7438)	10.687 (66.674)
	Co-operative	103	0.0138 (0.0119)	0.1400^{**} (0.0553)	0.0043^{***} (0.0016)	0.4635^{***} (0.1754)	2.251 (5.909)
Italy	Commercial	18	-0.0298 (0.0352)	0.0034 (0.1261)	0.0024^{*} (0.0013)	0.7052 (0.6525)	-18.302 (79.636)
	Savings	36	-0.0224 (0.0294)	0.0317 (0.0750)	0.0083^{***} (0.0019)	0.6436 (0.6107)	-8.110 (6.834)
	Co-operative	19	0.0229 (0.0452)	0.0125 (0.1735)	0.0021 (0.0022)	0.8150^{*} (0.5075)	-31.350 (97.568)
Neth’lands	Commercial	9	0.1054 (0.0807)	-0.2945 (0.2119)	0.0127 (0.0083)	0.6393 (0.6424)	-4.326 (22.432)
Spain	Commercial	31	0.0798^{**} (0.0313)	0.0404 (0.0883)	-0.0028^{**} (0.0013)	0.4341 (0.3501)	11.503 (27.114)
	Savings	25	0.0403^{*} (0.0234)	-0.0072 (0.1093)	0.0054^{***} (0.0013)	0.5169 (0.5370)	-1.320 (25.333)
UK	Commercial	65	0.0077 (0.0182)	0.1449^{**} (0.0675)	0.0020^{***} (0.0005)	0.2924 (0.4148)	-10.548 (26.618)
	Savings	41	0.0228^{***} (0.0062)	-0.0963 (0.0996)	0.0075^{***} (0.0011)	0.8443^{**} (0.3973)	-34.436 (48.693)

See notes to Table 3.

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Footnotes

1. Managerial theories of the firm are referred to as ‘non-value maximisation’ theories in Berger et al.’s (1999) review of consolidation in financial services industry. Evidence in support of these theories is reported by Edwards (1977), Rhoades (1980), Berger and Hannan (1998).
2. Goddard, Molyneux et al. (2001) present a more detailed review of this literature.
3. According to Cabral (1995), sunk costs incurred through investment in capacity affect the empirical size-growth relationship. Small entrants are more likely to exit than large ones, and therefore tend to spread their sunk cost investment over several years, recording faster average growth. In Jovanovic’s (1982) model, a high exit rate among recent entrants is due to the latter only discovering their true efficiency and cost function after entry has taken place. Entrants whose realised costs exceed their expected costs pre-entry tend to withdraw quickly. Larger entrants, however, have a smaller cost disadvantage to overcome, and therefore have a higher survival probability. Agarwal and Audretsch (2001) make the relationship between age, size and the probability of survival differ over successive stages of the industry life cycle.
4. See, for example, Richardson (1964), Slater (1980), Seoki (1983), Cubbin and Leech (1986).
5. Chesher (1979) discusses the statistical interpretation of the persistence of growth coefficient.
6. Most previous cross sectional studies measure growth over a period of more than one year. It is easily shown that if growth is measured is measured over T years and the ‘slope’ coefficient in the regression of the T-year growth rate on initial size is b_{11}, then $b_{11}=\beta_{11}^T$, where β_{11} is the corresponding coefficient in [1] (Goddard, Wilson et al., 2001).
7. Non-zero individual effects with $\beta_{11}=0$ would create separate linear time trends for each bank: a possibility that is not permitted in the case $\beta_{11}\neq 0$.
8. When $\beta_{11}\neq 0$, the Breitung-Meyer panel estimator is biased due to the presence of $\beta_{11}s_{i0}$ in ξ_{1it}, the error term in [3]. This creates correlation between ξ_{1it} and the term in $(s_{it-1} – s_{i0})$ in [3]. Despite the bias, however, in a Monte Carlo investigation of the power of tests of the LPE based on the Breitung-Meyer panel estimator and the standard cross-sectional OLS estimator, Goddard and

Wilson (2001) find the former is more likely than the latter to reject the LPE in favour of an alternative of mean-reversion in most cases, when the alternative is actually true.

9. The specialised nature of the dynamic panel estimation methods employed, together with limitations on the coverage of the data set, imposes some further constraints on the specification and estimation of the VAR model. First, only the reduced form VAR is reported. No attempt is made to develop a structural VAR, even though the presence of simultaneous linkages between the current values of the growth and profit variables seems plausible. Second, the two equations are estimated independently using the methods described above. No attempt is made to allow for contemporaneous correlation between the errors of the two equations.

10. Banks from a number of smaller European Union countries (including Greece, Ireland and Portugal) were excluded from the sample because the data were insufficient or incomplete. All foreign-owned subsidiaries (including those owned by a bank based in another EU member country) were excluded, resulting in the omission of banks from Luxembourg, almost all of which were foreign subsidiaries.

11. Initially, seven observations of s_{it} and π_{it} are available for each bank (for the years 1992-1998 inclusive). Two observations are sacrificed in calculating Δs_{it} , Δs_{it-1} and π_{it-1}. In the growth equation, a third observation is sacrificed when creating the term in $(s_{it-1} - s_{i0})$ in [3]; in the profit equation, the third observation is lost when applying the transformation [4].

12. All commercial banks in the sample are privately quoted and/or owned banks. The co-operative banks have a mutual legal status. Savings banks have a range of ownership characteristics varying from mutual to near public (state) ownership. German savings banks are governed by their own public law and are underwritten by the relevant Land or Federal authorities. They are generally regarded as quasi-state institutions. In contrast savings banks in most other European countries are regarded as mutual institutions. In an analysis of cost and profit efficiency for a sample of German banks with different ownership characteristics, Evans et al. (2001) find little difference between private commercial banks, mutual co-operative banks and public savings banks. Their results do not indicate agency problems for non-private banks.