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Firm size and growth and the evolution of market structure in European banking.

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FIRM SIZE AND GROWTH AND THE EVOLUTION OF MARKET STRUCTURE IN EUROPEAN BANKING

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LIST OF ACRONYMS

BIS	Bank of International Settlements
CR	Concentration Ratio
E	Entropy Coefficient
EC	European Community
ECU	European Currency Unit
EFTA	European Free Trade Association
EMI	European Monetary Institute
EMU	European Monetary Union
ERM	European Exchange Rate Mechanism
ESCB	European System of Central Banks
EU	European Union
FTC	Federal Trade Commission
H-H	Herfindahl-Hirschman Index
H-K	Hannah and Kay Index
IBCA	International Bank Credit Agency
IO	Industrial Organisation
L	Lerner Index of Monopoly Power
LPE	Law of Proportionate Effect
MES	Minimum Efficient Scale
OBS	Off Balance Sheet
OECD	Organisation for Economic Co-operation and Development
OFT	Office of Fair Trading
PCM	Perfectly Contestable Market
SCP	Structure Conduct Performance
UK	United Kingdom
US	United States

ABSTRACT

This thesis examines the size-growth relationship for banking and manufacturing firms. In particular it tests the Law of Proportionate Effect (LPE) which suggests that there is no relationship between firm size and growth. Tests of the LPE are carried out for eight European banking markets (Belgium, Denmark, France, Germany, Italy, Netherlands, Spain and the United Kingdom) and for three bank types (commercial, co-operative and savings) over the period 1990 to 1994. Employing three measures of size (total assets, equity and off balance sheet business) models are estimated that test for size effects on growth, and the influences of previous growth, bank type and country membership. In the majority of cases, bank growth is independent of bank size, so the LPE holds. However, small banks grew faster than their larger counterparts (in terms of assets and equity) in France, Italy and Spain.

The LPE is also investigated for a sample of European manufacturing firms drawn from five countries and eleven industry groups. In contrast to the banking industry there is less evidence that the LPE holds. In most cases small firms grew proportionately faster than their larger counterparts.

Using stochastic simulation techniques, the effects of firm growth, entry, exit and merger activity on the evolution of bank sizes and market concentration is examined. Using a simulated industry in which the LPE holds as the benchmark, the implications of various alternative assumptions regarding bank growth were examined. Superimposition of entry leads to a lower mean bank size and lower levels of concentration. Exit leads to higher mean bank size and increased concentration. Mergers lead to increases in mean bank size and concentration in all simulated industries.

Using the simulations methodology, hypothetical projections as to the future structure of the banking markets in France, Germany, Italy, Spain and the UK are carried out. Overall, the simulations suggest that bank numbers are likely to decrease in all countries. The market shares of the largest banks are also projected to decline in all countries with the exception of the UK.

CHAPTER 1

INTRODUCTION

1.1 Background To The Study

European banking has experienced widespread changes over the last decade. Through a process of structural de-regulation (brought about through the EU's 1992 Single Market Programme as well as changes in domestic regulation), banks now find it easier to compete in previously inaccessible domestic and foreign markets (Arthur Andersen, 1993). The erosion of lines of demarcation between the different types of financial services has led to differences between different types of banks becoming blurred, creating greater homogeneity between the services and products offered (Gardener, 1997). In addition, technological developments have transformed the possibilities for economies of scale and scope. A trend towards internationalisation means that there has been greater involvement of foreign banks in European countries, leading to intensified competition and the lowering of profit margins in many European banking markets (EU, 1997a).

As a consequence, banks have attempted to adopt strategies aimed at improving efficiency, such as mergers and acquisition activity, in order to expand output and increase the range of services offered. A major motivation has been to realise potential scale and scope economies, and also to reduce labour and other costs in an attempt to eliminate inefficiencies (Molyneux et al, 1996). Many banks have pursued strategies of diversification and financial innovation (White, 1998). The result of diversification is that banks now offer a wider range of products and services, and now conduct much of their business off balance sheet (Morgan Stanley, 1994). The pursuit of financial innovation has led to the introduction of sophisticated financial instruments, such as swaps and options (Metais, 1997).

The outcome of these changes has been increasing competition, accompanied by increases in concentration through a process of consolidation (Berger et al, 1999). Metais (1997) argues that banks have increased in size in order to compete on a European wide basis. This process has been encouraged by the existence of excess capacity in many banking markets, and can be viewed as an unforeseen result of de-regulation. However, increased size is not always the sole objective for banks. Llewellyn (1995) for instance suggests that, '*Overall, the rate of return on equity rather than balance sheet size growth is likely to become the dominant business objective, and this could significantly affect the internal culture of banks.*'[1]

Almost all explanations of the increasing levels of concentration in banking markets rest on the assumption that differences between banks lead to some banks obtaining advantages over others, causing them to grow and achieve enhanced market power. However, it is possible that this process of consolidation is taking place through the workings of chance. These arguments are embodied in the Law of Proportionate Effect (LPE).

The LPE argues that firm size is unrelated to growth, implying that small and large firms share the same chance of growing by any (proportionate) amount in any period. If the LPE holds then the size distribution of firms observed in an industry at any given time is the cumulative outcome of a series of growth shocks to initial firm sizes. Under this type of growth process, the industry will tend to become increasingly concentrated through time as a consequence of such shocks.

The overall aim of this thesis is to test whether or not the LPE holds in eight European banking markets over the period 1990-94, using data on bank sizes measured by assets, equity and off balance sheet business. For comparative purposes, tests are also carried out on a sample of manufacturing firms using an assets measure of size. An investigation of this kind is relevant from a theoretical, empirical and policy making point of view. In this introductory chapter, the relevance of the thesis from each of these perspectives is discussed, and the structure of subsequent chapters is outlined.

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[1] Llewellyn (1995), p.18.

Theoretical Perspective

Concentration is normally defined as the extent to which a small number of firms account for a large proportion of industry output, sales or employees. The prevailing assumption is that the more concentrated the industry is, the more possibilities exist for abuses of market power by dominant firms. Traditional explanations of why industries become highly concentrated centre around the assumption that some firms hold advantages over rivals that allow them to grow faster, and become large and dominant. These advantages may either arise naturally as a consequence of the technical conditions of the industry which confer efficiency advantages on larger firms, or through the strategic moves of established firms relating to factors such as innovative ability, product differentiation, vertical integration and diversification. It is upon these kinds of explanations that the predominant approach to analysing industries and firms has rested (Bain, 1956; Schmalensee, 1985).

In contrast, another body of work has emphasised the role of what are essentially 'random' factors in generating industry structure. These arguments are embodied in what has become known as the LPE (Gibrat, 1931). This view contends that random factors or chance may outweigh any other determinants of firm growth. In essence, firms which end up dominating an industry, have simply been lucky and enjoyed a series of years when growth has been high. Under this type of growth process, a firm's expected growth rate in any given year is independent of its current size. Over time this process generates a size distribution of firms which exhibits a positive skew, with a few large firms, rather more medium-sized firms, and a large tail of small firms.

Empirical Perspective

The traditional view of concentration has produced a large amount of empirical evidence covering manufacturing industries. This literature not only uses cross sectional analysis to assess the determinants of concentration, but also examines the implications of concentration for the behaviour and performance of firms (Bain, 1956)

The banking literature also acknowledges the importance of concentration in determining bank performance (Berger et al, 1993; Berger, 1995 and Rhoades, 1997). In contrast, there is little evidence to explain the evolution of concentration in banking markets.

A substantial empirical literature exists which tests the LPE for manufacturing. This research has been conducted by examining differences in the mean and standard deviation of growth rates of different size classes of firms. If no relation exists between firm size and growth, then only random factors are important, and the LPE holds (Hart and Prais 1956, Ijiri and Simon, 1977).

As far as we are aware, there is only limited evidence as to whether or not the LPE holds in banking, and these studies all focus on the US banking market (Alhadeff and Alhadeff, 1964; Yeats et al, 1975; and Tschoegl, 1983).

Policy Perspective

If the LPE holds, this implies that European banking markets will grow more concentrated in the future, even in the absence of differences in efficiency between banks, or strategic behaviour by large incumbent banks which is designed to enhance their market power. The outcome of increased concentration is that it may enable established banks to collude to keep industry output at low levels while charging high prices. Regulatory concerns about increased concentration have led some to suggest that policy makers should formulate structural measures (such as market share ceilings) aimed at reducing concentration to promote competitive outcomes (Gual and Neven, 1993).[2]

1.2 Aims and Structure Outline

Given the limited attention which has been paid to the determinants of market structure in banking and the relationship between the size and growth of banks, the present thesis seeks to fill this void. The aim of the thesis is to test empirically the LPE for European banking using data for 1990-94 for a large sample of commercial, co-operative and savings banks from Belgium,

[2] The assumption here is that concentration may either result in collusion or enable large firms to extend market power.

Denmark, France, Germany, Italy, Netherlands, Spain and the UK. An important feature of the thesis is that it tests for differences in the nature of the size-growth relationship between banks based in different European countries, and between different types of bank. As well as evaluating the LPE using conventional (assets and equity) size measures, tests are also applied using off balance sheet business data, so as to draw inferences about growth patterns in what has been a dynamic and rapidly expanding form of banking activity in the 1990s. Similar tests are also carried out for a composite sample of European manufacturing firms.

The results for the LPE in banking are also used as the basis for various stochastic simulations of the possible future evolution of the structure of several major European banking markets. The simulations allow for the effects of bank growth, entry, exit and merger in modelling the possible long run evolution of the bank size distribution and concentration in each banking market. Overall, the thesis seeks to address the following questions:

1) Does the LPE hold in EU banking and manufacturing markets?
2) Does the relationship between size and growth differ between different types of bank, or between banks in different EU countries?
3) What are the implications for the evolution of industry structure of different patterns of bank growth, and different rates of entry, exit and merger?

This section provides a summary of the material contained in each chapter, in order to provide an overview of the structure of this thesis. In chapter 2, the changing structural and regulatory environment of European banking is described, together with an examination of EU banking before and after the implementation of the Single Market Programme in Financial Services. The chapter examines the programme of structural de-regulation that took place in EU banking markets during the 1980s and 1990s, and charts the subsequent supervisory re-regulation that accompanied the creation of the Single Market. The impact of these changes on the structure of the banking industry, and the implications for bank strategies and performance are also highlighted. Recent commentary suggests that a process of consolidation will continue in the EU banking industry (EU, 1997a). The overall purpose of the chapter is to describe the background to the industry within which the present study is set.

Market structure is important in determining the conduct and performance of firms, which in turn are instrumental in shaping the future evolution of the industry. Chapter 3 reviews the areas of the field of industrial organisation which cover this topic. The chapter discusses the usefulness of the Structure Conduct Performance Paradigm (SCP) and Contestable Markets Theory for analysing firm performance within a given market structure. The role of economies of scale, entry and exit, market growth, innovation, mergers, government regulation and other factors in determining the size distribution of firms is highlighted. On balance the evidence reviewed suggests that systematic and chance factors may both play a role in the evolution of manufacturing industries.

Chapter 4 builds on these theoretical insights to examine empirical research in banking markets. The chapter discusses early SCP studies of bank performance and empirical studies of contestable markets in banking. Recent literature, which tests for the importance of economies of scale and scope, technological change, mergers and regulation in determining the structure of banking markets, are also examined. Overall, there is some evidence to suggest that economies of scale and market growth are instrumental in increasing industry concentration. However, there is limited direct evidence on the relationship between firm size and growth in banking, especially outside the US.

Given the scope of this thesis, chapter 5 examines the literature that has tested whether the LPE holds in manufacturing industries. This is covered in detail as it provides an important framework for the methodological approach which is adopted to examine the LPE in European banking and manufacturing in the following chapters. Some evidence on the LPE for various countries and industries suggests that many industry firm size distributions may be consistent with patterns of growth which are consistent with the LPE. However, different studies have yielded contrasting results in this respect, suggesting that the sample used, or the time period under investigation may affect the results.

In chapters 6 and 7, the factual, theoretical and empirical literature discussed in chapters 2, 3, 4, and 5 is used as the basis for the presentation of new evidence as to whether or not the LPE holds in the EU banking industry. The LPE is tested using data on eight EU banking markets (Belgium, Denmark, France, Germany, Italy, Netherlands, Spain and the UK) over the period 1990-94, using a data set comprising approximately 600 banks taken from the International Bank Credit Agency's (IBCA) Bankscope database. Tests are also carried out for a sample of approximately 750 manufacturing firms from five EU countries (France, Germany, Italy, Spain and the UK) taken from DATASTREAM. This sample is analysed to allow comparisons to be drawn between patterns of growth in banking and manufacturing. For example, it could be the case that banks grow in order to meet the needs of large corporate customers (Walter, 1988). If so, some similarities may exist between the growth processes of banking and manufacturing firms.

Chapter 6 describes the sources of data and the method of sample selection, and presents descriptive statistics for the samples of banking and manufacturing firms. The chapter also describes a methodological approach for testing the LPE that allows the relationship between size and growth to vary by bank type and country membership. This approach is also applied to the manufacturing sample.

In chapter 7, the banking and manufacturing data are used to test the LPE. The extent to which LPE holds is measured by the estimated slope coefficient in a regression of logarithmic growth on initial logarithmic size. A coefficient of one implies that the LPE holds. This suggests that concentration will tend to increase over time even though large firms do not have any particular advantages over small firms. A coefficient below one implies that smaller banks grow proportionately faster than their larger counterparts. This suggests that there is no natural tendency towards increasing concentration. A coefficient above one implies that large banks have advantages over small banks (derived from economies of scale, market power etc.) which tend to accelerate the tendency towards increased concentration. These estimations also yield estimates as to whether the LPE holds across different types of banks (commercial, savings and co-operative) and for different countries. This chapter also extends the basic growth model to examine the impact of age on a bank's growth prospects. Overall, the estimation results suggest that the LPE holds for the majority of EU banking markets, with the exceptions of France, Italy and Spain, in which small banks grow faster than their larger counterparts.

In contrast, the manufacturing results indicate rejection of the LPE for most industries and countries. In the majority of cases, smaller manufacturing firms grow faster than their larger counterparts, implying that firm sizes tend to converge toward some long run mean value. It is suggested that the differences between the estimation results for manufacturing and banking may arise fundamentally from differences between competitive conditions and the regulatory environment in the two cases.

Recognising the dynamic nature of the LPE, in chapter 8 stochastic simulation methods are adopted in order to examine the possible future evolution of bank size and concentration for five EU banking industries (France, Germany, Italy, Spain and the UK). The simulations examine the implication for bank size distributions of various scenarios regarding patterns of bank growth, and rates of entry, exit and merger. The projections suggest that each of these banking markets may in future be characterised by smaller numbers of banks arising from merger of existing banks. Mean and median bank size may increase in response to increasingly competitive conditions. It is argued that this process may result in an increased number of mergers as banks attempt to gain a competitive advantage through the realisation of scale and scope economies. The projections also suggest there may be a decline in the market shares of the top banks in all banking markets except the UK.

Finally, chapter 9 summarises the discussion and results of preceding chapters. Some limitations of the work are identified, and possible directions for future research are suggested.

CHAPTER 2

CHANGES IN THE EU BANKING INDUSTRY

2.1 Introduction

Over the past twenty years, the nature of the banking industry has undergone major changes, which has led to increased competition at both the national and international level. These changes have arisen partly from the de-regulation of financial markets, which to some extent has occurred in response to the increasing trend toward global markets in goods and services. This trend towards de-regulation has created an increasingly competitive industry, in which banks have sought to expand operations in order to reduce costs, while at the same time diversifying into new products and services to increase revenues. This chapter provides an overview of the changing regulatory and structural characteristics of the EU banking industry. Section 2.2 provides an overview of the EU banking industry before any substantial progress was made towards the creation of a single market. Section 2.3 examines the regulation, which was implemented to create a single market in financial services. Section 2.4 describes subsequent moves toward the creation of a single European currency. Section 2.5 discusses the economic issues surrounding the single market programme and the potential welfare benefits deriving from the single market. Section 2.6 outlines the impact of the single market programme on the structure, conduct and performance of EU banking markets. In particular, this section examines the effects of the single market on concentration, employment, bank efficiency and performance. Finally, section 2.7 provides an overall assessment of changes in the EU banking industry.

2.2 The EU Banking Industry in the 1980s

The single market in goods and services involves free internal trade, the removal of trade and tariff barriers and the unhindered movement of goods, services and capital within the European Union.

Vesala (1993) argues that for a single market in financial services to be possible, four main criteria must be met. First, credit institutions must be free to establish branches anywhere within the EU without restriction. Second, capital should be able to able to flow freely between countries, so allowing customers to buy services wherever they want. Third, a common legal framework is required for all countries, leading to equal competitive and regulatory conditions for all market participants. Fourth, there must be a single currency.

Neven (1990) asserts that the internal market has important consequences for EU banking markets. He argues two possibilities exist for trade in financial services:

'*...first, trade can arise, in the classical sense, through the cross border movement of a good or service. In the banking sector, this would occur if a resident in one country obtains (and pays for) services performed by a bank established in a foreign country. Alternatively, rather than supply its customer from abroad, the bank could choose to open a subsidiary or branch in the customer's country.*'[1]

In the 1980s, before any significant progress was made towards the creation of a single market in financial services, EU banking markets were very separate. In each country, banks operated under restrictive regulations and practices, which inhibited domestic competition, and provided a high degree of protection from banks operating in other countries. The majority of EU banking markets (most notably France, Germany, Italy and Spain) followed what has become known as the 'bank based system', whereby banks played a dominant role in the financing of industry. In contrast, the UK followed a 'market based system' whereby capital markets played a much more important role than banks in the financing of industry.[2] Each banking market had some distinguishing features. In some markets (Greece, Portugal, Italy and France) a large public commercial banking industry operated. In some cases (Germany) universal banking was the norm. In other markets (Luxembourg, Netherlands and the UK) foreign banks played an important role.

[1] Neven (1990), p.155.

[2] Fraser and Vittas (1984) and Rybcynski (1988) discuss the development of the bank based and market based systems. See also chapter 4.

Competition was limited by a broad range of barriers which are summarised in Table 2.1. The extent to which different types of restrictions were prevalent in each country is summarised schematically in Table 2.2.

Table 2.1: Barriers to a Single Market in Financial Services

Barriers to establishment in banking
1. Restrictions on the legal forms banks may adopt.
2. Limitations on the number of bank branches which may be established.
3. Restrictions on the take-over of domestic banks.
4. Restrictions of equity control of domestic banks.
Barriers to operating conditions in banking
1. The need to maintain separate capital funds.
2. Differences in the definition of own capital funds.
3. The need to maintain certain capital – asset ratios.
4. Exchange controls.
Barriers to competing for business in banking
1. Limitations on services offered.
2. Restrictions on local retail banking.
3. Restrictions on acquisition of securities and other assets.
Barriers to establishment in insurance
1. Lack of harmonisation of licensing procedures.
2. Lack of harmonisation in the constitution of technical reserves.
Barriers to operating conditions and competing for business in insurance
1. Direct insurance: Restrictions on the placement of contracts with non-established insurers.
2. Co-insurance: establishment of a permanent presence imposed on lead insurers.
3. Custom and practice in government procurement policies.
4. Lack of harmonisation in the supervision of insurance concerns.
5. Reinsurance: Compulsory or voluntary cessation of a percentage of contracts to a central pool or prescribed establishment.
6. Lack of harmonisation in the fiscal treatment of insurance contracts and premiums.
Barriers to establishment in securities
1. Membership of some stock exchanges limited to national citizens.
2. Constraints on the establishment of offices to solicit and carry out business in secondary markets.
3. Restrictions on the take-over of , or equity participation in domestic institutions.
4. Limitations on the establishment of securities firms in a universal banking system.
Barriers to operating conditions in securities
1. Exchange controls and other equivalent measures which prevent or limit the purchase of foreign securities.
2. Conflicting national prudential requirements for investors' protection.
3. Discriminatory taxes on the purchase of foreign securities.
Barriers to competing for business in securities
1. Limited access to primary markets in terms of lead management of domestic issues.
2. Restricted access to secondary markets because of national stockbroker monopolies on some stock exchanges.
3. Restrictions on dealing with investing public.

Source: Price Waterhouse (1988, p.62).

Table 2.2 Restrictions In EU Banking Markets In The Early 1980s

Country	B	DK	F	D	GR	Irl	I	L	Nl	P	E	UK
Interest rate restrictions	X	X	X		X	X	X	X		X	X	
Capital controls	X		X		X					X	X	
Bank access to stock exchange membership		X	X				X			X	X	X
Bank ownership restrictions										X	X	
Branching restrictions			X				X			X		
Foreign bank entry					X						X	
Credit ceilings					X							
Mandatory investment requirements										X	X	
Restrictions on insurance, underwriting and brokerage		X	X	X[1]	X				X[1]	X	X	
Portfolio management					X						X	
Leasing and factoring					X					X	X	

X - Restrictions in place

[1] - Insurance underwriting business not allowed but insurance brokerage business permitted.

B – Belgium, DK – Denmark, F- France, D – Germany, GR – Greece, Irl – Ireland, I – Italy, L- Luxembourg, Nl – Netherlands, P- Portugal, E – Spain, UK – United Kingdom.

Source: Broker (1989), p.24.

With reference to specific regulations, interest rate restrictions were in force in all countries except Germany, Netherlands and the UK. Capital controls operated in five of the twelve countries (Belgium, France, Greece, Portugal and Spain). Significant restrictions on branch expansion (France, Italy and Portugal) and areas of specialisation (Denmark, France, Greece, Italy, Netherlands, Portugal, Spain and UK) were commonplace.[3]

In the 1980s, EU countries could be grouped as to whether regulation was high (France, Greece, Portugal and Spain), medium (Belgium, Denmark, Ireland and Italy) or low (Germany, Luxembourg, Netherlands and the UK).

[3] For discussion of these issues for individual countries see: Colmant (1990) and De Boissieu (1990) for France; Llewellyn (1992b) and Mayer (1990) for the UK; Szego and Szego (1992) and Bruni (1990) for Italy; Maude and Molyneux (1996) for Germany; and Revell (1991) and Carminal et al (1990) for Spain.

Most European banking markets were characterised by a concentrated market structure dominated by a small number of 'core' banks (Revell, 1987). Table 2.3 shows the 3-firm assets and deposits concentration ratios for the banking markets of the twelve EU member countries in 1985, as well as the number of banks operating in each country and the value of total assets. Concentration is generally higher for the smaller banking markets (with the exception of Luxembourg) than for the larger, with Germany and the United Kingdom having relatively low levels of concentration.

Table 2.3 Size and Market Concentration of Banking Markets in the EU 1985

Country	Number of banks	Size of Banking Industry Assets (ECU billion)	Concentration of total market[1] CR3 (Assets)	Concentration of total market[1] CR3 (Deposits)
Germany	4739	1495	21.2	19.1
France	1952	1349	42.3	45.5
UK	605	1294	26.5	21.6
Italy	1101	547	35.2	41.6
Spain	364	311	21.9	24.3
Netherlands	178	227	71.3	83.9
Belgium	120	286	57.1	59.0
Luxembourg[2]	118	170	16.7	16.5
Denmark	259	96	36.7	45.3
Greece	41	69	-	49.7
Portugal	226	38	49.7	49.6
Ireland	38	21	71.0	-

- not available
[1] Three firm concentration ratios calculated using data from the consolidated accounts published in *The Banker 'Top 500.'*
[2] Only 12 of the 120 Luxembourg banks were domestic institutions
Source: National Central Banks. Reprinted in EU (1997a), p.15.

In 1985, Germany had the largest banking market measured by the value of total assets, followed by France, UK, Italy and Spain. In terms of the concentration ratios, these ranged from relatively highly concentrated markets in Netherlands, Belgium and Ireland to less concentrated markets of Luxembourg, Germany and Spain.[4] Germany, France and Italy had the largest numbers of banks, while Greece and Ireland had the lowest.

[4] The effect of high market concentration on the performance of banks is discussed in chapter 4.

At the beginning of the 1980s, of the five largest EU countries France, Italy and Spain had the most restricted banking markets, with regulation imposed on interest rates, commissions, fees and the extent of specialisation. However, during the 1980s many of these regulations were abolished.

Banks in France had previously been encouraged to compete in specialised banking activities (e.g. deposit banking, investment banking). However, since 1984, some de-regulation took place, which allowed banks to enter previously restricted areas and offer many types of product (Bertero, 1994). Canals (1993) notes that '*... the new legislation is based on the principle of universality and establishes standardised directives.*'[5] Regulations that fixed the level of fees and commission were relaxed. However, some separation of banking business still remained in place (de Boissieu, 1990) by the end of the 1980s. Towards the end of the 1980s, interest rate regulations and capital restrictions were removed leading to intensified levels of competition.

In Italy, branching and various portfolio restrictions were removed gradually. Since 1985, banks (domestic or foreign) were free to open branches providing they had sufficient capital to back assets (Szego and Szego, 1992). Italian banks were allowed to offer a variety of merchant banking services, although by the end of the 1980s, Italy still remained one of the more highly regulated EU banking markets (Bisoni, 1990, Bruni, 1990). Gual and Neven (1993) note that '*...if anything the discrepancy between Italy and the rest of Europe in terms of regulation is all but widening.*'[6]

Restrictions on foreign bank entry were lifted in Spain, along with controls on interest rates and capital flows (Caminal et al, 1990). During the late 1980s and the early 1990s, Spain relaxed many of the regulations regarding domestic entry, which allowed banks to offer more types of service.

[5] Canals (1993), p.128.
[6] Gual and Neven (1993), p.155.

In the UK, since 1986, building societies were allowed to compete for business normally reserved for banks, while banks in turn were allowed to diversify into securities business (Llewellyn, 1992b; McKillop and Ferguson, 1993). London's 'Big-Bang' in October 1986, deregulated the London Stock Market, and allowed banks to acquire stockbroking and jobbing firms (Gardener and Molyneux, 1993).

In Germany, differences between commercial, savings and co-operative banks have lessened, with many banks operating in similar business areas. The restrictions that separated the activities of insurance firms and banks have also been lifted (Maude and Molyneux, 1996). Bisigano (1992) suggests that the de-regulated nature of the German and UK markets have proven very attractive to foreign banks.[7]

Overall, throughout the 1980s the changing market environment, increasing use of technology as well as the prospect of the single market in financial services, led to substantial de-regulation in the financial markets of all EU member states. As we have seen previously, there was substantial de-regulation in the major banking markets of the EU. This de-regulation led to increasing competitive pressures facing banks. This in turn, some argue, encouraged banks to move into riskier activities through financial innovation (Kane, 1987). Masera (1990) notes three important trends that increase bank risk, namely securitisation, off-balance sheet activities and the global integration of financial markets. These activities can lead banks to holding insufficient capital to cover the risks associated with their investments. Masera further contends that this led to a need for financial re-regulation to ensure the stability of the banking industry and the integration of financial markets.

Although, the timetable for the creation of a single market programme was specified by the Single European Act in 1986, at the time, most industry experts suggested that changing technology would affect the future performance of banks more than the single market (Arthur Andersen,

[7] The influence of foreign banks on the competitive structure of EU banking markets is examined in greater detail later in the chapter.

1986). However, by 1989, survey evidence suggested that the single market was considered the most important imminent development affecting banking in the EU (Arthur Andersen, 1989).

2.3 The Single Market For Financial Services: Regulatory Issues

This section examines the regulatory issues involved in the creation of a single market in financial services. De-regulation at the national level (see above) was also accompanied by a series of EU banking directives aimed at integrating banking markets. This section introduces the main types of regulation open to policy makers, and examines regulation that has been implemented in the EU.

Three main types of regulation are open to policy makers, namely structural, conduct and prudential regulation (Diamond and Dybvig, 1986). Structural regulation seeks to alter or maintain the structure of the banking industry. Measures include the functional separation of banks into different activities (e.g. commercial banking and investment banking), entry restrictions and rules regarding the operation of foreign banks. Gual and Neven (1993) maintain that structural regulation is likely to make entry into banking markets difficult, thereby giving incumbent banks the opportunity to exercise market power and increase size.

Conduct regulation attempts to alter the behaviour of banks by controlling the extent of banking activities. These controls can restrict the levels of interest rates offered, regulate fees and commissions, the extent of loans granted, and or restrict the rate at which banks can expand their branch networks.

Prudential regulation involves protecting consumers (retail depositors) and ensuring the stability of the banking industry. Relevant measures include the imposition of minimum capital requirements or solvency ratios, restrictions on ownership, and requirements for banks to participate in deposit insurance schemes and lender of last resort facilities.

Overall, the banking markets of the EU have undergone a process of structural de-regulation, and conduct re-regulation, the net effect of which has been to increase competition in EU banking markets. Specific EU legislative measures include: The First Banking Co-ordination Directive (1977), The Consolidated Supervision Directive (1983), The Second Banking Directive (1988), The Own Funds and Solvency Ratio Directives (1989), the Large Exposure Directive (1992), and The Deposit Guarantee Scheme Directive (1994). These directives, and their effects on banking in the EU, are outlined below.[8] The timing of the implementation of the aforementioned regulations is summarised in Table 2.4. The table also shows when interest rate de-regulation and the liberalisation of capital flows took place in EU member states.

Baltensperger and Dermine (1990) suggest that the first major progress toward the creation of a single market for financial services in the EU was achieved as far back as 1977, with the First Banking Directive. This directive allowed banks to set up operations in EU states other than their country of origin. However, the supervision and control of such banks was the responsibility of the country of origin. In 1983, the Directive of Consolidated Supervision stipulated that if a bank owned more than 25 per cent of another bank, they would be supervised on a consolidated basis.

Although these two directives represented some progress towards the creation of a single financial services sector, a number of restrictions still existed. These included controls on capital flows, host country regulation, which constrained substantially the activities of guest institutions, and rules in a number of countries requiring foreign banks to be backed by endowment capital (Baltensperger and Dermine, 1987 and Bisigano, 1992).

In 1986, The Single European Act outlined the legislative programme for the creation of the single market. The general tenet of banking legislation was built around the concepts of mutual recognition and home country control. [9] These principles were embodied in the Second Banking Directive (1988) and related directives based on capital adequacy, namely the Own Funds Directive (1989) and the Solvency Ratio Directive (1989).

[8] White (1994) provides a detailed discussion on the international harmonisation of bank regulation.
[9] The concept of mutual recognition involves EU member states recognising the way in which all other member states regulate their financial markets. Under the concept of home country control banks are supervised by their country of origin even if they operate in other EU countries. However, the host country retains control over aspects of monetary policies such as interest rates.

Table 2.4: The Timing of EU Legislative Implementation

Directive	B	DK	IRL	F	D	GR	N	I	L	P	E	UK
First Banking Directive (1977)	1993	1980	1989	1980	1978	1981	1978	1985	1981	1992	1987	1979
Consolidated Supervision Directive (1983)	1985	1985	1985	1985	1984	1986	1986	1986	1986	1986	1985	1979
Second Banking Directive (1988)	1994	1991	1992	1992	1992	1992	1992	1992	1993	1992	1994	1993
Own Funds Directive (1989)	1994	1990	1991	1990	1992	1992	1991	1993	1992	1993	1993	1992
Solvency Ratio Directive (1989)	1994	1990	1991	1991	1992	1992	1991	1993	1993	1993	1993	1992
Large Exposure Directive (1992)	1994	1993	1994	1993	1995	1994	1993	1994	1994	1992	1993	1993
Deposit Guarantee Scheme (1994)	1994		1995	1995	1995	1995	1995			1995		1995
Interest Rate De-regulation	1990	1988	1993	1990	1981	1993	1981	1990	1990	1992	1992	1979
Liberalisation of Capital Flows	1991	1982	1985	1990	1967	1994	1980	1983	1990	1992	1992	1979

B – Belgium, DK – Denmark, F- France, D – Germany, GR – Greece, Irl – Ireland, I – Italy, L- Luxembourg, Nl – Netherlands, P- Portugal, E – Spain,

UK – United Kingdom.

Adapted from EU (1997a), Table 2.2, p.22.

The Second Banking Directive (1988), introduced a single licence for EU banks, laid down the rules for home and host country control, and introduced guidelines for dealings between EU and non-EU banks.[10] The single licence allows banks which are established in a member state to operate branches in any other member states, subject to the approval of the financial authorities in their country of origin. Such banks are allowed to offer any services in other states, which are permitted to them in their own country. This licence resulted in the abolition of minimum endowment capital requirements for bank branches operating in other EU member states, (branches in other EU member states having previously been treated as separate banks). One potential problem with this legislation was that banks might seek to identify their home base in a country where regulations are the least onerous. To avoid this a minimum capital requirement of ECU 5 million was imposed on the establishment on a new bank.[11]

The Second Banking Directive also addressed bank investment interests in non-bank industries. In an attempt to reduce banks' risk profiles, the Directive stipulated that banks' interests (measured by the value of shares held) in any single non-financial institution should not exceed 50 per cent. For supervision purposes home countries are responsible for supervising banks' capital and investment activities, while host countries supervise liquidity and monetary policy. The Directive made provision for reciprocal agreements between EU and non-EU countries with regard to the establishment of banking presence.

Overall, the Second Banking Directive laid down the basis for a universal banking model throughout the EU. This was done by removing many of the regulatory barriers which had prevented commercial banks from carrying out business in various corporate, wholesale, retail,

[10] This act became effective from 1993.
[11] This followed an initiative passed by the Bank of International Settlements in 1987, known as the Basle Accord. This accord recommended that banks must hold capital equal to at least eight per cent of total investments.

investment and securities sectors. It also established conditions for unfettered provision of banking services based on mutual recognition of rules and regulations and home country supervision (Vesala, 1993). However, Canals (1993) argues that the ECU 5 million minimum capital requirements to set up a new banking entity was excessive, and represented a substantial barrier to entry. As a consequence, this part of the legislation may inhibit levels of competition.

The Own Funds Directive, passed in 1989, sought to ensure that banks maintain enough capital to meet their financial commitments. This directive splits banks' funds into internal and external capital. Internal (or Tier 1) capital consists of liquid funds which can be used to absorb any losses made by the bank. These funds include paid up capital and share premium accounts, profits, retained profits and revaluation reserves, working capital and long term securities. External (or Tier 2) capital are funds which are at the bank's disposal, but are not owned by the bank. These funds include undisclosed reserves and revaluation reserves, and should be approximately 50 per cent of internal funds.

The Solvency Ratio Directive, passed in 1989, established a uniform solvency ratio using capital in the numerator, and risk adjusted assets and off-balance sheet assets in the denominator. The denominator is calculated as a weighted average of the values of assets in each class.[12]

The Large Exposure Directive (1992) attempts to reduce risk by stipulating that banks should not commit more than 25 per cent of their own funds to a single investment, and that the resources invested in such activities should not exceed 800 per cent of own funds in total. The directive on Deposit Guarantee Schemes (1994) attempts to protect investors in the event of bank failure.

[12] Under this Directive different types of borrowers are assigned different risk weights ranging from 0 to 100 per cent. These categories include central banks, central governments and EU and non-EU private borrowers. Products and services which have risk weights of 100 per cent include standby letters of credit, risk participation and asset sales with recourse. Those with a 50 per cent risk weight include revolving underwriting agreements and note issuance facilities, while those with 20 per cent risk weights include commercial letters of credit. Therefore, if as under the Basle Accord, banks' capital asset ratios are set at 8 per cent, this means that products with 100 per cent risk require 8 per cent capital backing, while those with 50 per cent risk and 20 per cent risk require capital backing of 4 per cent and 1.6 per cent backing respectively. Dixon (1991), p.70-71 describes the Directive and the risk weightings.

This establishes a minimum guarantee of ECU 20000. Under this directive, banks with foreign branches must join the deposit insurance scheme of each host country.[13]

The thrust of the EU legislation has been to create a more competitive banking industry, reducing barriers to trade in financial services, and creating a level playing field in terms of minimum harmonised supervisory requirements (Lewis and Pescetto, 1996). The effect of the EU legislation of the 1980s and 1990s has been to establish the universal banking model as the 'norm' across EU banking markets by reducing barriers to entry and encouraging increased cross-border business (Canals, 1997). This has enabled banks to expand the range of products and services offered, and allowed them to move freely into new European markets. However, as we have noted above, the single market in financial services may expose the banking industry to greater risk. Strengthened prudential regulation, along with a strong deposit guarantee scheme are required, in order to protect depositors in the event of bank failure. Overall, the regulators have had to strike a balance between promoting competition and protecting customers from the new risks generated by the enhanced competitive environment.

2.4 A Note On European Monetary Union (EMU)

A natural progression from the integration of financial markets is complete monetary integration through the establishment of a single currency. Majoni, Rebecchini and Santini (1992) define monetary integration as follows:

' The term monetary integration, in particular, will refer to the process of co-ordination of national monetary policies and can be viewed as the progressive achievement of irrevocably fixed exchange rates and uniformly low inflation rates within the European area. More generally, though, the co-ordination involves the whole set of procedures through which monetary policy is

[13] Although these regulations are aimed at ensuring the efficiency of banks and the protection of customers, they can have negative effects. Vives (1991a) argues that deposit insurance schemes introduce a moral hazard problem for both banks and customers. Banks are willing to undertake more risky activities aimed at realising higher returns, as they know they will be bailed out if their investments subsequently fail. depositors tend to bank with banks which realise high returns through risk taking activities, as they are protected if things go wrong. Attempts to overcome these problems include controls on interest rates which banks can offer, minimum liquidity requirements and restrictions on the extent to which banks can concentrate investments in any single activity.

implemented: the definitions of the intermediate and operational targets, the use of the information set and the nature of intervention techniques.' [14]

Barber (1998) argues that '... *EMU is not just about money.....It is part of a wider process of European integration. It affects not just central and national banks, but companies and consumers. It might trigger harmonisation of prices and wages across Europe and ultimately it might lead to closer harmonisation of economic policy as well.'* [15]

The Delors report (1989) laid the foundations for the movement towards monetary union and the creation of a single currency. [16] The report outlined three phases in moving towards full monetary union.[17] Phase 1, which began in 1990, involved a greater convergence in economic performance of member states by active co-ordination of fiscal and monetary policies. During this phase member states joined and competed in a system of fixed exchange rates (European Exchange Rate Mechanism - ERM) whereby the currencies of the members were fixed within bands of 2.25 per cent (or 6 per cent in the case of the Peseta and the Escudo).

In September 1992, exchange rate parities were undermined by investor speculation which involved the selling of Sterling and the Lira, and buying of Deutsche Marks. This process culminated in the UK and Italy withdrawing from the ERM. After further speculative activity, (most notably against the French Franc in August 1993), and the devaluation of several currencies including the Escudo and the Peseta, the currency bands were widened to 15 per cent for the remaining members (with the exception of the Deutsche Mark and the Guilder).

Phase 2, which began in 1994, involved the establishment of institutional structures to supervise the setting up and operation of the European Monetary System and the promotion of the European Currency Unit (ECU) as a unit of currency. These institutional structures included the European Monetary Institute (EMI) based in Frankfurt and a system of European Central Banks

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[14] Majnoni, Rebecchini and Santini (1992), p.135.
[15] Barber (1998), p.4.
[16] Tew (1992) gives a discussion of early moves toward monetary integration including the Werner report, The Snake and the European Exchange Rate Mechanism. See also Baldwin (1991).
[17] Bank of England (1994) provides a detailed discussion.

(ESCB). The role of these institutions was to control the monetary and fiscal policies while at the same time devising a framework for a Single European Central Bank. Phase 3, which took place in January 1999, involved the final locking together of member currency exchange rates, a single union wide monetary policy, the adoption of a single currency, the pooling of foreign reserves, and the establishment of the European Central bank. This bank and the ESCB is responsible for following a single European Monetary policy, and has the power to constrain national member states fiscal policies. The countries which adopted the EURO was decided in May 1998, when eleven of the fifteen EU member states (excluding Denmark, Greece, Sweden and the United Kingdom) committed to go ahead with full EMU on January 1st 1999. The Euro has been introduced as the single currency, but only for wholesale business. Retail Euro business will commence within two to three years of 1st January 1999.[18]

The introduction of a single currency is likely to impose substantial costs on the banking industry. Such costs include: 1) administrative costs of changing records and updating other types of information; 2) changes in software and hardware used in the delivery services; and 3) re-training costs of staff to the new system (Molyneux et al, 1996 and McCauley and White, 1997).[19] Leach (1997) argues that the adoption of the Euro will result in the lowering of entry barriers to domestic markets, which in turn will increase competition and consolidation.

The Euro is also likely to reduce the revenue earned by many banks from foreign exchange transactions, corporate banking services and government bond trades. Foreign exchange revenue will decline as the eleven member currencies are consolidated into a single currency. Trade in government bonds will decline as national government borrowing is restrained to maintain the EU's stipulated debt to GDP ratio, (currently set at 60 per cent).[20] Finally, large firms will no longer require loans, or deposit currencies in national denominations (Economist, 1998b).

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[18] See Blanden (1998), Euromoney (1998) and FT (1998) for a discussion of these issues.
[19] Recent estimates suggest that these costs will be between $15billion to $20 billion (Economist, 1998b).
[20] These ratios were agreed under the terms of the Single European Act (1986).

Overall, '*European Monetary Union will confront financial services with much more intense competition. It will be the catalyst for trends already evident in the sector, such as dis-intermediation, internationalisation and changing customer preferences.*'[21]

2.5 The Single Market For Financial Services: Economic Issues

The aforementioned sections have emphasised how regulatory changes have resulted in an increased competitive environment in European banking and financial services. However, the impact of these changes has only been justified by a handful of studies. This section discusses some of the economic issues relating to the single market in financial services. The section describes the welfare gains and losses associated with establishing a single market in financial services. Particular focus is placed on the Price Waterhouse (1988) study, which was seminal in assessing the impact of the single market in financial services.

McDonald (1992) summarises the benefits of a single market as follows:

' *The bulk of the benefits are seen to derive from the effects of increased competition and lower costs which lead to lower prices, and also stimulate investment. New market opportunities allow for increased economies of scale, and the rationalisation of artificially segmented markets. The increase in competition allows for considerable improvements in the effective use of inputs, and reductions in the anti-competitive practices of companies. This process is further aided by reductions in the costs of consumer services by the liberalisation of the service sector.* '[22]

Many authors argue that a single market in financial services has beneficial effects for EU member states. Llewellyn (1992a) argues that if a single market increases competition, then firms become more efficient, leading to lower prices for consumers. In addition, cross subsidisation disappears as new competitors target markets in which prices are artificially high. Inefficient firms are acquired, and collusive agreements collapse due to external competitive pressure, as banks diversify into new markets in search of new opportunities.

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[21] Deutsche Bank Research (1998), p.1.
[22] McDonald (1992), p.28.

Vesala (1993) asserts that:

'..... an increase in banking competition accompanying financial integration would give rise to significant welfare gains through enhanced price transparency and harmonisation, diffusion of banking technologies and the removal of industry-specific inefficiencies. Those countries with a low degree of price competition and operating efficiency would be the ones with the largest potential benefits to be gained in the long run, but they would also face the largest reorganisation pressures. Cross border competition is assumed to grow substantially as the EC legal measures provide a "level playing field" for all banking institutions located in the Single Market Area and effectively abolish regulatory barriers to entry and cross border provision of banking services.'[23]

A single market in financial services effectively increases the potential market for all firms, creating the potential for firms to exploit economies of scale and scope, leading to a more efficient allocation of resources (European Economy, 1988).

Price Waterhouse (1988) attempt to estimate the gains in consumer surplus that could result from a free market in financial services. The removal of regulatory barriers allows financial services firms to expand production leading, to lower costs through economies of scale and scope, creating an increase in consumer and producer surplus, and an overall gain in welfare. Existing price differentials were examined for a bundle of financial services in a sample of eight countries, and the future pricing structure of the industry was estimated.[24]

The price differences between countries were calculated as the difference between the price recorded in an individual country and the average of the four lowest prices quoted nationally. The findings pointed to substantial price differences between countries for the sixteen products.[25]

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[23] Vesala (1993), p. 167.

[24] The countries studied were France, Germany, Italy, Spain, UK, Belgium, Netherlands and Luxembourg. Price Waterhouse chose 16 financial products thought to be broadly representative of the EU financial sector.

[25] Llewellyn (1992a) contends that prices can vary for many reasons, including differences in efficiency, differences in taxes, differences in the competitive environment allowing monopoly rents, unexploited economies of scale and scope, and the existence of cross subsidisation practices.

Financial products included in the study came from the banking, insurance and securities industries. Banking products included consumer credit, credit cards, mortgages, letters of credit, foreign exchange, travellers' cheques and commercial loans. Insurance products included life assurance, home insurance, motor insurance, commercial insurance and public liability insurance. Finally, securities products and services included private equity, private gilts, institutional equity and institutional gilts.

To assess the future prices of these financial goods and services after 1992, the differences in prices for each product were weighted according to their relative importance in their host country. This gave the potential reduction in the price of each product arising from the creation of the single market. The estimates were adjusted by between 40 per cent and 60 per cent to eliminate biases caused by country specific characteristics, which may have contributed to pricing differences in products.

In order to estimate the welfare gains from a single market, consumer surplus was estimated, using estimates of future price changes together with the price elasticity of demand, and the 'value added' for each of the financial products in the sample. The increase in consumer surplus was estimated to be between ECU 11 billion and ECU 33 billion. Of this banking contributed between ECU 8 billion and ECU 22 billion. The report concludes that substantial welfare gains would be derived from a single market in financial services.[26]

Overall, the report found that a single market would lead to enhanced competition within financial markets. However, it took little account of strategic reactions, and possible anti-competitive outcomes. For example the new competitive environment could lead to consolidation and increased concentration, with anti-competitive effects (Gual and Neven, 1993).

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[26] For detail see Price Waterhouse (1988), Table 5.1, p.15. See also Gardener and Teppet (1990) for a similar study carried out for EFTA countries.

Neven (1990) argues that the study takes no account of the strategic responses of banking and other financial firms after 1992, (such as vertical integration, predation and branch proliferation). It also fails to recognise any natural non-regulatory barriers that may remain, such as reputation effects.[27] Dixon (1991) identifies several problems with the report. The products included may not be comparable across countries, which may have affected the results. The prices of the products may differ between countries due to variations in risk, or through the practice of cross subsidisation. According to Llewellyn (1992a) '*...the calculations are based upon identifying standardised financial products and comparing each country's prices with the average of the lowest prices for the product, making a comparison with a benchmark that no consumer is actually paying.*'[28]

In general, since the advent of the single market in financial services, there has been increasing competition accompanied by increases in concentration through a process of consolidation. Metais (1997) argues that banks have pursued size in order to compete on a European wide basis. He contends this is the unforeseen result of de-regulation. A report by EU (1997a) notes that '*...there still remain a number of barriers that continue to constrain the exploitation of the full benefits of the Single Market. These barriers are quite diverse and vary from one EU country to the next. Various legal and fiscal (tax) treatment barriers still remain. Important barriers also remain relating to restrictions on marketing activities and the range of products that banks can offer outside their territory.*'[29]

Of course, EMU and the introduction of the Euro are natural extensions of the single market programme, and it has removed a major barrier to cross-border competition by eliminating currency risk within the EMU-bloc of countries.

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[27] These strategies are examined in more detail in chapters 3 and 4 of this thesis.
[28] Llewellyn (1992a), p.118.
[29] EU (1997a), p.18.

2.6 The Impact of the Single Market on European Banking

In recent years, the competitive environment in which European banks operate has undergone significant changes arising from technology advances, the globalisation of markets, volatility in macroeconomic conditions, and the creation of a single market in financial services (De Bandt and Davis, 1998). This section examines the implications of the single market for the competitive environment of the EU banking industry.

Increasing levels of competition has ensued as barriers between different banking activities have been removed, and as the entry of foreign banks has continued to increase (Vesala, 1993). Consequently, market structures have become increasingly concentrated as banks engage in merger and acquisition activities in an attempt to increase size (Gual and Neven, 1993). Competitive pressure has also prompted banks to make efficiency savings by shedding jobs and eliminating x-inefficiencies, and expanding the scale and scope of operations by diversifying into new product areas (Conti and Maccarinelli, 1993). The increasingly competitive environment has put pressure on interest margins and encouraged banks to develop fee and commission based services (White, 1998). Overall, the single market has produced an industry where incumbent banks are larger, generally more efficient and strategically focused (Morgan Stanley, 1994).

The rest of this section explores these changes using recently published data (EU, 1997a). Section 2.6.1 describes structural changes in the EU banking industry during the period 1985 to 1994. Section 2.6.2 examines the conduct of banks in response to these structural changes. Section 2.6.3 analyses the performance of banks, reflected in efficiency and profitability measures, in response to the changes in structure and conduct.

2.6.1 Structural Characteristics of EU Banking Markets Pre and Post 1992

In recent years, the level of competition has increased substantially in the EU banking industry. This has been partly due to de-regulation, freeing up the areas within which different types of banks operate (e.g. savings banks can compete directly for the business of commercial banks; commercial banks can compete for insurance business etc.). Most countries within the EU have experienced an increase in the size of their banking markets over the past decade or so. Table 2.5 shows total banking assets of each banking market over the period 1985-1994.

Table 2.5: Total Banking Assets, 12 EU Countries (ECU billion in current prices)

Country	1985	1990	1994
Belgium	285.9	420.7	589.4
Denmark	96.3	143.5	125.5
France	1348.8	2111.0	2513.7
Germany	1495.1	2555.4	3584.1
Greece	69.2	74.8	94.0
Ireland	21.0	27.7	45.8
Italy	546.8	816.9	1070.5
Luxembourg	169.8	294.2	445.5
Netherlands	226.7	485.5	650.0
Portugal	38.0	60.1	116.3
Spain	311.3	542.0	696.3
UK	1293.6	1774.1	1999.5

Source: National Central Banks, Reprinted in EU (1997a), p.70.

There has been some consolidation. Table 2.6 shows that the total number of banks in the twelve EU countries taken together, fell between 1985 and 1994. In each of the five countries with the largest numbers of banks in 1985 (Germany, France, Italy, the UK and Spain), there were also fewer banks in 1994 than in 1985.

Table 2.6: Number of Banks by EU Country (includes commercial, public and co-operative banks)

Country	1985	1990	1994
Belgium	120	121	131
Denmark	259	222	202
France	1952	2048	1608
Germany	4739	4710	3872
Greece*	41	47	53
Ireland	42	36	48
Italy	1101	1043	1002
Luxembourg*	120	179	224
Netherlands	178	180	173
Portugal	226	265	259
Spain	364	327	316
UK	772	665	586
TOTAL	9914	9843	8474

* Includes foreign commercial banks

Adapted from EU (1997a), Table 4.19, p. 68.

The fall in the number of banking institutions has also been accompanied by changes in the number of employees and bank branches. Table 2.7 shows the numbers of branches fell in France, Belgium, Denmark and the UK between 1985 and 1994. This has been accompanied by decreases in employee numbers in France, Belgium and the UK. The decreases in employee numbers have been particularly pronounced in France and the UK, since 1990. The table also shows increased numbers of employees and bank branches for Germany, Greece, Italy, Luxembourg, Netherlands, Portugal and Spain.

Table 2.7 The Numbers of Branches And Employees (in 000's) In Each EU Country

Country	1985		1990		1994	
	Branches	Employees (000's)	Branches	Employees (000's)	Branches	Employees (000's)
Belgium	8207	71	8314	62	7791	60
Denmark	3411	52	2965	55	2245	50
France	25782	449	25742	440	25389	406
Germany	39925	591	44345	637	48721	675
Greece	1815	27	2125	52	2417	54
Ireland	-	-	75	-	808	-
Italy	13033	319	19080	334	23120	341
Luxembourg	19	10	30	16	69	19
Netherlands	6868	92	8992	117	8269	120
Portugal	1494	59	1999	59	3401	60
Spain	32503	244	32234	252	35591	247
UK	22224	350	20081	445	17522	384
Total	149101	2264	165982	2469	175343	2416

- denotes not available.

Source: National Central Banks. Adapted from EU (1997a), Table 4.21, p.71 and Table 4.24, p.77.

Overall, the combination of decreasing numbers of banks and increasing branch numbers suggests consolidation in many EU banking markets.

According to EU (1997a), competition has also intensified as the result of the increased influence of foreign banks in EU banking markets. Table 2.8 shows increase in the absolute numbers of banks, while Table 2.9 shows changes in the market shares of foreign banks.

Table 2.8 Number of Foreign Banks Operating in Selected EU Countries

Country	1987	1988	1989	1990	1991	1992	1993	1994
Belgium	5	6	6	6	6	6	7	7
Denmark	65	68	70	74	78	79	84	92
France	117	131	157	216	217	261	277	285
Italy	36	34	36	37	38	40	41	45
Luxembourg	-	-	121	125	127	146	129	127
Netherlands	-	-	-	-	-	40	71	104
UK	254	256	259	255	255	255	254	257

- denotes not available

Source: EU (1997a), p.56.

Table 2.9: Market share of Foreign Banks Operating In Selected EU Countries (%)

Country	1987	1988	1989	1990	1991	1992	1993	1994
Belgium	47.0	47.0	47.0	47.4	-	-	-	48.1
Denmark	-	-	-	-	-	-	-	-
France	11.4	12.4	13.2	13.0	13.2	14.1	14.2	14.2
Germany	4.2	4.4	4.4	3.9	3.8	4.4	4.5	4.5
Greece	13.1	-	-	10.0	-	-	11.3	-
Ireland	24.0	-	-	24.0	-	-	-	37.0
Italy	2.9	2.8	2.9	3.1	2.1	2.7	3.4	3.5
Portugal	4.1	4.2	4.7	-	-	-	-	-
Spain	9.7	9.0	9.7	10.0	-	-	-	-
UK	61.6	60.8	59.1	57.2	54.9	56.3	56.6	57.4

- denotes not available

Source: EU (1997a), p.56.

The number of foreign banks operating in France increased by more than 100 per cent between 1987 and 1994. Over the same period substantial increases were also recorded in Denmark and the Netherlands. Although there was relatively little growth over this period, foreign banks maintained a significant presence in the UK and Luxembourg. With the exception of the UK and Greece, foreign banks increased their market share in all of the markets for which complete data were available.

Along with the increasing influence of foreign banks, there has also been an increase in acquisition and merger activity, strategic alliances between banks and insurance firms, and cross border alliances between commercial banks.[30] All of these initiatives can be interpreted as

[30] Examples of cross border alliances include Credit Lyonnais with Commerzbank and Banco di Roma, and BNP with Dresdner Bank, Credit Romagnolo and Banco Bilbao Vizcaya.

attempts on the part of existing banks to diversify income streams and increase their own market power against a background of increasing competitive pressure. The trend toward larger size is illustrated in Table 2.10, which compares concentration in selected EU banking markets pre and post 1992.

Table 2.10: Five Bank Concentration Ratio 1979-1994

Country	Average CR5: 1979-1992	Average CR5: 1993-1994	Percentage Change (+ or -)
Belgium	56.1	61.2	+5.1
Denmark	59.6	87.0	+27.3
France	49.1	44.2	-4.9
Germany	26.8	28.4	+1.6
Greece	66.0	59.9	-6.1
Italy	40.6	42.1	+1.5
Luxembourg	23.0	19.0	-4.0
Netherlands	86.1	89.9	+3.8
Portugal	57.2	55.0	-2.2
Spain	47.1	59.5	+12.4
UK	37.0	46.1	+9.1

Source: OECD, Central banks, Banking Associations. Adapted from EU (1997a), Table 4.23, p.76.

The large increases in the concentration ratios in Denmark and Spain can be attributed to mergers between large banks, as well as a number of acquisitions by large commercial banks of smaller savings and co-operative banks. Examples of merger between large Spanish banks include the 1988 amalgamation of Banco de Bilbao and Banco de Vizcaya, creating Banco Bilbao de Vizcaya; and Banco Central and Banco Hispanoamericano, creating Banco Central Hispano.

In the Netherlands ABN and Amro merged to create ABN Amro (1990), and NMB and Postbank merged to create NMB Postbank (1991).[31] In Denmark consolidation mainly resulted from restructuring as a consequence of poor performance of domestic banks in the early 1990s (EU, 1997a). Although not shown in the table, significant increases in concentration occurred in Scandanavian markets during the 1990s in the aftermath of their banking crisis in 1991-1992. In Greece, concentration has fallen as more efficient banks have entered what was previously a heavily regulated market. In France, the substantial losses of Credit Lyonnais in the early 1990s led to a fall in its market share, which partly explains the fall in market concentration. [32]

Overall, since the single market, the structure of the banking industry has substantially altered. Most banking markets have increased in size. In general, the industry post 1992 is characterised by fewer numbers of large banks operating larger branch networks.

2.6.2 Conduct Characteristics of EU Banking Markets Pre and Post 1992

The conduct of EU banks is influenced by factors including, competition from domestic and foreign banks, changes in national and supra-national legislation, changes in technology and variations in general macroeconomic conditions. Using the data from two surveys, Table 2.11 summarises the perceptions of EU banks concerning the importance of these factors in influencing their own behaviour.

[31] The importance of acquisition and merger activity as a bank strategy is examined in the following section. For further detail see Lafferty Business Research (1990) and Canals (1993).
[32] See Morgan Stanley (1995) for further detail.

Table 2.11 Relative Importance of Factor Affecting Bank Conduct

Factor	Importance of factor (Arthur Anderson, 1993)[1]	Importance of factor (EU postal study, 1996)[2]
Technological Change	5	83
Competition From Domestic Financial Firms	-	76
Competition Between Banks And Non-banks	2	68
Domestic Regulatory Developments	4	65
EU Single Market Programme	1	53
Competition From Financial Firms In Other EU Countries	3	53
Competition From Financial Firms In Other Non-EU Countries	3	47

- not available

[1] Ranking in terms of importance on a scale of 1 to 5, where 1 = most important and 5 = least important.

[2] Where 0 is ' not important', 25 is ' of little importance', 50 is 'quite important', 75 is 'very important', and 100 is 'critically important.'

Source: Arthur Andersen (1993) and EU postal survey 1996. Adapted from EU (1997a), Table 4.38, p.109.

In 1993, a survey carried out by Arthur Andersen revealed that bankers viewed the EU single market programme as the main factor likely to shape their conduct in future years. Competition from other banks and non-banks also appeared to play an important role, followed by changes in domestic regulation and technology. In 1996, an EU survey suggested that bankers' attitudes to many of these factors had changed. Technological change was now perceived to be the most important element in determining the strategies which banks pursued, while the single market in financial services now appeared less important. This change in attitudes can be partly explained by the fact that as banking markets have become harmonised across EU countries, banks have placed greater emphasis on searching for cost efficiency savings. In addition, the universal banking model permits banks to offer different types of products and services. Banks have further sought to improve their competitive position by focusing on cost efficiency and shareholder value issues, and engaging in forms of non-price competition such as product and process innovation (Canals, 1993).[33]

In order to exploit fully opportunities for product and process innovation, and to provide a comprehensive service to their customers (such as large multinational firms), banks now have to be large. This is true especially for those banks which have large corporate customers (Walter, 1988). The responses of banks to changes in the competitive environment are summarised in Table 2.12.

Table 2.12: Strategic Responses of Banks to Structural Change

Product area	Increased cross border activity	Product diversification / Innovation(both cross border and retail)	Merger / Alliance / Take-over
Investment management	21	41	10
Off balance sheet activities	22	46	4
Corporate customer loans	17	50	4
Corporate customer deposits	13	46	4
Retail deposits (sight and time)	9	54	6
Retail customers loans	8	51	7
Other retail saving products	4	64	7
Retail customer mortgages	4	48	8
Retail insurance products	2	42	20

All figures are number of ' Yes ' responses from a total sample size of 115 banks.
Source: EU (1997a), Table 4.41, p.113.

In all of the product areas covered, some European banks have adopted strategies of product diversification or innovation. Reasons given include: 1) reducing the variability of revenues

[33] The Second Banking Directive has encouraged this type of competitive trend.

through offering a wider range of services; 2) reducing the risks inherent in certain types of banking services; and 3) making more efficient use of market presence in a particular area (Canals, 1993). For instance, respondents from 21 different banks stated that structural change encouraged them to undertake more cross border investment management business. In general most increases in cross border activity tended to be in the wholesale area of banking business.

As part of a strategy of diversification and innovation, many banks have begun to offer off balance sheet and fee based services in an attempt to capture market share, and partly to move beyond traditional areas of business in which competition has intensified (Gardener and Molyneux, 1993, chapter 5). The importance of these new areas of business is reflected in the increase in fee and other non-interest income as a proportion of the total income of many banks, (Arthur Anderson, 1993), as shown in Table 2.13.

Table 2.13: Fees, Commission and other Non-Interest Income as a Proportion of Gross Income

Country	1990	1991	1992	1993	1994
European Union	21.5	24.9	28.1	36.0	31.6
Belgium	25.5	25.1	25.3	33.1	26.7
Denmark	20.3	18.6	18.2	17.6	17.9
France	20.8	23.7	29.1	34.6	31.1
Germany	16.1	13.7	21.9	26.9	23.1
Greece	14.5	16.7	25.5	49.7	54.1
Ireland	43.2	29.8	25.6	30.0	31.8
Italy	26.8	27.4	20.1	32.2	25.9
Luxembourg	65.6	62.1	54.6	45.0	38.6
Netherlands	22.9	23.4	30.5	64.5	61.8
Portugal	18.0	18.8	21.8	26.1	21.7
Spain	14.2	17.9	19.4	25.7	17.0
UK	34.3	36.9	41.9	47.8	42.3

Source: IBCA Bankscope. Adapted from EU (1997a), Table 4.36, p.105.

Table 2.13 shows the proportion of banks gross income accounted for by fees, commissions and other non-interest income. For the EU as a whole, the proportion of non-interest income has risen from 28.1 per cent in 1992, to 31.6 per cent by 1994. All countries except Spain, Denmark and Luxembourg show increases in fee and commission income since 1992, with the largest increases recorded in Netherlands and Greece.

Strategic responses to changes in the competitive environment include mergers and acquisitions, and strategic alliances. Banks may merge to achieve economies of scale to boost profitability through efficiency gains; to achieve a presence in another market segment or establish a foreign presence; to increase size to discourage any future take-over threat; to satisfy managerial objectives; or to increase profits by the exercise of market power (Berger, Demsetz and Strahan, 1999).

Abraham and Lierman (1991) and Gual and Neven (1993) study merger and acquisition activity, and other types of co-operation agreements over the periods 1984 to 1989, and 1984 to 1991 respectively. Merger and acquisition activity increased during the period leading up to the creation of the single market. Most of this activity involved domestic institutions. Since 1992 there have been a number of cross border acquisitions and co-operation deals. These deals range from loose arrangements relating to marketing activities to tighter agreements involving the swapping of ownership stakes (Vesala, 1993).[34] These agreements involve trying to penetrate foreign markets through existing branch networks, or reducing the likelihood of take-over (Lafferty Business Research, 1990, 1993).

According to EU (1997a), merger and acquisition activities increased in EU banking markets that were characterised by a high degree of regulation in the 1980s, including France, Italy and Spain. Banks also increased domestic and cross border activities by becoming bigger. The extent of acquisition and merger activity is shown in Table 2.14.

[34] Vesala notes the historical development of what he terms as banking clubs. He outlines five main banking clubs including, 1) ABECOR which consists of Algemene Bank Nederland, Banque Bruxelles Lambert, Banque Internationale a Luxembourg, BNP, Barclays Bank, Hypo-Bank, Dresdner Bank and Osterriche Landesbank; 2) EBIC which consists of ABN AMRO, Deutsche Bank, Generale Bank, Midland Bank and Societe Generale; 3) EUROPARTNERS which consist of Commerzbank, Credit Lyonnais, Banco Hispano Americano and Banco di Roma; 4) INTER-ALPHA which consists of Allied Irish Banks, Banco Bilbao Vizcaya, Banco Espirito Santo e Commercial de Lisboa, Berliner Handels und Frankfurter Bank, Credit Commercial de France, Instituto Bancario San Paolo di Torini, Kredietbank, Nederlandsche, Middenstandsbank, Unibank, and Royal Bank of Scotland and 5) SCANDANAVIAN BANKING PARTNERS which consists of Suomen Yhdyspankki, Bergen Bank, Unibank, S-E Banken, and Scandinavian Banking Partners.

Table 2.14 : Acquisition and merger activity 1985-1995: intra and extra-EU

Area	Internal	BEL	DK	FR	GER	GRE	IRE	ITA	LUX	LUX	POR	SPA	UK	TOTAL	JAP	USA	OTHER	TOTAL
EU	580	14	2	26	19	-	8	12	5	8	2	6	28	130	1	19	36	56
Bel	10	-	-	5	2	-	-	1	1	2	-	2	-	13	-	-	1	1
Dk	21	-	-	1	-	-	1	-	-	-	-	-	-	2	-	-	-	-
F	77	4	-	-	4	-	1	6	2	2	-	-	11	30	-	4	5	9
D	22	-	1	3	-	-	-	1	-	-	-	1	3	9	1	-	3	4
GR	2	-	-	1	-	-	-	-	-	-	-	-	1	2	-	-	1	1
IRE	7	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	1	1
ITA	22	-	-	3	4	-	-	-	-	1	-	1	4	13	-	-	2	2
LUX	-	3	1	-	-	-	-	-	-	-	-	-	1	5	-	-	3	3
NET	7	3	-	2	-	-	-	-	-	-	-	-	2	7	-	-	1	1
POR	6	-	-	-	-	-	-	-	-	1	-	1	-	2	-	-	-	-
SPA	26	-	-	5	1	-	-	2	1	-	2	-	5	16	-	-	1	1
UK	380	4	-	6	8	-	6	2	1	2	-	1	-	30	-	15	18	33
NON - EU	583	-	1	24	7	-	7	4	1	16	-	16	72	148	19	21	80	120
JAP	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
USA	353	-	-	2	1	-	6	2	-	5	-	2	39	57	13	-	28	41
OTHER	218	-	1	22	5	-	1	2	1	11	-	14	33	91	6	20	52	78
TOTAL	1163	14	3	50	26	-	15	16	6	24	2	22	100	278	20	40	116	176

Figures denote number of deals in banking and finance
- denotes no figures available
Source: Acquisition and merger annual reports. Adapted from EU (1997a), table 4.18, p.60.

In the UK a large number of domestic mergers took place. Target banks for cross-border acquisitions were primarily located in France, Italy, Spain and the UK. In the main, acquiring banks were from the UK, France and Germany (Gual and Neven, 1993 and EU, 1997a).

In summary, changes in the competitive structure of EU banking appear to have affected the strategies which banks follow. In particular, the single market programme has led to increased cross-border activity, especially in wholesale banking. Strategies of product diversification and innovation, strategic alliances and merger activities have contributed to the growth of many banks. These strategies are likely to affect substantially the performance of the industry as a whole. This proposition is now examined.

2.6.3 Performance Characteristics of EU Banking Markets Pre and Post 1992

This section examines the effects of structural change in EU banking on the performance of EU banks. The competitive pressures faced in EU banking markets has encouraged banks to become more efficient by reducing costs, eliminating inefficiencies and increasing productivity, while at the same time expanding the scale and scope of operations. Increased competition has also exerted pressure on the revenues, margins and the general profitability of banking institutions. This section examines briefly trends in costs and performance of EU banks in recent years. Section 2.6.3.1 examines the implications for the efficiency of banks, while section 2.6.3.2 examines the effects of these structural changes on the performance of banks.

2.6.3.1 Efficiency Levels

Previous research by Salomon Brothers (1993) and Morgan Stanley (1994) suggests that cost minimisation is an important objective for many banks. The expansion opportunities offered by the single market can enable banks to reduce average costs, if they expand operations to exploit economies of scale and scope. The extent to which x-inefficiencies have increased or decreased depends partly on the market for corporate control, and partly on the frameworks in place to prevent the failure of banks. If corporate governance structures are strong, it is likely that managers will be pressured to eliminate x-inefficiencies (Lohneysen et al, 1990). However, if banks are protected from failure by strong depositor insurance schemes, x-inefficiencies are likely to remain (Neven, 1990).

A study of efficiency on the cost side normally involves testing for the existence of economies of scale and scope and x-inefficiencies. EU (1997a) tests for the existence of economies of scale in ten EU banking markets, and examines the relationship between output and costs pre and post 1992.[35] Using data from 1987 to 1994 for certain countries, and 1990 to 1994 for others, the report finds evidence that smaller banks made substantial cost savings by growing to exploit economies of scale. They also find that economies of scale tend to increase during recovery/boom periods and decrease in periods of recession.

Variation in bank costs can be also be examined in respect of changes in staff and non staff costs as a proportion of total assets. Conti and Maccarinelli (1993) find that over the period 1982-1991, staff and non staff costs declined for banks in most EU banking markets. EU (1997a) examine trends in these costs pre and post single market. They find that non-staff costs as a proportion of total assets have fallen since 1992, while the reduction in staff costs have been greatest in relatively high cost countries such as Spain, Italy and Portugal.

Cost-income ratios also provide useful evidence concerning efficiency. Recent research by Morgan Stanley (1994) and EU (1997a) suggest that cost-income ratios have declined in Belgium, Germany and the UK suggesting efficiency gains. However, for the EU banking industry as a whole, the average cost-income ratio has remained relatively constant at around 68 per cent (EU, 1997a). Changes in these ratios immediately before and after 1992 are summarised in Table 2.15.

[35] The ten banking markets examined included UK, Spain, Netherlands, Belgium, Germany, Italy, Luxembourg, Portugal and Denmark.

Table 2.15: Cost Income Ratios for EU Banking Markets 1990-1994 (in percentage terms)

Country	1990	1991	1992	1993	1994
European Union	68.26	68.24	66.28	63.46	68.66
Belgium	80.42	77.28	74.20	70.26	71.60
Denmark	61.88	64.39	57.83	40.83	68.33
France	74.71	72.26	69.60	66.57	73.08
Germany	74.15	72.39	65.47	60.57	61.02
Greece	64.03	66.88	61.23	78.65	76.82
Ireland	66.23	63.85	63.06	63.71	63.12
Italy	64.94	67.26	70.39	63.84	79.02
Luxembourg	46.69	46.30	50.77	48.14	57.54
Netherlands	75.34	75.85	69.32	81.70	80.77
Portugal	44.72	51.55	53.71	59.52	65.01
Spain	59.18	63.74	65.91	62.82	71.91
UK	63.55	62.45	61.97	59.42	62.43

Source: Adapted from EU (1997a), Table 4.26, p.87.

Several explanations can be forwarded as to why cost income ratios have not uniformly fallen in the 1990s. Firstly, restrictive employment legislation in various EU countries (e.g. France and Italy) makes it difficult and costly for banks to shed staff. Secondly, banks that engage in merger and acquisition activity often incur substantial costs associated with such deals. It therefore may take some time for scale and scope economies of such merged entities to be realised.

In recent years the increased use of information technology has offered the possibility for banks to offer a number of products and services from the use of the same sets of inputs into the production process. Revell (1987) argues that although new technologies such as electronic banking give banks the opportunities to expand and diversify to exploit economies of scope, they confer an advantage upon smaller banks. As technology becomes less expensive smaller banks become able to enter markets and offer similar services as large banks. They are also able to offer such services at lower cost, as they do not incur the costs of maintaining large branch networks. Since the advent of the single market, banks have diversified into offering other types of financial services by the pooling of information (EU, 1997 a). This has led to costs savings in the joint production of goods and services.[36]

The extent to which banks have become more or less efficient over time can be measured by calculating x-inefficiencies. Following Liebenstein (1966) x-inefficiencies are the difference between actual average cost of banks and the minimum attainable long-run average cost. Recent evidence suggests that since the advent of the single market, x-inefficiencies have fallen for many banks (see Table 2.16).[37]

[36] EU (1997a) shows that economies of scope exist for banks with assets between ECU 1000-9999 million, and for banks with assets of greater than ECU 50 billion. The report finds for that in France, Germany, Italy and Spain banks in the size range ECU 1000-9999 had dis-economies of scope for the period preceding the formation of the single market and economies of scope thereafter.

[37] EU (1997a) calculates x-inefficiencies for an individual country by estimating a long-run cost function, and then measuring by how much the banks in each country deviate from the function, thus yielding an efficiency score for each country. The results for ten countries are shown in Table 2.16.

Table 2.16: X-inefficiencies In EU Banking Markets 1987 -1994 (%)

Country	1987	1988	1989	1990	1991	1992	1993	1994
Belgium	-	-	-	21.6	19.2	20.0	19.0	17.6
Denmark	-	-	-	-	-	21.2	21.7	12.2
France	18.0	19.8	22.1	21.0	21.3	21.4	20.2	18.7
Germany	19.1	18.3	19.9	20.2	21.3	19.9	18.4	17.4
Italy	15.4	15.2	17.2	14.3	16.6	19.2	19.2	13.3
Luxembourg	-	-	-	15.2	15.3	13.8	13.6	11.5
Netherlands	-	-	-	18.1	17.1	25.7	26.9	24.5
Portugal	-	-	-	-	-	24.5	18.2	12.3
Spain	16.0	14.8	15.1	17.9	21.2	20.4	22.0	16.1
UK	-	-	-	18.1	19.0	19.5	18.2	18.0

- denotes insufficient data was available to allow the necessary computations.

Source: Adapted from EU (1997a), Table 4.28, p.93.

Table 2.16 shows that there were significant deviations from the efficient long-run average cost function for the period 1987-1994. However, x-inefficiencies appear to have decreased towards the end of the period.

Bringing all the available evidence on EU banking industry efficiency together, it appears that the single market programme in financial services has resulted in more efficient banks, through the realisation of greater scale, scope and x-efficiencies (EU, 1997a). EU (1997a) contends that if universal banking is now the norm, there should be greater opportunities for scope economies.

2.6.3.2 Performance Levels

In recent years, the performance of banks operating within the EU is likely to have been influenced by the process of de-regulation (OECD, 1992). Conti and Maccarinelli (1993) assert that increased competition has led to pressure on incumbent banks to sustain interest margins and boost returns on equity. Such pressures have intensified as savings and other types of institutions move into areas traditionally dominated by commercial banks. De-regulation of financial markets and the increasing influence of foreign banks in many markets have threatened the profitability of incumbent banks (White, 1998).

However, the general decline in national interest rates brought about by the low inflation environment of the 1990s, coupled with EMU convergence criteria, means that margins are likely to be low. Especially, as the competition for savings and lending services has intensified (OECD, 1992). Table 2.17 shows the trend in net interest margins over the period 1990-1994.

Table 2.17: Net Interest Margins

Country	1990	1991	1992	1993	1994
European Union	2.46	2.29	2.19	2.16	2.09
Belgium	2.19	2.08	1.98	1.69	1.76
Denmark	2.81	2.77	2.74	2.58	2.37
France	2.53	2.37	2.15	1.99	1.91
Germany	1.63	1.63	1.71	1.84	1.81
Greece	4.51	4.15	5.62	2.03	1.80
Ireland	1.90	2.30	4.72	4.12	3.39
Italy	3.41	3.09	2.96	3.25	2.77
Luxembourg	0.62	0.57	0.86	1.07	1.05
Netherlands	1.87	1.76	1.77	1.89	1.90
Portugal	3.21	3.04	3.62	3.90	4.05
Spain	4.92	4.02	3.43	3.00	3.06
UK	2.39	2.33	2.25	2.22	2.28

Note: Data in percentage terms
Source: IBCA Bankscope (1996) Adapted from EU (1997a), Table 4.35, p.103.

Net interest margins have fallen in the EU banking industry as a whole. By individual banking market, margins have declined by the largest amount in countries which were previously among the most heavily regulated, including Spain, Italy, and Greece. On the other hand, increases in margins were recorded in Portugal, Netherlands, Germany, Luxembourg and Ireland.

Returns on equity have, in the majority of cases also fallen, in response to consumers exercising greater choice between competing products and services, and movements in the business cycle (Conti and Maccarinelli, 1993). Table 2.18 shows average returns on average equity by banking market for the period 1990-1994.

Table 2.18 Return on Average Equity for the EU Banking Markets 1990-1994

Country	1990	1991	1992	1993	1994
European Union	10.9	8.05	5.53	7.38	5.53
Belgium	9.18	7.76	8.86	10.65	10.38
Denmark	-2.49	2.50	-7.70	17.01	-3.64
France	9.18	7.37	4.15	2.77	1.37
Germany	6.39	6.53	5.57	7.08	6.36
Greece	17.50	19.12	16.43	12.71	11.32
Ireland	11.71	13.19	16.40	13.03	14.64
Italy	11.16	8.51	4.58	4.76	0.70
Luxembourg	9.40	7.72	11.71	14.98	13.22
Netherlands	9.56	8.68	8.70	10.99	10.61
Portugal	18.66	20.54	15.56	8.73	10.73
Spain	15.60	14.23	11.20	9.19	10.25
UK	11.95	8.89	8.20	14.18	14.86

Note: Data in percentage terms
Source: IBCA Bankscope (1996) Adapted from EU (1997a), Table 4.37, p.107.

In the EU banking industry as a whole the average return on equity has declined from 10.9 per cent in 1990, to 5.53 per cent in 1994. In most countries, returns on equity fell between 1992 and 1994 including Spain, Italy, France, Portugal, Greece and Ireland. The less regulated banking markets in the EU enjoyed an increase in the return on equity including the UK, Germany, Belgium, Netherlands and Luxembourg. This is partly because these markets were better prepared for the consequences of the single market, and consequently found it easier to compete than banks which had previously been protected from intensive competition. Undoubtedly, however, the business cycle and re-structuring of many of these banking markets is also likely to influence the performance of banks.

Metais (1997) commenting on banking profitability in the 1990s observes that:

' *Bank profits did not only decline, they also seem now more volatile. More generally the economic environment has grown riskier during the past decade for banks and their customers alike: exchange rates, interest rates, assets prices all show higher volatility. This is often considered as an (unforeseen?) outcome of financial innovation and de-regulation.*'[38]

Section 2.7 Summary and Conclusions

This chapter has outlined the various changes which have taken place in European banking over the past 20 years. The banking industry in Europe has moved from a system of segmented national markets towards a more integrated market for financial goods and services. These changes have greatly affected the structure of the competitive environment under which banks operate. There are now fewer banks operating extensive branch networks, while employing less workers. Competition between commercial and other types of banks (as well as other financial services firms) has increased as a consequence of de-regulation and technological advances. In response to increasing competitive pressure, banks have pursued policies (such as merger and acquisition) aimed at differentiating themselves from rivals, through becoming larger, and / or more efficient. This has led to increases in concentration in some banking markets. In pursuit of these objectives banks have diversified into new product areas and services in order to pool risk, increased size to realise economies of scale and scope, and reduce x-inefficiencies. However, the falling costs of technology implementation, may in future give small banks or non-banks a competitive advantage (Llewellyn, 1995). Overall, the increased competition has led to declines in interest margins and increases in non-interest income. However, while the single market has increased competition, significant barriers still remain. For example the retail banking market is still organised at a national, not a European wide level. However, EMU is likely to make the market more contestable. ' *Banks are thus likely to pursue a broad range of strategies to add shareholder value in tighter market conditions, including in-market and cross-border mergers. Deeper strategic alliances could well be forged, emulating developments in other global industries.*'[39]

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[38] Metais (1997), p.23.
[39] Oxford Analytica / Citibank (1998), p.8.

CHAPTER 3

MARKET STRUCTURE AND THE PERFORMANCE AND EVOLUTION OF MANUFACTURING INDUSTRIES

3.1 Introduction

This chapter analyses the importance of market structure in determining the performance and evolution for manufacturing industries from a theoretical and empirical perspective. The first part of the chapter examines the likely behaviour and performance of firms under different market structures. This includes a discussion of the neo-classical theories of market structure that evolved into theories of industrial organisation. Many of the manufacturing studies discussed in this chapter have been influential in determining the research in banking markets. Therefore, a discussion of these is essential in understanding the rationale behind banking studies, which are examined in the following chapter. The rest of the chapter is structured as follows. Section 3.2 examines market structure within the confines of deductive micro-economic theory. Section 3.3 discusses how concentration is measured. Section 3.4 examines industrial organisation theory placing emphasis on the Structure Conduct Performance Paradigm (3.4.1), entry and exit barriers (3.4.2), the Theory of Contestable Markets (3.4.3), game theory (3.4.4), the persistence of profits (3.4.5), the Law of Proportionate Effect (3.4.6) and other determinants of concentration (3.4.7). Conclusions are drawn in section 3.5. Overall, the aim of this chapter is to examine performance outcomes arising from different types of market structure, and the most important factors in determining market concentration.

3.2 A Micro-economic Analysis of Industry Structure

There are four main theoretical market structures outlined in micro-economic theory, namely perfect competition, monopoly, monopolistic competition and oligopoly. The basic components of market structure include the number and size distributions of firms, the type of product produced (homogenous or differentiated), the extent of control over prices by incumbents, and the ease with which firms can enter or exit markets.

Neo-classical competition analysis began using a static framework first developed by Cournot (1838), who specified the effects of competition at its limit (i.e. competitive equilibrium). Cournot also developed a theory of oligopoly, which suggests that as the number of sellers in an industry increase price falls towards marginal cost. Emphasis is placed on the condition of equilibrium and not the process undertaken to reach such a state. Subsequent contributions by Jevons (1871), Edgeworth (1881), Clark (1899) and Knight (1921) led to the present day model of perfect competition.[1] Paradoxically, long run equilibrium under perfect competition implies an absence of rivalry. If the firm can do nothing to influence price, and all market participants are perfectly informed about all production possibilities in the market, then the competitive process has run its course.

A perfectly competitive industry has five main characteristics. First, there are many buyers and sellers such that the action of any individual buyer or seller has negligible influence on the market price. Second, producers and consumers have perfect knowledge of events in the market and act upon this knowledge. Third, the product is homogenous so consumers are indifferent between each producer's product. Fourth, firms act independently of each other in such a way as to maximise profits. Finally, there is perfect mobility of resources. Firms are free to enter or exit and to supply markets with the quantities they wish.

If these conditions are satisfied, a competitive equilibrium may exist in which all firms earn a normal profit. In the short run firms can earn supernormal profits, defined as returns in excess of normal profits (the minimum necessary to induce the firm to remain within the market it occupies). However, in the long run, new firms enter the market and bid these profits away, so eventually all firms earn normal profits. If the firm is unable to earn normal profits then in the long run resources leave the firm for other firms, or the firm withdraws from the market.

The theory of perfect competition assumes that all firms are free to enter and exit markets, which ensures that large numbers of small firms make normal profits. However, in reality, competitive

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[1] Stigler (1957) discusses the development of the theory of perfect competition.

conditions often give rise to many industries consisting of a few large firms which may have considerable influence over the prices charged, enabling these firms to earn abnormal profits.

Drawing on the earlier insights of Marshall (1890), Sraffa (1926) formulates a theory of monopoly. Sraffa argues that as firms grow in size they enjoy lower average costs through economies of scale advantages, which ultimately lead to a highly concentrated industry structure consisting of small numbers of large firms. In the extreme, the industry could become a monopoly in which a single firm normally selling a highly differentiated product can charge a high price and earn abnormal profits.

Influenced by Sraffa, Chamberlin (1933) brings together the previously separate theories of monopoly and perfect competition, to formulate theories of oligopoly and monopolistic competition.[2] Under the theory of monopolistic competition, markets contain elements of monopoly and competition. Chamberlin emphasises non-price as well as price competition. This non-price competition can come in the form of product differentiation, trademarks and brand names. Though a large number of sellers may exist in a market (this being the competitive part of monopolistic competition), each firm's product has some unique characteristics, which give the firm some discretion over price (this being the monopolistic part of monopolistic competition). As in perfect competition there is free entry and exit. However, unlike perfect competition each firm's product is slightly different. As a result, firms do not face perfectly elastic demand curves and are not price takers. An individual firm can charge more for a product than its competitors because there is brand loyalty. In the short run the firm can earn supernormal profits, but because there is free entry, only normal profits are earned in the long run.

[2] Robinson (1933) forwards similar arguments, under the heading of imperfect competition.

Chamberlin also contributes to the theory of oligopoly.[3] Under oligopoly, firms realise that their actions are interdependent (i.e. a change in output by one firm will alter the profits of rival firms and cause them to adjust their output). Competitive behaviour under oligopoly ranges from vigorous price competition which can often lead to competing firms making substantial losses, to collusion. Firms can collude either tacitly, (through dominant firm or barometric price leadership), or explicitly through a formal cartel agreement, with the most extreme version of this being joint profit maximisation, with the colluding firms operating as a single monopolist to maximise the industry profits (Machlup, 1952 and Bain, 1956).

3.3 Measurement Of Market Concentration[4]

An empirical analysis of the competitive environment usually involves examining the effects of market structure on the behaviour and performance of firms. Market concentration has been the predominant measure of market structure used. Any measure of concentration attempts to capture the prevailing structure and the extent of competitive forces operating in an industry. The behaviour of firms is affected by the number of firms, and whether or not there is mutual recognition of interdependence. The structure of the industry is also characterised by the size distribution of firms. For example, an industry consisting of ten equal sized firms will be very different to an industry with a dominant firm and a smaller competitive fringe. This section examines the more commonly used measures of concentration. These include Concentration Ratios, Gini Coefficient, Herfindahl-Hirschman Index, Hannah and Kay Index, Entropy Coefficient, The Variance of Logarithms in Firm Size and the Lerner Index of Monopoly Power.

[3] This work has its roots in earlier theories of oligopoly forwarded by Cournot (1838), Bertrand (1883) and von Stackleberg (1934). In Cournot's model, firms compete on output, while in the Bertrand model firms compete on the basis of price. In both models, firms sell homogenous products. Von Stackleberg updates this work by developing a model where one firm leads other member(s) of the industry and sets output, and leaves the rest to follow. Although, Chamberlin acknowledges these contributions, he extends the analysis by emphasising competition amongst firms selling differentiated products. See Chamberlin (1933) for a full discussion.

[4] Appendix 1 reviews studies which test for the importance of economies of scale, market growth and product differentiation in explaining the level and change in concentration.

The concentration ratio measures the market share of the top N firms in an industry where N is normally taken as 3, 4 or 8.[5]

$$CR_N = \sum_{i=1}^{N} x_i \qquad x_i = \text{market share of firm i.} \qquad (1)$$

For example, a four firm concentration ratio measures the sum of the shares of the top four firms. Traditionally, market share is measured as sales, assets or number of employees. The measure suffers from the problem that it only focuses on the top firms in the industry, and so takes no account of the distribution of remaining firms.

As a result many researchers have adopted summary measures of concentration, which take into account all firms. The Gini Coefficient is based on the Lorenz curve. The value of the coefficient is determined by the extent to which the Lorenz curve deviates from the line of absolute equality. A value of zero indicates that all firms are equal sized, while a value of one indicates that a single firm dominates the industry. The measure ignores the number of firms in an industry. For example, an industry with two equal sized firms would have the same Gini coefficient as an industry with one hundred equal sized firms.

The Herfindahl-Hirschman Index uses every point in the firm size distribution. It is defined as the sum of the squares of the market shares of each firm.[6]

$$H\text{-}H = \sum_{i=1}^{N} (x_i)^2 \qquad x_i = \text{market share of firm i.} \qquad (2)$$

5 Bailey and Boyle (1971) find a strong correlation between concentration ratios using varying numbers of firms.
6 This measure is due to Hirschman (1945) and Herfindahl (1950).

As a result larger firms receive a higher weighting to reflect their relative importance in the industry. A numbers equivalent measure can be calculated as $\frac{1}{\text{H-H}}$, which gives the number of equal sized firms that an industry can sustain.

Using a similar measure to the Herfindahl - Hirschman Index, Hannah and Kay (1977) argue that firm market shares can be given weights ranging from α = 0.6 to 2.5 depending on the importance the researcher wishes to attach to the larger firms in the industry. The index can be expressed as follows:

$$\text{H-K} = \sum_{i=1}^{N} (x_i)^{\alpha} \qquad x_i = \text{market share of firm i.} \qquad (3)$$

The larger the value of α, the more importance is given to larger firms.

The Entropy coefficient (E) is a measure that quantifies the degree of uncertainty. It is defined to be the sum of each firm's market share multiplied by the logarithm of its reciprocal, as follows:

$$E = \sum_{i=1}^{N} x_i . \log \frac{1}{x_i} \qquad x_i = \text{market share of firm i.} \qquad (4)$$

The higher the value of the coefficient the greater the certainty as to the established firms' future relationships with buyers in the market. A value of E = 1 indicates a monopoly position, which will ensure that the firm will have a captive market, as no substitute goods exist.

In reality, many industries have firm size distributions that correspond closely to the log normal distribution, with large numbers of small firms, fewer medium sized firms, and small numbers of large firms. As a result many researchers have used the variance of the logarithms of market shares to measure the inequality in firm sizes (Aitchison and Brown, 1966). This can be expressed as follows:

$$VL = \frac{\sum (x_i - \overline{x})^2}{N} \quad x_i = \text{market share of firm i; } \overline{x} = \sum x_i / N. \quad (5)$$

This measure suffers from the same limitations as the Gini coefficient.

Based on textbook models of profit maximising behaviour under perfect competition and monopoly, the Lerner Index (L) is a measure of monopoly power and specified as follows:

$$L = \frac{P - MC}{P} \quad (6)$$

where P = price charged and MC = marginal cost. L can take a value between zero and one. L=0 denotes a perfectly competitive industry where all firms are of equal size setting prices equal to marginal costs, while values of L > 0 indicate an element of monopoly power, allowing firms to set price above marginal cost.

Although most of these measures have their limitations they normally tend to correlate highly with one another (Scherer and Ross, 1990).[7] Hannah and Kay (1977) argue that if a measure is to capture the structure of an industry it must satisfy the following criteria. Concentration measures should rank one industry as more concentrated than another if the cumulative share of output of the largest firms is everywhere greater than the shares of firms from the other. A transfer of sales from smaller to larger firms should increase concentration. Entry of smaller firms should decrease concentration, while exit of small firms should increase concentration. The mergers of two firms within an industry should increase concentration. Random influences on firms' growth should increase concentration. If firms have the same proportionate chance of growth, then any growth

7 See Curry and George (1983) for a full discussion of the problems associated with various measures of concentration.

will affect large firms' size to a greater degree than smaller firms, and so increase the level of concentration.[8]

3.4 The Theory of Industrial Organisation

Much of Chamberlin's work on oligopoly, and product differentiation (discussed in section 3.2) has been pursued in the field that has become known as industrial organisation. The originators of this area of study are Edward Mason and Joe Bain, who both concentrate on empirical rather than theoretical studies. Later work focuses on competitive behaviour, using game theoretic models. However, in recent years there has been a renaissance in empirical research (Bresnahan and Schmalensee, 1987). In contrast to the deductive approach of standard micro-economic theory, the field of industrial organisation analyses empirical data, and by a process of induction develops theories that purport to explain the real world behaviour of firms and industries.

3.4.1 The Structure Conduct Performance Paradigm

From Mason's seminal articles (1939, 1949) many writers, most notably Bain (1951, 1956, 1959) have developed what has become known as the Structure-Conduct-Performance (SCP) paradigm to analyse competitive conditions in markets. The SCP paradigm studies how the structure of industry relates to the conduct and performance of firms. This approach attempts to explain and predict the performance of an industry (normally measured by profitability) as a consequence of market structure (normally measured by a concentration ratio or index). An analysis of structure involves examining the number of firms, their relative and absolute size, the extent of product differentiation and entry conditions. Market structure is expected to influence the conduct of firms that make up the industry. Conduct variables include price setting, collusion, strategic moves, advertising and innovation. Performance variables include profits, growth,

8 This relates to the stochastic explanation of industry concentration discussed under the heading of the Law of Proportionate Effect in section 3.4.6.

market share, technological progress and efficiency. The emphasis is therefore on the structure of industry and how it influences conduct and performance. The approach assumes that the smaller the number of firms in an industry, the greater the likelihood of the abuse of market power and the greater the profitability of these incumbent firms. However, it is possible that conduct and performance can have feedback effects on the structure of an industry (Phillips, 1976). Most early research focuses on the extent to which markets become concentrated, and how this affects performance. Therefore, a positive correlation between concentration and profits is caused by firms acting in a collusive manner to achieve high profits.

The SCP school views market structures as imperfect, requiring government regulation to check the abuse of market power. However, the Chicago School argues that government interference leads to less competition. (Stigler, 1968 and Demsetz, 1973). A positive relationship between concentration and profits does not necessarily imply collusive behaviour. It may be that bigger firms are more efficient and make higher profits as a result. Therefore, in markets with a small number of large firms, profits tend to be higher. These opposing views have formed the basis for a substantial empirical debate. This is now discussed.

At a theoretical level the traditional Structure Conduct Performance (SCP) view of industrial organisation considers the industry as a single unit consisting of firms which are assumed to be alike in all respects except size. As an industry becomes more concentrated, firms find it easier to collude and erect barriers to entry to earn excess profits. All firms are expected to earn similar profits if market power is shared. This view of industrial organisation has provided the basis for numerous studies that have found a weak positive correlation between concentration and profits. These findings have become known as the traditional market concentration doctrine. In brief, the traditional view of industrial organisation focuses on industry specific sources of market power.

Bain (1951) tests the concentration hypothesis for US manufacturing industries between 1936 – 1940, and finds that in industries with eight-firm concentration ratios (CR8) of more than 70%, profits were significantly higher than in those with CR8 less than 70%. These results have been interpreted as supporting the hypothesis that concentration facilitates collusion and limits rivalry.

Bain's findings were confirmed by numerous studies that provided empirical justification for government intervention aimed at increasing competition.[9] Bain's findings went unchallenged for more than twenty years, until the early 1970s.

Demsetz (1973,1974) and others challenge this traditional view of industrial organisation, forming what has become known as the "revisionist" school.[10] Revisionists argue that market structure affects profitability not through concentration, but by the association between market share and profitability. They argue that because by definition, concentrated industries contain firms with high market shares, the average level of profit is greater in more concentrated industries. Therefore, a positive relationship between market share and profitability at the firm level implies a relationship between profit and industry concentration, even if higher concentration has no effect on conduct. The revisionists assert that if the positive relationship between market concentration and profitability reflects the exercise of market power, it should affect all firms equally. If large firms in concentrated industries have higher profits than small firms, then the correlation between profits and concentration is the result of the underlying relationship between profits and efficiency which has allowed these firms to become large. Firms with a competitive advantage in production become large and attain large market shares, and as a consequence the industry becomes concentrated. If all firms operate at similar levels of efficiency, concentration and average profits are low. If some firms are more efficient than others, these firms capture a larger share of the market, so concentration is high. Efficient firms earn higher profits, so average profits are positively correlated with concentration levels, even though there is no collusion. This implies that a policy aimed at de-concentration to promote greater competition is not appropriate.

Demsetz (1973) tests the efficiency hypothesis and challenges the findings of Bain and others. Demsetz uses data from the US Internal Revenue Service for 95 industries. The data is classified

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[9] For a summary of these studies see Weiss (1974), p.204-15. Weiss reviews the results of a large number of concentration-profits studies, and finds that virtually all of these studies report a significant positive relationship between profits and industry concentration.

[10] The term revisionist is due to Schmalensee (1985). For related arguments see Peltzman (1977).

by industry concentration and firm sizes. Rates of return are measured by profit plus interest divided by total assets. The results are shown in Table 3.1.

Table 3.1: Rates of Return by Size and Concentration (weighted by assets)

CR4	Number of industries	R1	R2	R3	R4	$\overline{R}$
10-20	14	7.3%	9.5%	10.6%	8.0%	8.8%
20-30	22	4.4%	8.6%	9.9%	10.6%	8.4%
30-40	24	5.1%	9.0%	9.4%	11.7%	8.8%
40-50	21	4.8%	9.5%	11.2%	9.4%	8.7%
50-60	11	0.9%	9.6%	10.8%	12.2%	8.4%
Over 60	3	5.0%	8.6%	10.3%	21.6%	11.3%

CR4 is the four firm concentration ratio measured on industry sales in 1963.
R1 is average rate of return for firms with assets < $ 500,000
R2 is average rate of return for firms with at least $ 500,000 assets but < $ 5 million.
R3 is average rate of return for firms with at least $ 5 million assets but < $ 50 million.
R4 is average rate of return for firms with assets > $ 50 million.
Source: Demsetz (1973), page 6, Table 2

According to Demsetz, the association between collusion and concentration has little effect on the profits of firms in classes R1, R2 and R3. Profits of individual firms in these groups do not rise with concentration. However, in the largest class R4, profits do increase with concentration, lending support to the efficiency hypothesis. By regressing differences in profit rates on concentration ratios, Demsetz finds a significant positive non linear relationship between concentration and relative rates of return, which decreases in strength over the range R1 to R3.

Smirlock, Gilligan and Marshall (1984) test the efficiency against the collusion hypothesis using Fortune data on 132 US manufacturing firms covering the period 1961-69.
The estimated equation is:

$$q^* = \alpha_0 + \beta_1 MS + \beta_2 CR4 + \beta_3 HBTE + \beta_4 MBTE + \beta_5 MSG \qquad (7)$$

where q* is Tobin's q averaged over the sample period (ratio of the market valuation of the firm to replacement cost of its assets); MS is market share; CR4 is the concentration ratio of four largest firms; HBTE and MBTE are dummy variables measuring entry barriers (high or medium); MSG measures the firm's growth over the period as the ratio of its market share in 1968 to its market share in 1961. $\beta_1 > 0$ and $\beta_2 = 0$ would support efficiency arguments. $\beta_2 > 0$ and $\beta_1 = 0$, would support the traditional concentration hypothesis. Overall, they find that $\hat{\beta}_3$ and $\hat{\beta}_4$ are insignificant. $\hat{\beta}_5$ is significant, perhaps because MSG influences investors' expectations about whether the firm's market share will increase in the future. More importantly, however, they find $\hat{\beta}_1$ is significantly greater than one and $\hat{\beta}_2$ is also positive, but insignificant. These results provide general support for the efficiency hypothesis.

Schmalensee (1985) uses US 1975 Federal Trade Commission line-of-business data for 456 firms in 261 industries to investigate the relative importance of firm and industry effects. The estimated equation is:

$$\Pi_{ij} = \mu + \alpha_i + \beta_j + \gamma S_{ij} + \varepsilon_{ij} \qquad (8)$$

where: Π_{ij} is the accounting rate of return on firm i's production in industry j; S_{ij} is firm i's share in the market for industry j's product; α_i is the component of Π_{ij} which is specific to firm i (measured as the deviation of firm i's profits from the industry average, and is the same for all industries in which firm i operates); β_j is the component of Π_{ij} which is specific to industry j (measured as the average profits of the industry, and is the same for all firms which operate in industry j) and ε_{ij} is an error term. $\alpha_i = 0$ and $\beta_j \neq 0$, would support the traditional SCP hypotheses, whereas $\alpha_i \neq 0$ and $\beta_j = 0$ would support the revisionist view. Schmalensee finds that industry effects are very important, explaining 75% of the variations in profits, while firm effects are less important.[11] This, he argues, is supportive of the traditional view of industrial organisation. However, Schmalensee's study can be criticised for omitting important firm and industry level variables, which may cause bias in the observed results.

Eckard (1995) uses US data for five cohorts of firms (based on size) to examine the relationship between changes in profits (measured by the price-cost margin), arising from changes in market share between 1967-1972 and 1972-1977. If the efficiency hypothesis holds, a positive relationship should be observed between changes in profit and market shares, implying that profits change in response to changes in efficiency. He finds a positive relationship between market shares and profits for all firm size bands. These results suggest '*...a market process in which firms become large and profitable through superior efficiency...*'[12]

The empirical evidence as to whether firms earn high profits through collusion or differential efficiencies appears to be somewhat inconclusive. [13]

3.4.2 Entry and Exit Barriers

Entry barriers play a crucial role in defining industry structure. By deterring entry, established firms can grow, causing industry structures to become more concentrated over time. Bain (1956) defines barriers to entry as factors that allow established firms in an industry to earn supernormal profits without attracting entry. Stigler (1968) defines barriers to entry as '*...a cost of producing (at some or every rate of output) which must be borne by a firm which seeks to enter an industry but is not borne by firms already in the industry.*'[14] Entry barriers can be created by incumbents' superior access to high quality inputs which are in short supply, cheaper long term finance or from learning economies of scale. Caves and Porter (1977) argue that such barriers apply not only for entrants, but also between different groups of existing firms. Groups may arise due to differences in products, vertical integration or ownership.

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11 Schmalensee (1985), p.349.
12 Eckard (1995), p.223.
13 Economist (1998a).
14 Stigler (1968), p.67.

Shepherd (1997) differentiates between exogenous and endogenous barriers. Exogenous barriers arise from basic structural characteristics of the industry, such as product characteristics and production technology, while endogenous barriers arise from firms taking conscious decisions to impede entry through strategies which may ultimately influence the future structure of the industry. Shepherd's classification of exogenous and endogenous entry barriers is reproduced in Table 3.2.

Table 3.2: Sources of Entry Barriers

I. EXOGENOUS CAUSES: EXTERNAL SOURCES OF BARRIERS
1. Capital Requirements: related to minimum efficient scale of plants and firms, capital intensity, and capital market imperfections.
2. Economies of Scale: both technical and pecuniary, which require large-scale entry, with greater costs, risks, and intensity of retaliation.
3. Absolute Cost Advantages: many possible causes including lower wage rates and lower cost technology.
4. Product Differentiation: may be extensive.
5. Sunk Costs: any cost incurred by an entrant that cannot be recovered upon exit.
6. Research and Development Intensity: requires entrants to spend heavily on new technology and products.
7. High Durability of Firm-Specific Capital (Asset Specificity): imposes costs for creating narrow use assets for entry, and losses if entry fails.
8. Vertical Integration: may require entry at two or more stages of production, for survival; raises costs and risks.
9. Diversification by Incumbents: mass resources deployed among diverse branches may defeat entrants.
10. Switching Costs: complex systems may entail costs of commitment and training, which impede switching to other systems.
11. Special Risks and Uncertainties: entrants' higher risks may raise their costs of capital.
12. Gaps and Asymmetries of Information: incumbents' superior information helps them bar entrants and may raise entrants' cost of capital.
13. Formal, Official Barriers Set by Government Agencies or Industry-wide Groups: examples are utility franchises, bank entry limits, and foreign trade duties and barriers.
II. ENDOGENOUS CAUSES: VOLUNTARY AND STRATEGIC SOURCES OF BARRIERS
1. Pre-emptive and Retaliatory Actions by Incumbents: including selective price discounts to deter or punish entry.
2. Excess Capacity: the incumbent's excess capacity lets it retaliate sharply and threaten retaliation credibly.
3. Selling Expenses, Including Advertising: increases the degree of product differentiation.
4. Segmenting the Market: segregates customer groups by demand elasticities and makes broad entry more difficult.
5. Patents: may provide exclusive control over critical or lower-cost technology and products.
6. Exclusive Controls over other Strategic Resources: such as superior ores, favourable locations, and unique talents of personnel.
7. Raising Rival's Costs: actions that require entrants to incur extra costs.
8. Packing the Product Space: may occur in industries with high product differentiation.

Source: Shepherd (1997), p.210, Table 9.1.

Bain (1956) defines entry as the establishment of a new firm, which introduces new capacity that did not exist before the establishment of the new firm. Bain argues that a firm can enter either by building new capacity or by converting existing plant and machinery used in another industry for use in the new venture. However, Bain focuses mainly on the former. This assumption has been criticised, as it is unlikely that an established firm in another industry will set up a new legal entity in order to enter a market.

The following examines the sources of exogenous and endogenous entry barriers.

Exogenous Barriers to Entry

The study of exogenous sources of entry barriers began with the work of Bain (1956). Bain defines four types of exogenous barriers, namely, economies of scale, capital requirements, absolute cost advantage and product differentiation.

A capital requirements barrier can occur if the nature of the production process requires substantial set up costs. As a result the entrant finds it difficult or impossible to raise the finance to meet set up costs.

Economies of scale can also act as a barrier to entry. If the incumbent firm has a scale advantage, two possibilities exist. Firstly, the potential entrant can enter producing less output, in which case it will incur higher average costs. Secondly, the potential entrant can produce similar levels of output, in which case it may need to spend heavily on establishing capacity and capturing market share.

An absolute cost advantage for the incumbent firm may arise from control of the supply of key raw materials, superior production techniques, exclusive deals with suppliers and discounts for bulk buying. For example, a new firm normally has difficulty in hiring trained labour, and given a finite supply of skilled labour the entrant may have to pay more to attract labour away from incumbent firms.

Product differentiation can act as a barrier to entry, because an established firm gains advantages through customer brand loyalty and goodwill. The entrant then has to overcome this barrier in order to establish its product in the market. Even if the entrant does become competitive, the costs incurred initially in establishing the product are unrecoverable.

A substantive literature on the sources of entry barriers has developed from the initial contributions of Bain. Baumol, Panzar and Willig (1982) and Sutton (1991) identify the role of sunk costs as an entry barrier. Sunk costs are costs that once incurred are non-recoverable. Sunk costs are important for both the incumbent and the entrant because in both cases they imply commitment to a chosen course of action. The recognition of sunk costs as a barrier to exit therefore in itself acts as a barrier to entry.

Shepherd (1997) observes that in certain hi-tech industries such as pharmaceuticals and electronics, substantial investment in research and development may be required to establish the capability to produce some products. This is essentially another capital requirements entry barrier.

Williamson (1975) asserts that the degree of specialisation required to produce a good or service can often deter entry into a market. If the assets required to supply certain goods or services are specialised, then expenditure on such assets is essentially a sunk cost. This is likely to deter potential entrants because if entry fails, the assets cannot be used to produce alternative goods and services.

The extent to which incumbent firms are vertically integrated also has implications for ease of entry into markets (Davies, 1987). Vertical integration occurs when a firm operating at one stage of a production process moves into production at another stage. Movement into an earlier part of the production process is backward integration, and movement into a later stage is forward integration. A vertically integrated incumbent can make it difficult for non-integrated firms to enter the market, for example by charging the entrant high prices for a necessary input. The entrant could overcome this by integrating into another stage of the process, but this increases the cost of entry.

The extent to which established firms are diversified can create a formidable barrier to entry. If a firm diversifies into several industries, this can lead to increased concentration in these industries (Lyons, 1987). Furthermore, the diversified firm may be able to compete fiercely in a price war if necessary, as losses in one market can be recouped in another. This type of behaviour is likely to deter entry leading to higher concentration.

New entrants can incur high costs if capturing market share requires customers to bear switching costs. If customers face substantial costs in moving from an established firm to an entrant, then the entrant may provide outlays to assist with this switch, thus raising the costs of entry (Klemperer, 1987).

Special risks and uncertainties of entry can often lead to entry being deterred. New entrants are likely to make more mistakes than incumbent firms, as they are unaware of many of the pitfalls of operating in a particular market (Shepherd, 1997). As a result, financing costs for expansion are likely to be higher for entrants.

Gaps and asymmetries of information can also create advantages for incumbent firms. The more experienced the incumbent firm is, the more likely it is to have specialised knowledge of the market (Spence, 1981). Consequently, it may be able to keep costs down, especially if initial production is at low prices. The incumbent's demand is therefore likely to be high, creating opportunities for "learning by doing", enabling the incumbent to maintain its absolute cost advantage over the entrant.

Finally, legal barriers to entry are often a potent force in preventing competition in certain industries. Barriers may only persist if they are erected and supported by the state, for example through restrictions on the numbers of firms allowed to operate. Other such barriers include various forms of registration and licencing requirements. Governments can also raise such barriers indirectly through tax policies and labour laws (Demsetz, 1982).

Endogenous Barriers to Entry

Incumbent firms can actively affect industry structure by acting strategically to raise entry barriers. These strategies can ultimately lead to increasing concentration via feedback effects. Endogenous barriers include pre-emptive and retaliatory pricing actions by established firms; the building of excess capacity; the imposition of extra selling costs on entrants by excessive advertising; market segmentation; pre-emptive patenting activity; raising entrants' costs through control over key resources; and brand proliferation.

Kay (1993) argues that firms can draw on what he terms 'distinctive capabilities' including architecture and reputation in order to achieve a competitive advantage over competitors and achieve growth. Architecture refers to the firm's internal organisation, and contracts with suppliers and distributors. For example, knowledge of the industry may yield substantial advantages that allow the firm to grow over successive periods. However, if market structure or production technologies change, this advantage may be quickly eliminated. Reputation effects can also provide advantages over competitors. If a firm has a reputation for providing high quality and service, it will help add value and generate more sales. Kay argues that reputation can be sustainable over long periods, making it difficult for entrants to compete on equal terms with a reputable incumbent. Overall, Kay argues that in industries in which selective firms can draw on 'distinctive capabilities', these firms are likely to grow and achieve dominance for long periods.

Firms can implement certain pre-emptive and retaliatory pricing strategies that make new entry unprofitable, and so act as a deterrent to potential entrants. Incumbent firms could forestall entry by following a strategy of limit pricing (Bain, 1956). The limit price is the highest price the incumbent can charge without inviting entry. The effectiveness depends upon the cost structure of the potential entrant. Limit pricing theory is based on the assumption that potential entrants will behave as though they expect incumbent firms to maintain output at pre-entry levels even after entry takes place (Sylos-Labini, 1957). An incumbent operating with an absolute cost advantage, over entrant firms, could charge a mark up equal to the average cost differential, preventing new firms from entering profitably. If the potential entrant assumes that the incumbent maintains the same output post-entry, the entrant's output is a net addition to industry output. If the incumbent firm keeps the price as equal to the average cost differential, the entrant's demand curve lies below its average cost curve at all points, so there is no level of output at which the entrant can make a profit.

If entry is not deterred, and new firms enter the industry, the incumbent may wish to pursue a policy of predatory pricing. This involves the dominant firm cutting prices in the short run to force other firms out of the market. If successful, this allows the incumbent to raise prices in the long run. Alternatively, to exclude entry on a non-price basis, the incumbent could offer loyalty discounts to customers, or force customers into exclusive deals, thus starving potential entrants of retail outlets.

An incumbent firm can raise barriers to entry strategically by building excess capacity (Spence, 1977). If the established firm commits itself to building up capacity in excess of current demand, a clear signal is sent to the potential entrant about the incumbent's future behaviour if entry occurs, because once spare capacity is built the costs are likely to be 'sunk', i.e. non-recoverable. The existence of excess capacity may indicate that the incumbent is willing to fight a price war, if entry takes place.

Incumbent firms can also increase barriers to entry by large advertising outlays (Comanor and Wilson, 1967). This can be achieved through increasing returns from expenditure on advertising, (which arise from increasing consumer awareness of the incumbent's product), or discounts on bulk advertising. Heavy advertising outlays are likely to strengthen existing entry barriers.

The extent to which established firms can segment a market could determine the extent to which new firms can enter. If incumbent firms can successfully segment the market for a product by customer attributes or geographical location it may also be possible to engage in price discrimination (Shepherd, 1997). If successful this strategy may yield extra returns which could be used to fight entry in some future period.

Pre-emptive patenting can also be used to deter entry by lowering a potential entrant's expectation of profit (Gilbert and Newbury, 1982). Incumbents may have an incentive to pursue pre-emptive patenting, to deter potential entrants from using new technologies. This strategy is attractive if the cost is less than the profits preserved by discouraging entry.

Exclusive controls over strategic resources can also raise rivals' costs and so deter entry. An incumbent may deliberately seek to acquire key resources such as managers, patents or designers in order to gain an absolute cost advantages over rival firms. This in turn makes it difficult for potential entrants to compete (Salop and Scheffman, 1983).

Brand proliferation is an entry deterring strategy whereby the established firm fills the market with numerous closely related products or brands, making it difficult for the entrant to find a niche in the market (Schmalensee, 1978).

Overall, industrial organisation theory argues that whether barriers are exogenous or endogenous, if they are effective the outcome is normally anti-competitive. However, several theorists maintain that it is not only actual entry that determines industry performance, but also the threat of potential entry (Baumol et al, 1982).[15]

The literature reviewed above contends that barriers to entry and exit are crucial determinants of market structure and competitive conditions in that market. Drawing on the literature discussed above, the work of Schumpeter (1942) and Chandler (1990), and also empirical evidence on entry and exit, Geroski (1991) reformalises the relationship of entry conditions and market structure in a dynamic setting. When markets are first created, there is considerable confusion due to brand

[15] The importance of potential entry is highlighted in section 3.4.3.

proliferation, perhaps with large numbers of competing firms. As time goes by, consumers assess the usefulness of competing brands, and eventually a 'core' product becomes established. *'At some stage, a wide enough consensus amongst users develops to make an investment in large-scale production viable, and learning and economies of scale that lead to price cuts persuade even more consumers that they may as well climb on board. The emergence of these mass producers leads to sharp increases in market concentration, and these are the ' first movers' or dominant firms who often dominate their markets for decades. In short, much of what is interesting about what a market develops into and when it does so seems to be bound up with this process of standardisation.'*[16]

However, domination does not last indefinitely because as the industry matures, consumer tastes change and the 'core' products become obsolete.[17] New firms enter by introducing new products and the market undergoes a new phase of expansion and moves toward another equilibrium. Therefore, past patterns of entry determine the structure of markets at any time. Geroski assumes that firms leave the market relatively easily when their products are no longer demanded. On the other hand, according to Porter (1980) *'When exit barriers are high, excess capacity does not leave the industry, and companies that lose the competitive battle do not give up. Rather they grimly hang on.'* [18]

3.4.3 Contestable Markets

Traditional micro-economic and industrial organisation theory examines how established firms can be protected by entry barriers to gain advantages and exercise control over prices. However, in contestable markets theory, concentration does not always lead to this type of behaviour. Baumol, Panzer and Willig (1982) emphasise the role of potential rather than actual competition.

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16 Geroski (1991), p.268.

[17] Klepper (1996) refers to this process as the Product Life Cycle. He notes that as a market matures the rate of product innovation declines, and increased process innovation takes place to improve the production of existing products.

[18] Porter (1980), p.110.

Contestable markets are those in which competitive pressures from potential entrants act as constraints on the incumbent's behaviour. For a market to be truly contestable there must be no significant entry or exit barriers. This is the case whether the market consists of one or many firms, because it is potential rather than actual competition that actively constrains the equilibrium behaviour of the established firm(s), and ultimately dictates the structure of the industry.

Baumol et al introduce the concept of the perfectly contestable market, in which potential entrants have access to the same technology as incumbents, there are no sunk costs, and there is free entry and exit. In a perfectly contestable market, it is possible for a new firm to enter, sell goods at prices below those of existing firms, and leave again. It can do so provided it can identify customers and complete the sale of products, cover all necessary costs and exit before the incumbent firm has time to react. Baumol et al define this process as hit and run entry.

'*... in a PCM any economic profit earned by an incumbent automatically constitutes an earnings opportunity for an entrant who will hit and if necessary run (counting his temporary supernormal profits on the way to the firm). Consequently, in contestable markets zero profits must characterise any equilibrium even under monopoly and oligopoly.*' [19]

Therefore, according to the theory of contestable markets, it is entry or exit barriers that determine the performance of firms operating in that market.

3.4.4 Game Theory

Using the empirical findings of many of the studies discussed above, attempts have been made to utilise game theory to formulate theories to explain the behaviour of firms. This work has become known as the New Industrial Organisation (New I.O.). The New I.O. examines the strategic behaviour of firms with reference to output, price and non-price strategies. Fudenberg and Tirole (1989) define the game theoretic approach as: '*...a way of modelling and analysing situations in which each player's optimal decision depends on his belief or expectations about the play of his opponents.*' [20]

19 Baumol et al (1982), p.4.

20 Fudenberg & Tirole (1989), p.261.

In game theory opponents do not hold a priori beliefs about one another, but instead try to predict the other player's moves using previous knowledge of past encounters while assuming that their opponents' decisions are rational. Schelling (1960) defines a strategic move as

'.... *one that influences the other person's choice, in a manner favourable to one's self, by affecting the other person's expectations on how one's self will behave....The object is to set up for one's self and communicate persuasively to the other player a mode of behaviour (including responses to other's behaviour) that leaves the other a simple maximisation problem whose solution for him is the optimum for one's self, and to destroy the other's ability to do the same.*'[21]

In brief, in any game of strategic moves each player is assumed to act rationally to make optimal decisions given the behaviour of their opponents.

Game theory has been used extensively to examine competitive behaviour, where threats, commitments and reputation are deemed important. Dixit and Nalebuff (1991) argue that any strategy adopted by a firm must appear credible to its rivals. Therefore, it pays a firm to build up a reputation for 'toughness' over time in order to gain credibility (Axelrod, 1984). The firm can do this by making an irreversible commitment. Commitments include strategies of vertical integration, diversification, additional expenditure on increasing capacity, product differentiation and research and development expenditure.

Dixit (1982) presents a scenario where an incumbent monopolist seeks to deter the entry of a new firm. The success of such a strategy depends crucially on whether the incumbent firm is committed to the strategy (i.e. has prepared for the fight by prior spending on excess capacity) or is passive (in which case has not prepared itself to fight in the event of entry). These two possibilities are now discussed.

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[21] Schelling (1960), p.160.

Passive Incumbent

There are three outcomes if the incumbent has not prepared itself to fight in the event of entry. If the incumbent has not prepared to fight, and the entrant stays out of the market, then the incumbent continues to make monopoly profits while the entrant earns zero (Pm, 0). If entry does occur, the incumbent must decide whether to fight the entrant in a price war, (in which case both firms make losses (Pw < 0), or share the market in which case both firms earn positive profits (Pd> 0). Dixit argues that the incumbent's threat to fight in the event of entry is not credible, as it has no incentive to fight. Therefore, the solution is where the incumbent and entrant share the market, which is not as profitable as a monopoly, but more profitable than a price war (Pd, Pd).

Committed Incumbent

If the incumbent is committed to the market by making a prior commitment (C), and the entrant knows this, the incumbent finds it optimal to fight entry through a price war (Pw), if this is more profitable than sharing the market (Pd-C, Pd). The rational entrant realises the threat of price war is credible and stays out of the market. Therefore, the solution occurs where the incumbent firm earns monopoly profits minus the cost of the commitment, while the entrant earns zero (Pm-C, 0). As long as the incumbent's commitment is visible and irreversible, the threat is credible.

Although offering some additional insights into how firms and industries behave under different competitive conditions, the importance of game theory within the field of competition analysis has declined in recent years. Instead, empirical research has increased substantially, by making use of new sources of data and econometric techniques (Bresnahan and Schmalensee, 1987). This empirical research has focused on the dynamic nature of competition by examining the time series behaviour of profits and the relationships between firm size and growth.

3.4.5 The Persistence of Profits

Research that examines the time series behaviour of firm profits has cast doubt on the static approach adopted by proponents of the SCP approach. Geroski (1990) argues that the SCP cross-sectional results only provide a snapshot at some point in time, and can say little about the process of competition. There is no certainty that profits or other measures of performance observed at one point in time represent long run equilibrium levels of the performance variable. An empirical association between concentration and high profits may result from observation during a period of disequilibrium. If so, the cross-sectional studies do not capture (unless by luck) the long run equilibrium. Also, cross-sectional estimations usually do not contain enough information on which to base reliable policy decisions. For example, any monopoly profits found in one period could disappear in the next, rendering anti-trust intervention by regulatory organisations unnecessary.

A body of work, which has collectively become known as the 'Persistence of Profits' literature examines the process of competition via the following model.

$$\Pi_{it} = \alpha_i + \lambda_i \Pi_{it-1} + v_{it} \qquad (9)$$

Π_{it} is a measure of firm i's profits in time t. λ_i is the speed at which a firm's short run profits are competed away. $\lambda_i = 0$ implies there is no association between profit in successive years, or zero persistence. The closer λ_i is to one, the greater the persistence of profits. α_i determines whether long run (permanent) profits are positive or negative. Π_{ip} is the long run equilibrium profit at which $\Pi_{it} = \Pi_{it-1} ..... = \Pi_{ip}$, where $\Pi_{ip} = \frac{\alpha_i}{1 - \lambda_i}$.

The implicit hypothesis tested in these studies is that entry and exit into any market are sufficiently free to bring any abnormal profits quickly into line with the competitive rate of return. In other words, competitive forces are sufficiently powerful to ensure that no firm can persistently earn profits above the norm. Because each period brings new random shocks, profits are never the same for all firms. However, if the market is responsive to excess profits and losses, returns tend to gravitate towards some competitive level. The alternative is that some firms possess special knowledge or other advantages which enable them to react, preventing imitation and enabling them to earn profits above the norm, which persist from one period to the next.

Mueller (1990) uses a sample of 551 US firms covering the period 1950-1972 to test for persistence of profits. Mueller splits his sample of firms into six equal sized groups based on initial profitability (Π_{i0}). He then estimates the partial adjustment equation for each firm to yield estimates of long run profit (Π_{ip}) and the speed at which short run profits adjust to long run values (λ_i). Long run profitability differences are found, and there are differences in the speeds at which short run excess profits are competed away. The average profitability of the six groups remains stable over time. For example, in the initial period the top group of firms in the sample were earning 5.49 per cent above the norm, while the least profitable firms were earning 4.66 per cent below the norm. Over the entire sample period, the most profitable group were earning 4.68 per cent above the norm, and the least profitable firms were earning 2.83 per cent below the norm. Although Mueller finds differences in long run profitability differences between firms, there is some movement toward the average. The speed at which entry causes short run profits to be competed away and so adjust towards long run equilibrium also differs. In the top group this speed of adjustment is at its quickest with an average $\hat{\lambda}_i$ of 0.121, indicating that these firms are relatively unsuccessful in insulating themselves against entry. Overall, the average $\hat{\lambda}_i$ is 0.167, which relative to corresponding estimates reported in other studies, implies a relatively rapid convergence of short run profits to long run equilibrium. This may reflect a strong anti-trust regulatory tradition in the United States. Mueller also observes differences in long run profitability across firms. By regressing Π_{ip} on Π_{i0}, he finds that 69% of initial deviations of profits from the average are permanent.

Odagiri and Yamawaki (1990) test for persistence of profits in Japanese manufacturing using a sample of 376 firms for the period 1964-82. Profits are measured as net profit after tax plus interest payments divided by total assets. These profits are normalised by taking the firm's profits as an absolute deviation from the norm. The estimation results indicate some movement of profit rates of firms above and below the norm towards long run equilibrium levels, with an average $\hat{\lambda}_i$ of 0.47. However, there is evidence of differences between firms in the long run equilibrium rate of profit.

Cubbin and Geroski (1990) estimate the partial adjustment model for a sample of 243 UK companies, over the period 1951 to 1977. The sample is split into six groups based on initial profitability, and it is found that the groups are ranked in the same order by average profitability over the entire sample period. UK firms' profit rates show some tendency to converge over the sample period. For the first three years of the sample period the difference in profitability between the top and bottom groups is 13.3 per cent, but for the sample period as a whole this gap is narrowed to 2.58 per cent. However, there is a relatively high average value of $\hat{\lambda}_i$ of 0.491, which may be indicative of barriers to entry which prevent short run excess returns adjusting to long run values.

Goddard and Wilson (1996) present evidence on the persistence of profits for 335 UK manufacturing and 90 service firms for the period 1972-1991. They find an average value of $\hat{\lambda}_i$ of 0.45 for manufacturing, and an average of 0.46 for services. Some variation is found around these averages. For 22.7 per cent of manufacturing and 25.6 per cent of service firms, $\hat{\lambda}_i < 0.3$ while for 17.1 per cent of manufacturing and 17.7 per cent of service firms $\hat{\lambda}_i > 0.7$. Overall, very little difference is found between the distribution of $\hat{\lambda}_i$ for manufacturing and services as a whole.

Goddard and Wilson (1999) argue that in the persistence of profit literature, the standard test procedures, based on individual estimations of the partial adjustment model, allow only limited inferences to be drawn regarding values of λ_i. They argue that the standard univariate tests do not have enough power to enable reliable inferences to be drawn concerning the distribution across firms of true values of λ_i, and that procedures which pool data across firms should be capable of yielding stronger inferences. Adopting a simulation approach to generate profit data, the authors construct sampling distributions for $\hat{\alpha}_i$ and $\hat{\lambda}_i$ based on varying assumptions about the distributions of the true values of these parameters. They then use standard goodness of fit tests to establish which distribution for the true parameters produces sampling distributions which are most consistent with the actual distributions of $\hat{\alpha}_i$ and $\hat{\lambda}_i$ observed in the sample of 335 UK manufacturing firms (i.e. for which distribution is the goodness of fit test statistic minimised). Although, some evidence is presented that $0 < \lambda_i < 1$ for most firms, the authors are unable to rule out the possibility of zero persistence of profits ($\lambda_i = 0$) and complete persistence of profits ($\lambda_i = 1$) for up to 15 and 24 per cent of firms respectively.

Overall, the persistence of profits literature finds evidence that there are differences in the long run equilibrium rate of profit (measured by $\hat{\Pi}_{ip}$) and varying degrees of year-to-year persistence (measured by $\hat{\lambda}_i$), and so differences in the rate at which firms' profits are eroded through the process of entry. It is argued that these results may also reflect differences in efficiency across firms. Differences in the dispersion of long run equilibrium profits have also been found across countries, with the greatest dispersion found in UK and the smallest differences in Japan.[22] The smallest estimated λ_i are found for the US and the highest estimated λ_i for the UK. Whatever the reason for international differences, a general conclusion is that competitive pressure does not appear to be sufficiently strong to completely eliminate differences between firms in profitability, even in the long run.

3.4.6 The Law of Proportionate Effect

The persistence of profits literature discussed above generally focuses on the implications of profit performance in determining the long run configuration of industries. The relationship between growth and firm size also has important consequences for trends in concentration, and

[22] See also Khemani and Shapiro (1990), Jenny and Weber (1990) and Schwalbach and Mahmood (1990) for evidence concerning the persistence of profits for Canada, France and Germany respectively.

therefore market structure. In a seminal work, Gibrat (1931) examines the relationship between firm growth and size. This formulation later became known as the Law of Proportionate Effect (LPE). There are numerous factors that have an influence on growth, many of which are random in nature. These factors may include growth of demand, managerial talent, innovation, organisational structure and luck. According to the LPE, growth is unrelated to firm size, and a large firm has the same chance of growing by say ten per cent in any year as a small firm. Furthermore, the growth of any firm in time t+1 is unrelated to its growth in time t. However, over time, some firms will be lucky and grow in successive periods and so become very large, while others remain the same size or decline. This will eventually result in a firm size distribution that is skewed with a small number of large firms, several medium sized firms and numerous smaller firms. Many authors have found that this description accords with the actual size distribution of firms observed in many industries.[23] As a result the size distribution of firms at any time is a function of the initial size distribution plus any additional growth in successive periods. [24] If the LPE holds, industry concentration will increase even in the absence of economies of scale and other efficiency advantages, mergers and government regulation.

3.4.7 Other Determinants of Concentration

This section discusses briefly a number of other determinants of concentration. These include vertical integration, innovation, industry growth, mergers and government regulation.

Vertical Integration

Stigler (1951) examines the interaction between an industry's life cycle and the extent of vertical integration. In the early stages there are no specialist suppliers of raw materials, so manufacturers engage in backward integration. Alternatively, they may integrate forward to ensure proper sales service. As the industry grows specialists in the supply of raw materials and the distributions of goods and services appear, which leads to vertical dis-integration. As the

23 See Quandt (1966) and Silberman (1967) for a discussion of how closely the actual size distribution of firms in a particular industry conform to the log normal distribution. Clarke (1979) provides evidence for the UK.

24 Chapter 5 provides a detailed discussion of tests of the Law of Proportionate Effect for manufacturing, while chapter 4 does the same for the limited evidence that exists for banking.

industry matures and demand levels off, firms may again engage in vertical integration to protect declining market share.

Innovation

Nelson and Winter (1982) use simulation analysis to identify the impact of different types of innovative behaviour by firms on industry structures. In their model, firms can either invest in innovation or imitation depending on which is more profitable. The model assumes that the more firms invest in research and development, the more likely they are to achieve success. By producing at high output levels to meet the demand for their product, successful firms will gain economies of scale advantages over rivals, enabling them to expand further, and leading ultimately to increased concentration.[25]

Industry Growth

Market concentration is likely to be inversely related to the industry growth rate. With rapid growth, incumbent firms are unlikely to be able to expand capacity sufficiently to satisfy demand, so the opportunity exists for smaller firms to enter, leading to de-concentration. If sales are static or declining, incumbents are likely to collude or exercise market power in order to protect current and future profitability, leading to increased concentration (Dalton and Rhoades, 1974)

Mergers

Mergers can also lead to increased concentration, as firms continue either to exploit technical economies of scale or exercise market power advantages. Weiss (1965) examines the effects of merger on industry concentration over the period 1926-1959 for six US manufacturing industries.[26] A merger takes place whenever a plant in operation in the start of the period is taken over by an existing firm before the end of the sample period. Weiss calculates changes in plant

25 Scherer and Ross (1990), ch.17 contend that the speed at which a firm innovates will determine the success or otherwise of any investment. Early innovation allows the firm to exploit the market over a longer period of time, and improves the firm's position relative to its rivals. However, if the firm innovates too quickly, mistakes can follow which can lead to increasing costs.

26 These industries consist of steel, cars, petrol, cement, flour and brewing.

size for four separate years at approximately ten year intervals.[27] He decomposes changes in the concentration ratio into changes arising from merger, internal growth, exit and changes in the identity of the top firms in the industry. He finds that internal growth and exit had a large effect on concentration, while mergers played a lesser role.

For the period 1957-1969, Hannah and Kay (1981) find that mergers play a crucial role in raising concentration in the UK. Furthermore, if growth attributable to merger is ignored, then smaller firms grew more than large firms over this period.
'Merger has been the dominant force in increasing concentration in the UK since 1919...Its role has been growing and it now accounts for essentially all of currently observed net concentration increase.'[28] However, Hart (1981) suggests that Hannah and Kay exaggerate the role of mergers in raising concentration. Drawing on government statistics, he finds that: '... even if all the 122 large mergers (involving over £5 million) had been prohibited, aggregate concentration would have continued to increase...'[29] Although mergers are an important source of increases in concentration, Hart argues they are less important than internal growth by individual firms.

Regulation

Government policy can also influence levels of concentration. Strong policies aimed at increasing competition by discouraging restrictive practices and disallowing mergers, which may be against the public interest, tend to inhibit concentration. Conversely, policies which impose restrictions on the numbers of firms allowed to operate in specific industries and grant exclusive property rights to selected firms tend to encourage concentration (Burke, 1991).

27 The sample periods for the six industries are as follows: Steel, 1926-1957; Cars, 1948-1958; Cement, 1928-1958, Brewing 1947-1958; Flour, 1932-1959; and petrol 1946 -1956.
28 Hannah and Kay (1981), p.312.
29 Hart (1981), p.318.

3.5 Conclusions

This chapter has examined the role of market structure, in particular market concentration in determining the ways in which firms and industries behave and ultimately perform. The general view that emerges is that firms in highly concentrated industries outperform those in industries which are less concentrated. Empirical evidence as to whether this is due to collusion between incumbent firms or differential efficiencies tends to be inconclusive. The examination of the determinants of market structure has shown that both the level and rate of change in market concentration can be explained by the existence of entry barriers and strategic behaviour, mergers, government regulation, technological change and random disturbances. Overall, the evidence suggests that economies of scale, high levels of product differentiation and advertising, slow industry growth, small firm numbers and the operation of random factors lead to increased industry concentration, while high entry rates and industry growth lead to falling levels of concentration. Having examined the theoretical and empirical importance of market structure for research on manufacturing industries, chapter 4 examines the applications of the same methodological approach in banking.

CHAPTER 4

MARKET STRUCTURE AND THE GROWTH AND PERFORMANCE OF BANKS

4.1 Introduction

This chapter examines the role of market structure in determining the performance of the banking industry. It also evaluates how market structure shapes competitive conditions in the banking industry. The chapter is structured as follows. Section 4.2 examines the application of the Structure Conduct Performance (SCP) framework to the banking industry. This section examines whether market power or differential efficiency determines the performance of banking firms (section 4.2.1); evaluates the SCP approach (section 4.2.2); and the application of Contestable Markets Theory to banking (section 4.2.3). Section 4.3 examines the forces which determine the size distribution of firms within the banking industry. Factors such as economies of scale, barriers to entry, technological change, market growth, mergers, government regulation, strategic behaviour of incumbent banks and stochastic influences are considered. Finally, conclusions are drawn in section 4.4.

4.2 The Structure Conduct Performance Paradigm in Banking

This section describes research that applies the Structure Conduct Performance (SCP) paradigm to the banking industry. This research aims to quantify the influence of market structure on the conduct and performance of banks.

' *Analysis of the SCP relationship in banking is used to help evaluate the main policy issue of which type of banking structure best serves the public in terms both of cost and the availability of banking services. In general two main objectives have been sought; firstly, the attainment of an "efficient" banking system which in some way, secondly, minimises the likelihood of bank failure.*'[1]

4.2.1 Collusion versus Efficiency

The underlying assumption of early SCP based research in banking was that there is a strong causal link between market structure and the performance of banks. However (as in

[1] Molyneux et al (1996), p.93.

manufacturing), it is questionable whether high profits enjoyed by incumbent banks are a consequence of concentrated market structures and collusive price setting behaviour, or of superior production and management techniques that allow larger banks to keep costs low and make high returns. Gilbert (1984) finds that in 27 of 45 US studies surveyed, concentration is positively related to profits. Empirical studies have addressed whether high profitability arises from concentration or superior efficiency using data on US, Japanese, Canadian and Australian banks, as well as banks from most major Western European countries.

Short (1979) tests whether profits are a function of ownership type, concentration levels, growth in assets and capital scarcity, for a sample of 60 banks from Canada, Western Europe and Japan. A positive relationship between profits and concentration is found, implying that banks are able to earn high profits through collusion or the exercise of market power. Scarcity of capital also appears to provide banks with the opportunity to grant loans at higher interest rates. However, the rate of bank growth exerts a negative effect on profitability. Privately owned banks tend to be more profitable than state owned banks. Short's results '*... support the view that greater market power leads to higher bank profit rates.*'[2]

High profitability, however, may be the result of efficient banks securing large market shares and not collusive behaviour. Drawing on previous work, Smirlock (1985) investigates the relationship between profits, market share and concentration for a sample of 2700 US banks. The model includes an interaction term to test the relationship between concentration and market shares, and industry profitability. Smirlock's model also includes a set of control variables which reflect differences in the size and growth of the banking market, varying sources of finance, bank size and holding company affiliations. Smirlock finds a positive relationship between market share and profitability; an insignificant relationship between concentration and profits; and a negative relationship between the interaction of concentration and market share with profits, which leads him to reject the collusion hypothesis. If the market is growing quickly, banks can expand their

[2] Short (1979), p.214.

lending in search of increased profit opportunity.[3] Larger banks are slightly less profitable than smaller banks, perhaps as a result of diversification advantages, which permit them to settle for a lower return on capital. Overall, Smirlock concludes that no relationship between concentration and profits is evident after controlling for market share, and that successful banks are profitable through efficiency advantages.

Rhoades (1985) carries out a similar analysis for 6492 US banks between 1969-1978. He argues that the observed relationship between profits and market share does not reflect efficiency differences between banks, but rather differentiation advantages which allow some banks to charge higher prices than others, thereby earning higher profits.

Rhoades splits his sample of banks into concentration deciles to examine the relationship between profits, concentration and market share, and finds a positive relationship between profitability, and market share and concentration across groups. He tests whether this relationship varies within deciles by examining the relationship between market share and profitability for the highest and lowest ten per cent of banks based on market share. The results suggest that banks with higher market share make higher profit regardless of the concentration decile membership. Regression analysis is used to explain profitability for the sample as a whole, and by concentration decile. Explanatory variables include bank size, to proxy for economies of scale. There is a positive relationship between market share and profitability regardless of concentration decile membership. Rhoades concludes that the most profitable banks are those that can exercise market power through differentiation advantages.[4]

Evanoff and Fortier (1988) test the collusion against the efficiency explanation of excess profitability for a sample of 6300 banks located in 30 US states for 1984. Their model includes

[3] Intuitively one may expect a negative relationship between market growth and profitability as incumbent banks may find it difficult to expand to meet increased customer demand, which may ultimately lead to inefficiencies or the entry of other banks. However, given that entry of new banks is tightly regulated, a growing market yields new clients for incumbent banks in an uncontested market.

[4] He also finds significant relationships between profitability and many of the control variables. These include positive relationship between risk and profits, market growth and profits (which arises from the protection of incumbent banks from outside entry).

concentration and market share as determinants of profit, as well as a set of control variables which account for differences in risk, costs and demand factors.[5] They examine the effects of regulation on bank performance (by estimating the model for banks in markets protected from entry through government regulation and those that are not). Market share has a strong influence on profitability, especially when regulatory entry barriers are high. Market growth has a negative effect on profitability for banks that are not protected by regulatory barriers.

Bourke (1989) examines the determinants of bank profitability for a sample of 90 banks drawn from twelve countries for the period 1972-1981.[6] The explanatory variables are grouped into those specific to the bank itself (internal) and those facing all banks (external). Bank specific variables include capital and liquidity ratios. External variables include regulatory variables, bank size, market concentration, market growth, capital scarcity and inflation. Using three separate measures of bank profitability, he finds that concentration, capital ratios, liquidity ratios and the level of interest charged lead to the increased profitability of banks.

Berger and Hannan (1989) examine the relationship between concentration and prices using quarterly data for a sample of 470 US banks covering the period 1983 to 1985. They argue that prices should be high in collusive markets and low in efficient markets. Using interest paid on retail deposits as a dependent variable, a negative relationship between concentration and deposit interest rates is found. A pooled model including interaction terms between concentration ratios and time trends and market share produces similar results. Overall, support is found for the price-concentration relationship. Banks in concentrated markets tend to exercise market power by paying lower rates of interest to depositors.

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[5] Variables to control for risk include capital asset and loan asset ratios. Cost variables include asset size to account for efficiencies associated with scale economies, and a cost of capital variable which consists of the ratio of demand deposits to total deposits. Market demand variables include market size and growth, and population density.

[6] The sample banks were in the top 500 largest in 1980. The twelve geographic areas sampled were Australia, California, Massachusetts, New York, Ireland, England, Wales, Belgium, Holland, Denmark, Norway and Spain.

Amel and Froeb (1991) present evidence for a sample of 156 US banks, covering the period 1982-1987. The data is defined by the geographic market covered by each bank. It is argued that a geographical classification provides a more appropriate definition of a market than the Standard Industrial Code. Using an approach similar to that of Schmalensee (1985) (see chapter 3), they find that the variation in profitability between banks within each market is greater than the variation across markets. This may suggest that some banks earn high returns as the result of efficiency advantages, and not through collusive practices. The authors also find that concentration and market share are unimportant.

Jackson (1992) tests the price-concentration relationship for 221 banks in 104 different local banking markets in the US, using monthly data from November 1983 to November 1985. He finds a negative price-concentration relationship across the full sample. He also tests the relationship for three sub-samples from low, medium and high concentration industries, finding a negative price-concentration relationship for banks operating in low or medium concentration markets, but no relationship for those operating in highly concentrated markets. This implies banks in highly concentrated markets are likely to be more efficient, and as a result can pay higher deposit interest rates (i.e. charge lower prices) than banks operating elsewhere.

Molyneux and Thornton (1992) present evidence for a sample of banks drawn from 18 European countries over the period 1986-1989.[7] They use various measures of profitability including before and after tax returns on total assets and total equity. Explanatory variables for profitability include concentration (measured by the market share of the top ten banks in a given market), capital and liquidity ratios, inflation, growth in money supply and staff expenses. They find a positive relationship between profitability and concentration, interest rates, and staff expenses, and a negative relationship between profits and liquidity. Molyneux (1993) also incorporates market

[7] The sample banks are drawn from Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Liechtenstein, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Turkey and the UK. Each year of the sample period covers a different numbers of banks. The sample consists of 671 banks in 1986, 1063 banks in 1987, 1371 banks in 1988 and 1108 banks in 1989.

share variables. He finds that SCP relationships hold in Belgium, France, Italy, Netherlands and Spain, while the efficiency hypothesis holds for Norway.

Molyneux and Forbes (1995) test whether efficiency or collusive practices determine profitability in European banking, using pooled data on 18 European countries for the period 1986-1989. Using return on assets as a dependent variable, their explanatory variables include the market shares of individual banks, concentration ratios (measured as the percentage of industry loans accounted for by the top ten banks), and a set of control variables including bank capital / assets ratios (as a proxy for risk), bank assets (as a measure of bank size) and a dummy variable to differentiate state owned and privately owned banks. The model is estimated for the period 1986-1989, and also for each individual year. Market share is insignificant in every model, while concentration is positive and significant. Overall, '*... the results suggest that concentration in the European banking markets lowers the cost of collusion between banks and results in higher than normal profits for all market participants.*'[8]

Berger (1995) undertakes an evaluation of the SCP relationship in US banking. He identifies two 'market power' and two 'efficiency' theories of bank profitability. Banks can exploit market power by charging higher prices by differentiating products, or enter into collusive agreements to raise prices. Efficiency advantages can arise through superior management or innovative techniques that allow banks to capture market share (x-efficiency), or to produce at larger scale (economies of scale).

Berger argues that these competing hypotheses can only be tested if bank specific efficiency controls are included, allowing unambiguous interpretation of the market share term. This is necessary because a positive relationship between market share and profits has been interpreted as supporting the efficiency hypothesis (Rhoades, 1985; and Evanoff and Fontier, 1988).

[8] Molyneux and Forbes (1995), p.158.

Berger estimates a model to examine the determinants of profitability. Explanatory variables of profitability include market concentration, market share and efficiency.[9] The data set comprises thirty separate samples of between 1300 and 2000 banks from three types of regulatory environment, namely unit banking, limited branching and state wide branching states.

Using return on assets and return on equity as dependent variables, Berger finds that profits are positively related to x-efficiencies. There is little evidence to support that economies of scale influence profitability. With reference to the market power theories, he finds that profits are positively related to market share, but not to concentration. This suggests that banks can use differentiation advantages to raise prices and make high profits.

Although Berger has some success in discriminating between the various theories as explanations of bank profitability, the regressions leave large proportions of the variation in banks profit rates unexplained.

' *Our results also suggest that future research may benefit from looking beyond the current versions of the ES (efficiency) and MP (market power) hypotheses for explanations of the observed variation in bank profitability.* '[10]

Berger and Hannan (1998) examine the relationship between operational efficiency and concentration, to test the hypothesis that ' *... market power exercised by firms in concentrated markets allow them to avoid minimising costs without necessarily exiting the industry.*'[11] Using a sample of 5263 banks, the authors estimate a model in which bank efficiency is determined by concentration and a vector of dummy variables that control for differences in ownership structure and geographic location.

[9] Concentration is measured using the Herfindahl-Hirschman index. The efficiency variables are constructed to reflect advantages arising from scale economies (SEFF) and those arising from superior managerial talent (x-efficiencies, XEFF). The former are measured by constructing a cost function and estimating the minimum efficient scale, while the latter are estimated by examining changes in the residuals of the cost function over time.

[10] Berger (1995), p.430, brackets added.

[11] Berger and Hannan (1998), p.464.

The evidence suggests that banks in highly concentrated markets are less efficient. The authors suggest that these results could be used to argue for stronger anti-trust policy such as limiting the number of bank charters and powers of established banks in concentrated markets.

4.2.2 Critique of SCP Studies

Overall, there is no conclusive evidence as to whether collusive practices or superior efficiency is the main determinant of supernormal profits in banking markets. While Berger (1995) shows that market share and x-efficiencies are positively correlated with profits, statistically, the relationships are relatively weak.

Several authors have been critical of the application of SCP to banking. Gilbert (1984) provides a useful summary of the early SCP banking literature, and finds that of the 45 studies examined, 27 find support for a direct link between concentration and profitability. However, in many cases he finds deficiencies in the theoretical basis of the models estimated, the measurement of structure and performance variables, and the specification of the regression models. He argues that many authors apply the SCP approach to banking without taking into account the regulated nature of banking markets (including legal restrictions on entry and interest rate ceilings) when measuring structural and performance variables. However, several authors including Heggestad (1984) maintain that most US SCP studies do control for the effects of regulation by incorporating dummy variables to control for differences in regulatory regimes. Because SCP studies are cross-sectional in nature, then changes in regulation over time are of little concern. However, as we have seen, the static nature of cross-sectional studies is itself open to criticism.[12]

Furthermore, Gilbert points out that many SCP studies suffer from difficulties in measuring structure and performance variables. For, example many studies have used the price of a single banking product as a measure of performance. However, given that banks produce many products, a single performance measure is likely to be uninformative. Later studies (Molyneux and Forbes, 1995 and Berger, 1995) use profits to measure performance.

[12] Geroski (1990) provides an extensive analysis of these issues (see chapter 3). See also Berger, Demsetz and Strahan (1999).

Differences in bank objectives may also make the SCP relationship tenuous. For example, if banks are sacrificing potential profits in order to reduce risk by investing in more certain activities, then researchers should be more interested in variability in profit rates and not profits levels per se (Neuberger, 1998). Alternatively, if managers are maximising utility by adopting expense preference behaviour, then large banks in concentrated markets will not necessarily make abnormal returns (Berger and Hannan, 1998).

Overall, many of Gilbert's criticisms have been addressed in the later SCP studies. According to Heggestad (1984)

'*...Gilbert is unduly harsh on the empirical literature in banking. While much of the literature deserves criticism, not all of the studies are incorrect. They have provided overwhelming evidence of the link between market structure and limitations on entry on firm behaviour and performance in commercial banking.*' [13]

More recently, Berger (1995) argues that many regression models used to test SCP relationships may be mis-specified due to the omission of variables which could reveal differences in x-efficiency across banks. As a result some researchers (such as Rhoades, 1985 and Evanoff and Fortier, 1988) who have found a positive relationship between profitability and market share, may have wrongly concluded that the relationship is due to large banks exercising market power, and not superior efficiency.

4.2.3 Contestable markets in banking

The theory of contestable markets was developed in an attempt to address many of the criticisms of the SCP approach.[14] If markets are contestable then even under oligopoly, incumbent banks will be unable to collude or exercise market power to raise prices. In other words if entry and exit to banking markets are free, banks are forced to charge competitive prices. Even the mere threat

[13] Heggestad (1984), p.647.
[14] Chapter 3 discusses the theory of contestable markets.

of entry constrains the actions of established banks. If banking markets are contestable, then entrants would not be deterred from entering a particular banking market. This is because even if entry is unsuccessful, these entrants can leave the market again having incurred no sunk costs.

Only a few attempts have been made to empirically investigate evidence of contestable markets in banking. In contrast to the SCP approach, this type of study is more concerned with evaluating competitive conditions in banking markets, than with their underlying structural characteristics. Evidence of contestability can be inferred by investigating the competitive conditions in banking markets, using the following model

$$\begin{aligned}\ln TRASS &= a + b\ln PL + c\ln PK + d\ln PF + e\ln ASS + f\ln LNASS \\ &+ g\ln CAPASS + h\ln IBTDEP + u\end{aligned} \quad (1)$$

where ln is the natural logarithm; TRASS denotes the total interest revenue per $ of assets; PL denotes personnel expenses per dollar of assets (proxy for the unit price of labour; PK denotes capital expenses per dollar of fixed assets (proxy for unit price of capital); PF denotes the ratio of annual interest expenses to total funds; ASS is bank assets; LNASS is the loans to assets ratio; CAPASS is total risk capital to assets ratio; and IBTDEP is the ratio of interbank deposits to total deposits. Several of these variables are included to account for differences in size and risk. CAPASS and LNASS are included to proxy for differences in risk, ASS proxies for scale economies, while IBTDEP is included to account for differences between banks in the structure of their deposits. The Rosse-Panzar H-statistic is the sum of the estimated elasticities of output with respect to each input, i.e. H = $\hat{b} + \hat{c} + \hat{d}$. H is interpreted as follows:

1) H < 0, implies a collusive oligopoly or a monopoly, where increases in input prices and marginal costs lead to a fall in equilibrium output and total revenue. 2) 0 < H < 1, implies monopolistic competition, where increases in input prices and marginal costs do not affect the equilibrium output of firms. 3) H = 1 denotes a perfectly competitive industry, or a natural monopoly in a perfectly contestable market.

Shaffer (1982) uses this approach to test for competitive conditions for a sample of US banks. He finds a value of 0 < H < 1 suggesting that the New York banking market is characterised by monopolistic competition. This finding, Shaffer suggests, is consistent with New York based banks operating in a contestable manner, given that the market is relatively concentrated yet entry and exit conditions are relatively free.

Nathan and Neave (1989) test for competitive conditions for samples consisting of banks, trust companies and mortgage companies over the period 1982-1984. The authors test the model above on a cross sectional basis. For the sample of 72 banks, 39 trust firms, 37 mortgage companies the authors find 0 < H < 1. '*The significantly positive values of the elasticity measure indicate that Canada's financial system does not exhibit monopoly power.*'[15]

Molyneux, Lloyd-Williams and Thornton (1994) test the theory of contestable markets using European banking data over the period 1986-1989. The authors find 0 < H < 1 for Germany, France, UK and Spain, and H < 0 for the Italy. This suggests that monopolistic competition prevails in the former four countries, while collusion or monopoly prevails in Italy. Negative relationships exist between assets and profits, and between loans to assets ratio and profit, implying that smaller banks with a higher percentage of total assets in the form of loans tend to be more profitable.

De Bandt and Davis (1998) update the Molyneux et al study, for a sample of 757 banks drawn from France, Germany, Italy and the US over the period 1992-1996. The authors find 0 < H < 1, implying that monopolistic competition prevails in all of the banking markets sampled. Competition appears to be at its most intense in the US. However, small banks tend to enjoy a degree of monopoly power within the German and French markets. It is argued that these general findings provide some support for the view that European banking markets exhibit contestable market features.

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[15] Nathan and Neave (1989), p.576.

4.3 The Determinants of Market Concentration

In the previous section the empirical evidence concerning the consequences of market structure (often measured by concentration) on the performance of banks was examined. This section examines the factors that may explain the size distribution of banks in a given market. Such factors include economies of scale and scope, barriers to entry and exit, technological change and the stage of the industry life cycle, market growth, government regulation, the strategic behaviour of banks and stochastic influences.

4.3.1 Economies of scale

Molyneux et al (1996) suggest an analysis of bank costs can yield useful information for a number of reasons. First, it can aid banks in making pricing and output decisions at the point where average costs of production are at a minimum. Second, costs determine the most efficient size of production for incumbent banks and the numbers of banks which can successfully operate in a particular industry.[16] Third, low average costs can lead to concentrated industry structures if incumbent banks raise barriers to entry. Fourth, cost information can aid banks in taking long term strategic decisions such as to whether to expand existing levels of services into new areas or to acquire another bank to make gains in efficiency. Fifth, information on bank costs is important for the industry regulator when formulating policies which attempt to ensure an efficient and equitable allocation of resources. This section examines the role of costs in determining the structure of banking markets, by considering economies of scale in particular. The assumption is that banks seek to become large to achieve cost efficiencies, which may ultimately lead to a concentrated market structure.

Economies of scale result from cost savings that occur as banks change in size. Economies may be internal to the bank or branch. Revell (1987) classifies economies according to whether they

[16] The extent to which there is a unique bank size depends on the slope of the long-run average cost curve. If the long-run average cost curve is steep, and U-shaped, there is one optimum bank size. A bank not operating at this scale would incur substantially higher average costs. However, if the long-run average cost curve is flat, banks can operate at various points without incurring substantially higher average costs.

arise from more efficient labour usage, technology, marketing or managerial functions. He argues that each bank can be broken down into many branches, processes and divisions. Some branches will benefit from economies of scale, some may have excess capacity, and some may suffer from diseconomies of scale. Bank level economies are thus the summation of all of the branch level economies. Economies may also be identified at the industry level, for example if improvement in technology and automation leads to lower costs for all banks.

If a bank can widen the scope of its activities by engaging in related types of production, average costs may fall. Economies of scope are cost savings arising when a bank produces two or more outputs using the same set of resources, which result in the costs for the group of goods or services being less than the sum of the costs if they were produced separately. Economies of scope permit the bank to spread fixed costs across a larger product range. In particular, the increased use of computing and telecommunications are important sources of economies of scale and scope in the banking industry (Canals, 1993). For example, economies of scale can be realised because large banks handle thousands of transactions, making the average cost of a single transaction low. Economies of scope can be realised because computers possess excess capacity, so the information collected on clients can be used to service other accounts and provide additional services.

Extensive research has been conducted to examine the extent to which banks minimise long-run average costs.[17] Various measures of inputs and outputs and various functional forms for the cost function have been used, to test for economies of scale and scope. Two broad approaches have been followed. With the production approach, the bank collects funds and uses these to offer goods and services. Banking output can be measured by the number of accounts offered or number of loans granted, and costs by the capital and labour costs incurred in this production process. With the intermediation approach, banks are treated as financial intermediaries, which

[17] Early examples include Benston (1965a,b), Bell and Murphy (1968), Schweitzer (1972), Murphy (1972) and Mullineaux (1975).

put borrowers in touch with lenders. The value of loans granted or investments are the output measures, while operating costs and interest payments to depositors, are measures of costs.[18]

Early research adopted the production approach, and used the Cobb-Douglas Functional form to test for economies of scale (Benston, 1965; Mullineaux, 1975; Benston et al, 1982; and Gilligan, Smirlock and Marshall, 1984). This research was carried out for relatively small banks, and found either economies of scale or constant costs at fairly low levels of output, suggesting that economies of scale exist for small and medium sized banks only (Gilbert, 1984).

Later research adopted the intermediation approach and used more advanced statistical techniques to test not only for economies of scale, but also for scope economies (Hunter and Timme, 1986; Hardwick, 1989; and Coscutta et al, 1988). These later studies tested for scale and scope economies on samples which consisted of a wider dispersion of bank sizes. Results suggest that banks face U-shaped average costs curves, so there may be substantial cost penalties for operating at a sub-optimal scale. Overall, these studies suggest that economies of scale exist for small and medium sized banks. Only limited evidence is found for the presence of economies of scope (Berger, Demsetz and Strahan, 1999). Appendix 2 summarises selected studies which have tested for economies of scale in individual European countries.

Altunbas and Molyneux (1993) test for scale and scope economies for French, German, Italian and Spanish banks for 1988. Using the translog cost function, they regress the logarithm of total costs on the natural logarithm of output and the natural logarithm of input prices. Separate estimations are carried out for samples of 201 French banks, 196 German banks, 244 Italian banks and 209 Spanish banks, and for banks in the asset size bands \$0-\$100miliion dollars, \$100-\$300million, \$300-\$600 million, \$600-\$1000million, \$1000-\$3000 million, and greater than \$5000 million. Economies of scale are found in all banking markets. For Italy, economies of scale

[18] A full discussion of issues of measurement of output and inputs, and the specification of cost functions (such as Cobb-Douglas, Trans-log etc. are given in Kolari and Zardkoohi (1987), chapter 2. Berger, Hunter and Timme (1993) and Berger and Humphrey (1997) give a detailed review of the research in US markets, while Molyneux et al (1996) provides a synthesis of the European literature.

are found for the sample as a whole and for each size band. For Spain economies of scale are found for banks with assets less than $100million. For France economies of scale are found for the sample as a whole and for banks with assets below $3000million. No significant evidence of economies of scale is found for German banks, although there is some weak evidence of diseconomies of scale at low levels of output.

The authors also examine whether there are scope economies between loans and securities in each of the four countries. For Spain, there are substantial economies of scope for banks with total assets between $0-$1000m, and for the sample as a whole. Significant diseconomies of scope are found for the smallest Italian banks (confirming the earlier findings of Baldini and Landi, 1990), and for the largest French banks (confirming the earlier findings of Dietsch, 1993). The study also finds diseconomies of scope for German banks with assets below $1000million and for the sample as a whole. '*The results suggest noticeable differences in cost characteristics across European banking markets and evidence of economies of scale and scope.*' [19]

Allen and Rai (1996) test for economies of scale over the period 1988-1992, using a sample of 194 banks drawn from 15 countries. They find that scale economies exist for banks with assets less than ECU 10 billion. Banks with asset size between ECU 10 billion and ECU 100 billion experience constant costs, while diseconomies of scale are experienced for banks with assets greater that ECU 100 billion.

Vennet (1998) uses a translog functional form to examine cost and profit efficiency for a sample of 2375 EU banks drawn from 17 countries over the period 1995-1996. He splits the sample into universal and specialist banks, and finds that universal banks are more cost and profit efficient than their specialist counterparts. Vennet's overall estimates of scale economies are similar to those found by Allen and Rai (1996).

[19] Altunbas and Molyneux (1993), p.15.

Altunbas, Molyneux, Gardener and Moore (1999) add to the literature by testing for scale economies for a large sample of European banks over the period 1989-1996. Using the Fourier flexible form and stochastic frontier methods, the authors test for scale economies, x-inefficiencies and technical change. They find that scale economies are prevalent across all countries sampled ranging between five and ten per cent. Furthermore, these economies tend to increase with bank size. Some evidence is also found of substantial x-inefficiencies which tend to vary by country, size class and time period examined.

The authors conclude that:

' *This suggests that banks can obtain cost savings through reducing managerial and other inefficiencies and also by increasing the scale of production* '[20]

The early research tends to find that economies are exhausted at low levels of production. More recent research for US and European banks have found stronger evidence of scale economies for large banks (Berger and Humphrey, 1997 and EU, 1997a). In a review of 133 studies, Berger and Humphrey (1997) note that in the majority of cases, larger banks are more efficient than their smaller counterparts. The literature suggests that x-inefficiencies are also often important (Berger, Demsetz and Strahan, 1999).

Overall, there appears to be potential scale economies available to banks by increasing the scale of their operations. If these economies are realised, it is likely to lead to European banking markets becoming increasingly concentrated.[21]

The scale economies hypothesis concerns the number of banks that can operate given existing cost and demand conditions. However, it says little about the inequalities between bank sizes, suggesting that other forces may also be important in shaping industry structure.

[20] Altunbas et al (1999), p.13.
[21] EU (1997a) and chapter 2 of this thesis provide an extended discussion of these issues.

4.3.2 Entry and Exit

Several barriers to entry are likely to feature quite prominently in the banking industry. This section examines the four main barriers proposed by Bain (1956) (economies of scale, cost advantages, product differentiation, and capital requirements) in the context of banking.

Economies of scale can act as a barrier to entry if a new bank cannot produce at the minimum efficient scale. If a new bank enters below the minimum efficient scale, it will do so at higher costs, making entry unprofitable. EU (1997a) finds that banks entering at below the minimum efficient scale are likely have average costs which are around 5 per cent higher than those of established counterparts operating at the minimum efficient scale.

Absolute cost advantages arise due to superior managerial ability, preferential access to an important input, or learning economies of scale, causing costs of offering banking products and services to fall over time as the organisation becomes more experienced. As a consequence, a new bank will incur higher costs due to lack of experience.

Capital requirements can act as a barrier in two respects. Firstly, the EU Second Banking Directive, passed in 1988, requires that any new bank must have a minimum capital base of ECU 5 million. Secondly, large investments are required to invest in the necessary technology to meet the day to day demands of the banking business.

Product differentiation advantages can create a barrier to entry in three ways. Firstly, a bank which is established and built up a reputation over time is likely to enjoy the loyalty of customers (Neven, 1990). Ballarin (1986) asserts that ' ... *it is hardly surprising that image plays such a decisive role in financial services. After all, confidence has always been a key element for a banking system based on fractional reserve. What we are learning now are the important side effects that this confidence may have. Public trust has always been advocated to foster the necessary stability of the financial system. In a deregulated environment enhanced reputation may also turn out to be a powerful competitive weapon for a particular organisation, if used* *wisely.*' [22] Secondly, barriers may arise if substantial switching costs are involved in moving from one bank to another (Klemperer, 1987 and Vives, 1991b). Finally, if incumbent banks proliferate branches across geographical space, or products over product space, it becomes difficult for new banks to enter the market (Schmalensee, 1978).

Using data for 184 banking markets (based on the Standard Metropolitan Statistical Area for the period 1968-1974), Rhoades (1980) examines the effects of entry on competition in banking markets. He uses two measures of the extent of competition, namely mobility and turnover. Mobility is measured by the number of times the top five banks changed their rank over the sample period, while turnover is measured by the number of times banks which are not in the top five moved into this category over the sample period. Entry is measured in three ways. Firstly, net entry is the number of new banks entering minus the number of banks exiting. Secondly, significance of entry is the total number of new entrants as a percentage of the total number of banks operating. Finally, a dummy variable is included to distinguish between banking markets that experienced net entry and those that did not. As additional explanatory variables, Rhoades includes concentration, market growth, market size, numbers of mergers, and dummies for unit and branch banking markets. He finds that entry does not affect competition in the markets sampled. However, concentration and mergers tend to have a negative impact on competition, while market growth has a positive effect.[23]

4.3.3 Technological Change and Industry Life Cycles

Changes in technology, customer attributes and the natural life cycle of an industry can influence concentration. Revell (1987) identifies certain trends in the evolution of the banking industry, which are common to all major industrialised countries. Two types of bank were operating at the beginning of the 20th century. The first were banks in larger towns, which financed the activities of domestic and international business, while the second were smaller banks responsible for the financing of small firms and industries. Banking activity tended to be on a single (unit) bank basis. Originally most bank growth was internal, but as growth opportunities were exhausted and bank

[22] Ballarin (1986), p.223.
[23] See Rose (1987), chapter 3 for an extensive review of entry studies in the US.

failure became more common, growth began to take place by merger and acquisition (as smaller banks were rescued from failure by their larger and more successful counterparts). Banks in large towns generally had more opportunities to grow, due to access to larger markets.

The industrial revolution led to the growth of large industrial firms, and as a result banks had to grow in size to keep pace with the capital requirements of these firms.
' Just as banks became large to provide the funds needed by their large customers, so they had to spread their presence geographically. '...This was perhaps the first critical point in the development of a modern banking system.' [24]

Revell argues that until the 1920s, the size of an individual bank depended on three factors: the size and wealth of the market area served, the size of its largest customers, and the growth and concentration of industry. Eventually this led to what Revell terms a 'core' group of banks that were so big that governments could not allow them to fail, lest the rest of the financial system crash. Revell argues that these banks were instrumental in the evolution of the financial system and responsible for supporting industry and commerce. [25]

Rybczynski (1988) also draws links between the evolution of manufacturing and the development of the banking industry. He identifies three phases in the evolution of the banking industry: the bank orientated, the market orientated and the securitisation phases. In the bank orientated phase, industrial and service sector firms raised external finance in the form of loans from banks, and the banks decided which firms could grow. In the market orientated phase, industrial firms raised some external finance directly on the open market. If successful these firms gained access to large amounts of capital, and investors gained ownership stakes in the firms. Finally, in the securitision phase, industrial firms raise most of their capital through capital markets, while banks are involved in off-balance sheet activities and the underwriting of equity issues. This phase coincides with de-industrialisation or re-industrialisation with large amounts of capital required to invest in new and possibly risky industries.

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[24] Revell (1987), p.20.
[25] See Kindleberger (1984) for a related discussion.

Crucial in dictating the pace at which the banking industry evolves is the role of technology. Revell (1987) argues that although new technologies such as electronic banking give banks the opportunities to expand and exploit economies of scale and scope, it may also give smaller banks an advantage. As technology becomes less expensive, small banks can start to offer services similar to those of large banks. As the smaller banks do not incur the costs of maintaining a large branch network, they may be able to do so at lower cost than the large banks.

Several empirical studies have examined the life cycle of individual banking markets investigating trends in concentration over time. Aliber (1975) examines concentration in international banking over the period 1965-1974. As a measure of concentration, Aliber uses the percentage of total deposits of the world's 100 largest banks accounted for by the ten and twenty largest banks. Over the period, concentration amongst the top banks remained relatively steady.

Tschoegl (1982) uses assets data (at two yearly intervals) for the world's largest banks over the period 1969-1979. Six measures of concentration comprising three static measures and three dynamic measures are used. The static measures include the Herfindahl-Hirschman Index, Entropy Index and an index to reflect bank dominance. The dynamic measures reflect the stability of a bank's market share over time, the relationship between bank size and growth, and correlation coefficients between successive growth rates. In contrast to Aliber, Tschoegl finds that concentration fell during the 1970s in all countries.

Rhoades (1983) examines trends in concentration of banking deposits amongst the world's largest banks, and the stability of the rankings of various countries' banks within this group over the period 1956-1980. Using the total deposits of the 500 largest banks in the denominator, Rhoades calculates concentration ratios for the world's top 100 banks, along with banks ranked (by size) 1 to 5, 6 to 10, 11 to 25, 26-50 and 51-100. He finds that the concentration ratio for the top 100 banks increased from 63.3 per cent in 1956 to 70.5 per cent in 1979. Over the same period, the share of the largest banks fell from 14.3 per cent to 9.4 per cent. Concentration also increased for the other size bands. Country rankings are calculated as the proportion of the deposits of the 100 largest banks controlled by banks from each country. Japan, US, Germany and France were the highest ranked countries. Japanese banks gained the most rapid increase in their share of total deposits over the sample period.

Baer and Mote (1985) examine trends in banking concentration in Canada, France, Germany, Japan, UK and US over the period 1930 to 1980. Using five bank concentration ratios, they find for Canada and Germany, concentration fell over the period, from 84 per cent to 80 per cent, and 44 per cent to 24 per cent respectively. In Japan concentration remained at around 22 per cent, while in the UK it fell from 70 per cent to 68 per cent. In the US and France concentration doubled with increases from 9 per cent to 18 per cent in the US and 41 per cent to 81 per cent in France.

Revell (1987) compares concentration for Germany, Italy, Spain, Japan, Australia, France, Belgium, Ireland, Switzerland and Sweden. Three, five and ten bank concentration ratios are calculated for commercial banking and for the banking industry as a whole. For concentration in the commercial bank industry, Revell finds (with reference to the 5-bank concentration ratio) that all commercial bank industries in individual countries tend to be concentrated, and that this result applies to the banking industries as a whole in these respective countries. The most concentrated banking industries are found in Australia, Sweden, Belgium and Switzerland, while Japan, Italy and Spain are the least concentrated.[26]

Thornton (1991) uses data on the world's 500 largest banks to examine trends in concentration, over the period 1979 to 1989. Concentration ratios are calculated for various groups of banks within the top 500. The share of the top 100 in the total assets of the top 500 declined slightly during the sample period. However, the share of assets accounted for by the top five banks increased from 8.77 per cent to 10.18 per cent. Overall, evidence suggests that aggregate concentration in international banking has fallen slightly over the past twenty years, but certain large banks may be increasing their share of total world deposits.

[26] For a detailed discussion see Revell (1987), p.27.

Overall, most evidence suggests that the majority of developed banking markets have moved from being relatively unconcentrated and technically backward, to technically advanced market structures where a small number of 'core' banks dominate.

4.3.4 Market Growth

The rate of growth of a market will influence the intensity of competition. If there is free entry, then rapid growth is likely to lead to entry which is likely to intensify competition and reduce concentration (Rhoades, 1980). However, if entry is restricted (as in many banking markets) then rapid growth gives incumbent banks the opportunity to expand, leading to more highly concentrated markets dominated by large banks (Smirlock, 1985).

4.3.5 Mergers

Banks may decide to merge for several reasons, namely 1) to achieve economies of scale and scope through the increased size and possibly diversity of operations; 2) to gain enhanced market power by eliminating competitors in the short-run, so prices can be raised in the long-run; 3) to pursue managerial objectives such as growth and size maximisation; and 4) to meet changes in customer attributes. For example, banks have had to increase their international presence in response to the growth of multinational manufacturing firms (Walter, 1988).

A number of studies have investigated whether mergers increase efficiency and improve performance. Most, (but not all), examine performance indicators before and after the merger event. The results have been rather mixed.

Rhoades (1986) using data on a sample of over 4000 US banks compares the performance of banks that were acquired over the period 1968-1984 and those which were not. He finds no difference in performance between the two groups. Spindt and Tarhan (1992) also compare the performance before and after merger of merged banks with non-merged banks for the US. They find that the profitability of many merged banks improved in the years after merger. Shaffer (1992) uses a simulation approach to estimate average cost functions to examine the potential reduction in costs from a merger. His sample includes US banks with total assets greater than $1 billion. He finds that the majority of simulated mergers lead to an increase in costs.

The earliest European studies of Revell (1987) and Berg (1992) find little evidence of efficiency gains through merger. More recently, Vennet (1995) examines the implications for bank conduct and performance using data on 492 take-overs. Mergers are categorised into domestic majority acquisitions, domestic integral acquisitions (a large bank takes over a small bank), domestic mergers among equal partners, and cross border acquisitions. He examines the performance of acquiring, acquired and merged entities using a variety of measures to account for risk levels and profitability. In general, he finds that domestic majority acquisitions result in acquiring banks maintaining above average performance by exercising market power (through increasing interest margins), while acquired banks often under perform compared with industry averages. For integral mergers, the combined values of the merged banks do not differ significantly from their pre merger levels, but liquidity decreases. Vennet speculates that in this type of deal, banks typically, pursue managerial motives such as utility, size and growth maximisation. For domestic mergers between banks of similar size, he finds that the combined bank experienced significant decrease in costs through economies of scale advantages, and improved profitability. Cross border acquisitions normally involve large profitable banks acquiring less efficient banks. After acquisition, the acquiring bank remains profitable, while the acquired bank's performance improves. However, the acquired bank tends to adopt more aggressive lending policies, as technologies and managerial practices are transferred from one bank to another.

Following Shaffer (1992), Molyneux, Altunbas and Gardener (1996) adopt a simulation approach to examine possible efficiency gains arising from hypothetical mergers in Spain, France, Germany and Italy. They find that merger activity in Spain is likely to lead to falling costs as banks realise economies of scale. However, for France, Germany and Italy increased merger activity is likely to lead to higher costs.

Using a case study approach, Rhoades (1998) uses sixteen financial ratios to examine the effects of merger on efficiency and profitability for a small sample of US banks. He finds that in the nine mergers studied, all achieved significant cost cutting objectives. Rhoades also finds that four of the nine merged entities showed substantial efficiency gains relative to the average achieved by banks in the same peer group, while seven of the nine showed improvements in profitability.

Overall, mergers are likely to result in higher concentration (Rhoades, 1980). The empirical evidence on merger suggests that in many cases there is little improvement in the efficiency or performance of the merged entities. It is likely that many mergers take place in order to increase market power (Berger, Demsetz and Strahan, 1999).

4.3.6 Regulation

Governments have felt it necessary to supervise and regulate the activities of individual banks. Regulation is designed to increase the efficiency of banks, while at the same time protect the interests of depositors. Regulators can ensure that banks remain solvent by building up reserves, and ensure that depositors are protected, by instituting deposit insurance schemes, providing lender of last resort facilities and by bailing out failed banks. Given that banking is highly regulated, the nature of regulation is likely to have a substantial effect on the structural composition of the industry.

There are three main types of regulation which may influence the current and future structure of the industry, namely structural regulation, conduct regulation and prudential regulation. Structural regulation seeks to alter or maintain industry structure. Measures include the functional separation of banks into different activities (e.g. commercial banking and investment banking), the imposition of entry barriers including minimum capital requirements and restrictions on the type of business banks can undertake. Regulatory authorities can limit the numbers of banks by placing restrictions on the number of bank licences granted. This type of regulation is likely to make entry into banking markets difficult, giving incumbent banks the opportunity to exercise market power and increase size (Gual and Neven, 1993). Conduct regulation attempts to alter the behaviour of banks. Controls can be imposed on the levels of interest rates, the extent of loans granted and branch expansion. Finally, prudential regulation attempts to safeguard the stability of banks and protect the interests of consumers. Relevant measures include participation in deposit insurance schemes and provisions for the central bank to act as lender of last resort (Baltensperger and Dermine, 1990).

The extent to which regulation increases or decreases concentration depends upon whether the regulator wishes to increase competition (by making it easier for new banks to enter the market), or to increase the stability of the industry (by imposing high minimum capital requirements, which may act as entry barriers).

4.3.7 Strategic Behaviour of Incumbent Banks

Drawing on Porter (1980), Canals (1993) discusses the value chain. The value chain dis-aggregates a bank into its strategically relevant activities, i.e. those that reduce costs or are potential sources of differentiation.[27] Activities can be split into primary and support activities. Primary activities are those which are associated with the physical creation of the product or service. Support activities are those activities that support the primary activities and each other, for example, by providing purchased inputs, technology and human resources. Once the bank's activities have been dis-aggregated, the process of appraisal can take place. Each of the support activities is linked to each of the primary activities to a greater or lesser extent. The analysis examines how these links can be improved in order to increase the margins on each product.

Canals contends that a bank must select and follow a generic strategy to add value, and gain a competitive advantage over competitors. These generic strategies consist of cost leadership, differentiation and focus. Cost leadership is a strategy, by which a bank attempts to keep its costs lower than that of the competition.[28] To do this the bank must identify cost savings at some point in its value chain and produce at lower cost, or alternatively change the structure of the value chain. For example, the bank may be able to strike an exclusive deal with suppliers for raw materials such as auto teller machines. Differentiation is a strategy by which a bank gives its product some unique characteristic that appeals to its customers, leading to higher margins and

[27] Gardener (1992) also applies Porter's work to the EU banking industry. For applications of Porter's ideas to the US banking industries see Ballarin (1986), chapter 2.
[28] Salomon brothers (1993) identify the importance of low costs in determining the success or otherwise of a bank.

profits relative to competitors. Finally, focus is a strategy that can apply to cost leadership and differentiation. In both cases, the strategy requires the bank to focus on a particular segment of the market. In the case of differentiation this may involve gearing a product towards a particular group of customers. Only banks following generic strategies will add value and gain a competitive advantage over rivals.

Competitive advantage can arise in four main areas within the banking industry: human resources, financial resources, physical assets and intangible assets. With human resources, banks can gain advantages through the quality of their workforce or through training. Banks can also build up financial resources to become large and exercise market power or realise efficiency gains from building up the capital base or total deposits. By using physical assets (such as branch networks, information systems and telecommunications systems), or intangible assets (such as brand image, experience, managerial talent, and product and service quality), banks can gain and sustain a competitive advantage over rivals. This will lead ultimately to a market structure where a few large banks dominate.

4.3.8 Stochastic Factors

The discussion thus far has assumed that bank can grow either through superior efficiency, access to economies of scale and scope, or by deterring entry of rival banks. Whatever the reason, the consequence is an increasingly concentrated market structure. However, industries can become concentrated even if banks do not have efficiency or market power advantages. If bank sizes are the result of random influences, this can eventually lead to a skewed size distribution of banks. In other words if the distribution of growth rates in any year is independent of size, over time some banks will be lucky and become large, while others will be unlucky and decline. These arguments are embodied in The Law of Proportionate Effect (LPE) (see section 3.4.6). There are few empirical studies which test the LPE explicitly with respect to banking. However, there has been some research on the relationship between bank size and growth.

Alhadeff and Alhadeff (1964) compare the growth of the top 200 largest US banks in the US over the period 1930-1960, to the growth of the total banking industry assets. The authors use three separate samples, namely 1930-1960, 1940-1960, and 1950-1960, so the identity of the top 200 banks at the start of each period is different.

To compare the growth of the largest banks to the growth of banks across the entire market, the authors calculate the ratio of the growth of the large bank group to the average growth of all banks. For each of the three periods studied, they find that the large bank group grew more slowly than average.

To examine the relationship between size and growth on a dis-aggregated basis, the sample of 200 banks is split into ten sub-groups based on initial size. The mean growth rate for survivors in each decile is expressed as a percentage of the mean growth rate of all banks in the top 200. They find that in general smaller banks enjoyed higher growth than their larger counterparts.

Rhoades and Yeats (1974) examine growth, concentration and merger activity in the US commercial banking industry over the period 1960-1971. Using a sample of 600 banks they distinguish between internally generated growth and external growth by merger. The latter is isolated by removing the deposits of acquired banks from the assets of the acquirer. It is assumed that the acquired bank would have grown by the average for the entire industry until the end of the sample period. Splitting the sample into six bands, they find that banks in the smallest and largest bands experienced the slowest growth. A regression of size in the terminal period on size in the initial period yields a slope coefficient of less than unity, implying that smaller banks grew faster than larger banks. Merger is found to be the most important source of growth for banks in the largest size group. When this growth is removed, the internal growth of the largest banks is found to be well below that of the smallest banks. However, internal growth is very high for medium sized banks.

Yeats, Irons and Rhoades (1975) examine growth for a US sample of 48 new banks which entered over the period 1960 to 1963, and the subsequent growth of these banks over a ten year period. They argue that one should expect some similarities in the patterns of growth between these banks for three reasons. Firstly, banking services tend to be homogenous, so one would expect banks to charge similar prices and grow at similar rates. Secondly, the extent to which banks can compete with each other is tightly regulated. Thirdly, banks naturally locate in markets which give them maximum access to a large pool of customers. Given that banks seek to capture similar types of business, they will tend to locate in similar markets. If banks are uniformly distributed geographically, then they will tend to capture similar shares of any existing or new business.

Yeats et al model bank growth, using age, average changes in disposable income for the market which each bank serves, and the number of entrants as explanatory variables. They find a positive relationship between growth and bank age, and changes in disposable income. Entry is found to have a negative effect on bank growth.

Yeats et al argue that the model can be used by managers and regulators to examine deviations of actual from expected growth rates. Regulators can use the model to intervene if a bank seems to be in trouble, while managers of banks can use it to judge when to raise capital.

Alhadeff and Alhadeff (1976) examine the growth up to 1970 of 986 new banks that entered the US banking industry between 1948 and 1966. They explain bank size in 1970 using environmental factors common to all banks, internal factors specific to a bank and the number of years since entry as explanatory variables. They argue that in banking markets internal factors are likely to be less important because of tight regulation that constrains the activities of management. External factors therefore tend to determine the growth and performance of banks. Such factors may include restrictions on entry of new banks, branch expansion, and the size and structure of banks' assets and liabilities. Consequently, banks that are successful in identifying areas where regulation is conducive to growth will be successful.

Variables capturing entry restrictions, restrictions on branch expansion, market growth, the size of local markets, and a time trend (to control for learning effects) are found to have a positive effect on bank growth.

The authors examine the robustness of the results to see whether new banks which have entered unit banking states had different growth experiences to those which entered branch banking states. They find that restrictions on branching and market growth do most to explain the positive growth rates enjoyed by new banks in branch banking states, while market growth did most to explain the growth of new banks in unit bank states.

The size of branch banks at the end of the period was found to be around 10 per cent higher than that of unit banks, perhaps because the former can open branches. However, unit banks were four times more likely to survive than banks operating in branching states.

Tschoegl (1983) investigates the relationship between size and growth for a sample of large international banks. He tests three hypotheses relating to the LPE, namely that the growth rates are independent of bank size, variability of growth rates in bank size is independent of initial size, and growth rates do not persist from one period to the next. Tscheogl argues that if these propositions hold concentration will increase over time. '*This result is due strictly to the workings of chance and requires no assumptions about the behaviour of firms or managers, economies of scale, or monopoly advantages.*'[29]

Tschoegl uses total assets as a measure of size.[30] The data consists of 100 banks in the years 1971, 1973, 1975 and 1977. He estimates four equations, using book value of assets and market value of equity as size measures. He also allows for serial correlation in growth rates (by including lagged growth terms) and national differences in the size-growth relationship (using dummy variables).[31] Tschoegl finds that initial size is unrelated to final size, thus lending support to his first hypothesis, implying that concentration is likely to increase over time.

[29] Tschoegl (1983), p.189.
[30] Tscheogl augments this measure by using equity in some estimations. The equity measure is included to allow for some of the difficulties in using the asset measure of bank size. These problems mainly relate to differing accounting practices across countries. The author argues that some countries allow banks to keep hidden reserves that allow them to smooth performance from year to year. He argues that this can bias the estimated coefficients towards accepting the LPE.
[31] The three equations using assets as a measure of size were carried out by regressing size in 1977 on 1975, 1975 on 1973, and 1973 on 1971. The equity equation was carried out by regressing size in 1977 on size in 1973.

To examine whether the variability of growth is independent of the bank size, Tschoegl regresses the estimated (absolute) residuals on initial bank size. He finds that variability of growth declines with size in all equations, implying that smaller banks tend to exhibit more variable growth rates than large banks. This suggests that big banks are less risky than small banks.

Tschoegl finds a weak positive, but insignificant relationship between growth rates in successive periods, implying that growth in one period does not act as a good predictor of growth in subsequent periods. Consequently, banks find it difficult to sustain above average growth over several time periods. This suggests that financial innovation or superior management talent is weak or absent.

Tschoegl finds a positive relationship between size and transnationality, but also finds that growth and transnationality are unrelated. He argues that if banks become more transnational as they grow, then they are likely to be subject to more random shocks, which leads to the acceptance of LPE. The variability of growth in book assets is positively related to transnationality, but negatively related to equity. A positive relationship suggests banks engaging in foreign activities are likely to have more variable growth rates than banks specialising in domestic operations. In contrast, a negative relationship suggests that transnational banks are likely to be more diversified, and benefit by pooling risks across several markets.

Tschoegl concludes that because banks growth rates tend to be less variable for larger and transnational banks, there should be scope for regulation which takes account of differences in the risk profile of large and small banks.

Overall, the evidence as to whether the operation of the LPE shapes the structure of banking industries is somewhat limited. On balance, the available evidence suggests that size is unlikely to enhance a bank's growth opportunities through economies of scale or other efficiency advantages, but may aid in smoothing the variability of growth.

4.4 Conclusions

This chapter has discussed the application of industrial organisation theory to the empirical analysis of competition in banking. In particular the role of market structure in determining the performance of banks, and the forces which in turn may determine banking market structure have also been explored. When analysing SCP relationships in banking, substantial evidence supports the view that concentration levels and barriers to entry influence performance. Among the determinants of market structure, the evidence on economies of scale is mixed. In contrast to manufacturing, there is some evidence that high growth leads to increasing concentration in banking. There is also evidence that technological advance and changes in customer attributes lead to increased concentration, as banks grow to meet new competitive challenges. Finally, some evidence suggests that stochastic forces play a part in shaping banking market structure, evidenced by the failure to reject the LPE in the Tschoegl (1983) study. No evidence for the LPE exists for European banking markets. Given the limited attention devoted to testing the LPE, the rest of this thesis aims to estimate and simulate stochastic models, which examine the relationship between size and growth, in order to test whether it is possible to reject the idea that growth is determined independently of size. The following chapter gives an overview of the empirical literature that tests the LPE for manufacturing industries.

CHAPTER 5

THE RELATIONSHIP BETWEEN SIZE AND GROWTH, AND THE LAW OF PROPORTIONATE EFFECT IN MANUFACTURING INDUSTRIES

5.1 Introduction

Market concentration is the proportion of an industry's total assets, sales or employment that is controlled by its largest firms. Traditional industrial organisation literature suggests a number of factors can cause industries to be dominated by a few large firms. Such factors include entry and exit barriers, economies of scale or the adoption of entry deterring strategies to prevent the growth of rival firms. Typically, this literature suggests that large firms are likely to gain a competitive advantage through enhanced efficiency or market power, which enables them to grow at faster rates than their smaller rivals, and which tends to lead to a market structure in which a few large firms dominate.

However, industries may evolve into concentrated structures even if size does not enhance a firm's growth prospects. Gibrat (1931) investigates the implications if each firm's growth in any year is determined randomly, and is therefore independent of its size and its growth in previous years. He shows that this non-relationship between growth and firm size has important consequences for changes in concentration and market structure over time. According to the Law of Proportionate Effect (LPE hereafter), the factors which influence a firm's growth, such as growth of demand, managerial talent, innovation, organisational structure and luck, are distributed across firms in a manner which is essentially random. This results in a firm size distribution that becomes increasingly skewed towards a small number of large firms. Previous research has found that this process accords well with the actual size distribution of firms observed in many real world industries.[1]

1 Quandt (1966), Silberman (1967) and Clarke (1979) test how closely the actual size distribution of firms in particular industries conform to a family of skewed distributions including the lognormal, Yule and Pareto distributions.

The following chapter describes the literature which follows from Gibrat's original contributions. The chapter is organised as follows. Section 5.2 illustrates by means of a simple example, how stochastic influences can cause the concentration of industry to increase over time. Section 5.3, discusses previous empirical studies which have sought to test the LPE. This section is split into two subsections to reflect the different methods used to test the LPE. Section 5.3.2 describes tests of the LPE between two time periods by means of log-linear regression analysis. Section 5.3.3 describes tests for the LPE using cross sectional data collected at a single point in time. This research compares (through the use of goodness of fit tests) the actual size distribution of firm sizes with a family of theoretical skewed distributions that would be generated if the industry had evolved through the influence of random shocks. The LPE is judged to hold when the actual size distribution of firms corresponds closely to the theoretical distribution. Section 5.4 concludes.

5.2 Absolute and Proportionate Growth of Firms And Market Concentration

Several economists have noted the importance of random factors in determining the growth of firms. Sherman (1974) uses Schwed's (1965) ' *great coin flipping contest* ' to illustrate how inequalities can arise over time.

' *The referee gives a signal for the first time and 400,000 coins flash in the sun as they are tossed. The scorers make their tabulations, and discover that 200,000 people are winners and 200,000 are losers. Then the second game is played. Of the original 200,000 winners, about half of them win again. The third game is played, and of the 100,000 who have won both games half of them are again successful. These 50,000, in the fourth game are reduced to 25,000, and in the fifth to 12,500. These 12,500 have now won five straight without loss and are no doubt beginning to fancy themselves as coin flippers. They feel they have an 'instinct' for it. However in the sixth game, 6250 are disappointed and amazed they have finally lost, and perhaps some of them start a Congressional investigation. But the victorious 6,250 play on and are successively reduced in number until less than a thousand are left. This little band have won nine straight without a loss, and by this time most of them have at least a local reputation for their ability. People come from some distance to consult them about their method of calling heads and tails, and they modestly give explanations of how they have achieved their success. Eventually there are about a dozen men who have won every single time for about fifteen games. These are regarded as the experts,* *the greatest coin flippers in history, the men who never lose, and they have their biographies written.'*[2]

Sherman argues that it is important not to regard all large firms as successful and efficient; to do so is like treating coin flippers as skilled. In many cases, luck may have a significant effect on the growth of firms.

Prais (1976) argues that random shocks can lead to a greater dispersion of firm sizes over time even if large firms are not growing any faster than small firms over time. He demonstrates this by a 'Special Theory' where all sizes of firm have the same chances of absolute growth in any time period. He later modifies this assumption to that of proportionate growth.

The example involves a hypothetical industry that consists of 128 firms, each employing 100 employees. Firms are governed by a growth process, where in any year 50 per cent remain the same size, 25 per cent increase in size by 10 workers and 25 percent decrease in size by 10 workers. Table 5.1 shows this process over a three year period. For example, at the end of year one, there are 32 firms with 90 employees, 64 firms with 100 employees, and 32 firms with 110 employees. Total industry employment is still 128,000 workers. However, total industry employment is distributed in differing proportions across the industry.

The final column of Table 5.1 shows the concentration ratio for the 10 largest firms in each of the four years. Concentration has increased from an initial value of 7.81 per cent in year zero to 9.53 per cent at the end of year three. Prais observes that '*The dispersion of the distribution thus grows inexorably as time proceeds as a result of spontaneous drift (the sizes of firms follow a random walk, as sheep which have no shepherd).'*[3]

Prais contends firms may have an equal chance of growing by the same proportionate amount. This type of growth process can cause concentration to grow more rapidly than under the

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[2] Schwed (1955), p.160-161 (quoted in Sherman, 1974, p.9)
[3] Prais (1976), p.26.

Table 5.1: Growth Processes of 128 firms for three years under the assumption of equal absolute growth rates

	Firm Size (number of employees)								
Year	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**mean**	CR_{10}
0				128				128	7.81
1			32	64	32			128	8.59
2		8	32	48	32	8		128	9.22
3	2	12	30	40	30	12	2	128	9.53

Table 5.2: Growth Processes of 128 firms for three years under the assumption of proportionate growth

	Firm Size (number of employees)								
Year	**75.13**	**82.64**	**90.9**	**100**	**110**	**121**	**133.1**	**mean**	CR_{10}
0				128				128	7.81
1			32	64	32			128.29	8.57
2		8	32	48	32	8		128.58	9.24
3	2	12	30	40	30	12	2	128.89	9.58

Notes: The example above has been adapted by the author from Prais (1976).

In Table 5.2, under the assumption of proportionate growth there is a slight increase in the mean industry employment as time proceeds from year 0 through to year 3. (see Prais, 1976, chapter 2, note 4.)

assumption of absolute growth. Table 5.2 shows this process. The starting point is the same as in the previous example, but this time 50 per cent of firms in any period stay the same size, while 25 per cent grow by 10 per cent and 25 per cent decline by 10 per cent. The process of proportionate growth leads to an increase in the mean employment in the industry. After year three concentration has increased from 7.81 per cent to 9.58 per cent (compared to 9.53 per cent in the previous example).

If this process continues for long enough the size distribution of firms will approximate the lognormal distribution, which is very close to the actual size distribution of firms observed in many industries.[4]

Hannah and Kay (1977) use the following gambling analogy to describe the above process.
'.... *if a group of rich men and a group of poor men visit Monte Carlo, it is likely that some of the rich will become poor and some of the poor become rich: but it is also probable that some of the rich will get richer and some of the poor will get poorer, so that the extent of inequality within each group and over the two groups taken together is likely to increase. The process works to increase industrial concentration in much the same way.*'[5]

The LPE in its general form ignores many systematic factors that may affect firms' growth prospects and the size distribution of firms within an industry. These factors include the entry of new firms and exit of established firms, mergers and acquisitions, persistence of individual firm growth rates through time, the potential to exploit economies of scale and potential entry. These are now discussed.

Entry and Exit

The LPE in its simplest form takes no account of entry of new firms and exit of established firms. Most empirical studies report results on samples of firms that have survived over the entire period of the investigation, consequently, taking no account of the size-growth relationship for non-

[4] See Aitchison and Brown (1966) for an extended discussion of the lognormal distribution.
[5] Hannah and Kay (1977), p.103.

surviving firms. If chances of survival are inversely related to initial size and subsequent growth, estimation using a sample of surviving firms may introduce a selection bias (Mansfield, 1962).

Mergers

The LPE focuses on growth from internal sources, and has little to say about growth from acquisitions and mergers. Evidence suggests that the chances of take-over and merger are related to size (Dunne and Hughes, 1994).[6]

Persistence of Growth

The LPE assumes the growth rates of firms are independent in successive periods. However, in reality, the effects of managerial efficiencies are likely to carry forward across more than one time period. If there is a positive correlation in growth rates between successive periods, the observed relationship between size and growth is likely to be biased upwards (Chesher, 1979).

Attainment of the Minimum Efficient Scale

The LPE also assumes that firms face flat cost curves. However, according to microeconomic theory, most industries are characterised by U-Shaped cost curves, in which case firms must reach the industry minimum efficient scale (MES) to ensure survival (Stigler, 1958).[7] The extent to which the LPE operates may depend on the size classes of firms that are examined. Small firms must pursue rapid growth to reach the MES, or die through bankruptcy or take-over. In contrast, large firms which have reached the minimum efficient scale are unlikely to grow as fast, since they could encounter the disadvantages associated with diseconomies of scale. Consequently, the LPE is more likely to hold for large firms which have already reached the minimum efficient scale (Simon and Bonnini, 1958). This implies that some threshold for firm size may exist below which the LPE does not hold (Davies and Lyons, 1982).

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[6] Several authors most notably Kumar (1985) have attempted to examine the growth process of individual firms from internal and external courses. See section 5.3.1 for a discussion of such issues.

[7] Chapter 3 provides a discussion of these issues.

Heteroscedasticity in growth rates

The LPE assumes that growth rates are homoscedastic for firms of all sizes. However, larger firms are likely to pursue a strategy of diversification, and so can spread risk over a large number of production activities. This ensures stability in growth over time (Singh and Whittington, 1968). Larger firms are also likely to be older than smaller firms, so may experience learning economies of scale which enable them to avoid making costly mistakes. Such benefits are unlikely to be available to smaller firms, which are also often younger, and through inexperience more likely to make mistakes (Jovanovic, 1982).

It may also be the case that the prevailing type of competition influences the variability in growth rates of firms. For example, in industries that are characterised by a high degree of non-price competition, firms will be subject to more variable returns. This is because the outcomes of product and process innovations are uncertain, and so are likely to exert a random effect on individual firm growth rates (Weiss, 1963).

Entry and Exit Barriers

The LPE ignores barriers to entry and exit. Entry may be at its largest in smaller size groups as small firms are born (Simon and Bonnini, 1958). However, the model does not recognise the implication if large firms enter in order to diversify, causing concentration to increase (Davies, 1989). The problem of unobservable entry (as in the contestable markets literature), where incumbent firm behaviour is constrained by actions of potential entrants, is also ignored (Baumol, 1982).

Section 5.3 Review of Previous Studies

Empirical research that has tested the LPE has used comprehensive data sets, and various econometric techniques. The research is grouped into two categories. The first approach uses samples of firms to test LPE using log-linear regression, to examine the relationship between the size and growth of firms between two time periods. There is extensive evidence for manufacturing in the UK and US, and there is also some evidence for Germany, Austria and Italy. Results have been mixed with early studies finding no relationship between size and growth, or a positive relationship between firm size and growth. More recent studies find that small firms grow faster with more variable growth rates. Testing procedures have become progressively more sophisticated, with many authors drawing links between evolutionary learning models (where younger less experienced firms enjoy less stable growth than their larger counterparts), and more traditional arguments based on economies of scale and strategic behaviour. These studies are reviewed in section 5.3.1. The second approach adopts a static approach, examining the frequency distribution of firm sizes. Using goodness of fit tests, it is possible to test how closely the observed, often skewed firm size distributions approximate to a set of skewed distributions (such as the lognormal, Pareto and Yule) which are the outcome of a random data generating process. There is evidence for the US, UK, Sweden and former socialist countries. This research is reviewed in section 5.3.2.

<u>5.3.1 Empirical Studies which use the Log Linear Formulation to test LPE</u>

This section outlines studies that have used the log-linear regression model to test the LPE. These studies vary in terms of data and geographical coverage, and method of investigation. The section, also describes the various data and methodological difficulties associated with testing for the LPE.

In the main researchers in this area have tested a log-linear regression of the general form.

$$s_{it} = \beta_1 + \beta_2 s_{it-1} + u_{it}; \qquad E(u_{it}) = 0 \text{ and } var(u_{it}) = \sigma_{it}^2. \qquad (1)$$

s_{it} is some measure of firm size (in natural log form). Interpretation of β_1 depends on whether β_2 = 1 or β_2 < 1. β_2 reflects the relationship between firm size in the current and the previous period, and σ_{it} measures the dispersion of firm growth rates relative to mean size. If β_2 = 1, there is no relationship between size and growth, and so LPE holds. If β_2 < 1, small firms tend to grow faster than larger firms. If β_2 > 1, the opposite applies.

Hart and Prais (1956)

In a seminal paper, Hart and Prais (1956) analyse trends in concentration for the period 1885 to 1956, using a sample of firms quoted on the UK Stock Exchange. The number of firms varies over time, ranging from 60 firms in 1885 to 2,103 firms in 1956. Firm size is measured as the stock exchange valuation of the firm.

Transition matrices are used to examine the mobility of firms over time. The sample period is split into five sub-periods of approximately fifteen years each. They find that for firms that survived in each of these time periods, the dispersion of firm sizes increased, implying increasing concentration.

Hart and Prais carry out a log-linear regression analysis of opening firm size on closing firm size for the periods 1885 to 1896, 1896 to 1907, 1907 to 1924, 1924 to 1939, 1939 to 1950. For periods up to 1939, $\hat{\beta}_2$ is approximately unity, but from 1939 onwards the value is below unity. The authors argue that industry concentration in the UK was increasing up to 1939 through the operation of LPE, but stabilised after this point as smaller firms grew faster than their larger counterparts.

Hart (1962)

Hart (1962) asserts that if LPE is valid, the following must hold. Firstly, large, medium and small firms have the same average proportionate growth. Secondly, dispersion of growth rates around this mean level is equal for all sizes of firms. Thirdly, the distribution of firm sizes follows a lognormal distribution. Finally, the relative dispersion of firm sizes increase over time.

Using gross profits minus depreciation as a measure of firm size, and a data set consisting of UK firms drawn from four industries over various time periods, he finds no differences in the mean profit growth of small and large firms.[8]

[8] The sample consists of 40 brewing firms covering the period 1931 - 1932 to 1937 - 1938 (comprising 22 small and 18 large) , 36 cotton spinning firms covering the period 1937 and 1938 (comprising 18 large and 18 small) 124 firms from the drinks industry, 1950 and 1954 (comprising 57 small and 67 large). Hart also uses a data set of 229 unquoted firms (comprising 113 large and 116 small).

' These results are consistent with that part of the law of proportionate effect which states that on average the proportionate growth of firms is the same irrespective of whether they are large or small.'[9]

However, Hart does find that the dispersion of growth around the common mean differs for large and small firms in the brewing industries, with large firms experiencing more variable growth.

Hart plots the sizes of firms between 1950 and 1955 for a sample of 1981 firms, to test whether the distribution is lognormal. He finds that departures from lognormality are modest, and that the variance of the size distribution increases over the period. He carries out a regression of the variances in 1955 firm size, on the variance of firm size in 1950, (for a sample of 1981 quoted firms), and finds that the coefficient is close to unity, implying that size in the two time periods is unrelated.

' We should expect the growth or decline of a firm to depend on the quality of its management, on the tastes of its customers, on the development of techniques, on government policy, and on many other forces. But if the argument of this paper is accepted, we should expect these influences to account for a relatively small part of proportionate growth of firms. There will be a long list of causes - the weather, the international political situation, the import policy of countries overseas and many more - some making for growth, some making for decline, but together apparently acting randomly on the sizes of firms.' [10]

Hymer and Pashigian (1962)

Hymer and Pashigian (1962) examine the relationship between firm size and growth for a sample of 1,000 large US firms. The growth rate of an individual firm is measured in terms of changes in asset size over the period 1946 to 1955. The authors divide the 1,000 firms into ten industrial groupings. The sample is split into size quartiles, and the mean growth rates and standard deviations of these respective quartiles are calculated. They find that mean growth rates of firms are unrelated to size, but that dispersion of growth tends to be negatively related to firm size. This

[9] Hart (1962), p.33.
[10] Ibid., p.39.

contradicts earlier arguments of Simon and Bonnini (1958), who assume that all firms in an industry are subject to the same costs (see section 5.3.2). In contrast, Hymer and Pashigian's findings imply that costs tend to decline with firm size, either as a result of economies of scale or diversification advantages held by large firms.

Mansfield (1962)

Mansfield (1962) tests the LPE for the US tyre, petrol and steel industries over ten sub-periods.[11] He classifies firms by their initial size and computes a frequency distribution of growth rates within each size class. He then carries out a chi-squared test for each of the size classes to determine whether the observed frequencies of firm sizes were equal in all classes.

The role of firm exit in driving the relationship between size and growth is analysed by evaluating three different versions of the LPE. Version one tests LPE for all firms in existence in a given time period, even if some firms did not survive to the end of the period. In seven out of ten cases tested, the LPE does not hold. This is because the chances of firm failure or exit do not operate equally for all size bands of firms. Version two tests the LPE for firms that survived for the entire period under investigation. He finds that the LPE holds. Version three examines the proposition that the LPE should hold for firms whose size is equal to or above the industry minimum efficient scale (MES). In this case, the LPE holds to the extent that firms have equal mean growth rates, but the dispersion of these growth rates is more variable for small firms.

Following the work of Simon and Bonini (1958), Mansfield examines the size mobility of firms in his sample. He finds that the probability of an initially small firm growing to be larger than a larger

[11] Steel industry data covers the period 1916 to 1957, petrol industry data covers the period 1921 to 1957, and tyre industry data covers 1937 to 1952. Size is measured in tonnes for steel, employees for tyres, and barrels for petroleum. Steel is split into four sub-periods, petrol into four and tyres into two.

counterpart, is greater, the smaller the initial difference in market share. Overall, the results suggest that small firms are more likely to die than large firms, and those which do survive tend to have higher and more variable rates of growth. Overall, this was the first study to formally reject the LPE.

Samuals (1965)

Samuals (1965) presents results for a sample of 400 UK manufacturing firms covering the period 1951 to 1960. Net assets (total assets minus current liabilities) are used to measure firm size.

The sample is split into four size groups. Samuals finds a significant difference in the mean growth rates across the four groups. He constructs bivariate size distributions of firms yielding fifteen net asset size groupings over two periods, 1950/1951 and 1959/1960 (the upper limit of each size grouping being twice the lower limit), and finds a positive skew in firm sizes. The author tests the LPE by regressing the variance of firm growth in 1959/60 on variance of firm growth in 1950/1951. The LPE fails (with an estimated coefficient equal to 1.07), implying that (over the period sampled) larger firms grew faster than small firms. He uses the standard deviation of the growth equation as a measure of the mobility of firms throughout the period and finds a value of 1.38 implying some level of competition. He compares these findings with those of Hart and Prais (1956) of 0.99 and Hart (1962) of 1.24. Samuals' results tend to contradict the earlier findings of Hart (1962) that the LPE held between 1950 and 1955. Samuals' results could be reconciled with those of Hart (1962) for his post 1956 sample, if it was the case that from 1956 onwards, larger firms grew faster than small firms.

Samuals study also examines the extent to which mergers play a important role in helping large firms to grow faster than smaller firms. He finds that mergers tended to increase the growth rates of medium, and large firms. However, even allowing for merger activity, larger firms still grew faster than their smaller counterparts. This may be caused by large firms re-valuing their assets on a more regular basis than small firms.

Steindl (1965)

Steindl (1965) tests the LPE for a sample of 1,269 Austrian firms. The sample is split into eight size bands based on initial size, and the mean and standard deviation of growth for each class for the period 1950-1957 is calculated. Mean growth rates and the standard deviation in growth rates differ between different sizes of firms. Growth tends to decline by firm size, with the largest and smallest size bands of firms recording average growth of -0.05 per cent and 0.17 per cent respectively. The standard deviation of growth rates also tends to decline by size, with the largest firms' standard deviation in growth equal to 0.02, compared with 0.33 for the smallest firms. Overall, the evidence suggests that smaller firms enjoyed much faster rates of growth over the sample period, but that this growth is more variable than that recorded for large firms.

Singh and Whittington (1968)

Singh and Whittington (1968) examine the size and growth of firms across four UK industries covering the period 1948 to 1960.[12] They sum up the essence of the LPE by stating that:

' *The chance of growth or shrinkage in the sizes of individual firms will depend on their profitability as well as on financial policy and other decisions of their respective management's. Profitability in turn will depend on a number of factors such as the quality of the firm's management, the range of its products, availability of particular inputs, general economic climate, political conditions and so on. During any particular period of time, some of these factors would make for an increase in the size of the firm, others for a decline, but their combined effect would yield a probability of the rates of growth (or decline) for firms of each given size. The law of proportionate effect assumes that this probability distribution is the same for all size classes of firms.*'[13]

They argue that there are four main economic implications of this, namely 1) no optimum size of firm; 2) current growth is not influenced by previous growth; 3) dispersion of firm sizes and concentration will increase over time; and 4) the process can help explain the observed firm size distribution.

[12] The period was also split into two sub-periods covering 1948 to 1954 and 1954 to 1960. The four industries are shipbuilding and non-electrical engineering, food, clothing and footwear, and tobacco.
[13] Singh and Whittington (1968), p73.

Singh and Whittington test the LPE by regressing initial firm size on closing size, for two sub-periods in each industry, and for the period as a whole (entry and exit is ignored). They find values of $\hat{\beta}_2$ greater than unity for all industries for the two sub-periods, and for the sample period as a whole. Furthermore, departures from LPE are more pronounced over time, lending support to the earlier findings of Samuals (1965).

Utton (1972)

Utton (1972) tests LPE for a sample of 1,527 UK manufacturing firms over the period 1954 to 1965. He regresses the variance of firm sizes in 1965 against variance in firm sizes in 1954, for thirteen manufacturing industries, and for the manufacturing industry as a whole. He accepts the LPE for seven manufacturing industries. In addition, large firms grew faster than small firms in five industries, and for manufacturing as a whole.

To examine the mobility of firms, Utton estimates the residual variance of the growth equation to be 0.73 which is smaller than the previous estimates proposed of Hart and Prais (1956), Hart (1962) and Samuals (1965).

Utton tests whether faster growth of large firms is the result of internal or external growth. To isolate mergers Utton re-estimates the model for firms that were not involved in mergers over the period. He finds that for manufacturing as a whole the LPE is accepted, and that it can be accepted where it was previously rejected in three of the five industries. These results imply merger activity caused large firms to grow faster than small firms. In two other industries, the LPE is rejected implying that internal growth, possibly through the operation of scale economies, allows larger firms to grow faster than smaller firms. Utton argues there is a role for the Monopolies and Mergers Commission to intervene in the industries where external growth has led to increasing concentration.

Samuals and Chesher (1972)

Samuals and Chesher (1972) test the LPE for a sample of 183 UK commercial and manufacturing firms covering the period 1960 to 1969. They carry out a regression of closing on opening size for the entire sample period and for selected sub-periods, and find that for the entire period that the estimated $\hat{\beta}_2$ < 1, implying that small firms grew faster than large firms. The model is re-estimated for eleven industrial groups. They find that small firms grew faster than large firms in five out of eleven industries, while large firms grew faster in the remaining cases.

Samuals and Chesher examine the residuals of the growth equation to see if concentration increased over time. They estimate the residual variance to be 1.21, which means that for a number of companies of similar size in 1960 approximately 35 per cent would be twice the size by 1969, and approximately 35 per cent would be half the size. This result is similar to that of Hart and Prais (1956) for the period 1938 to 1950, but lower than previous results obtained by Samuals (1965) for the period 1951 to 1960, and larger than estimates previously obtained by Utton (1972).

Singh and Whittington (1975)

Singh and Whittington (1975) update previous work, by testing the LPE for a sample of 2,000 firms, which are divided into 21 industry groups. They argue that a priori, one would expect a negative relationship between size and growth based on traditional economies of scale arguments (i.e. smaller firms adjust their outputs upwards to reach the minimum efficient scale to ensure survival).

The authors test three hypotheses derived from the LPE. Firstly, firms of different size classes have the same proportionate growth rates. Secondly, the dispersion of growth rates about a common mean is the same for all size classes. Thirdly, the rate of growth of the firm in one period should be independent of its growth rates in previous periods.

To test for differences in mean growth rates they group the sample into six size classes for the two sub-periods and the sample period as a whole.[14] Overall, they find a positive relationship between growth and size, which they confirm by a regression of growth on firm size. This suggests a rejection of proposition one. In addition, they find that the standard deviation of growth rates tends to decline as size increases.

They augment these tests by carrying out a regression of closing on opening size, and find that in the majority of industries $\hat{\beta}_2 > 1$, implying that large firms grew faster than smaller firms. However, they argue that this coefficient could be upwardly biased if large firms re-value assets more often than small firms. Furthermore, the variance of growth is heteroscedastic (which they argue appears likely given that the dispersion of growth rates differs across size classes). Heteroscedasticity may affect the estimation of the relation between firm size and growth.

Values of $\hat{\beta}_2$ are highest in the industries with the slowest growth rates. They argue this provides support for standard oligopoly theory, (i.e. that large firms are likely to grow faster in industries where they are protected by entry barriers, and operate in an environment of implicit or explicit co-operation).[15]

Singh and Whittington test whether individual firms' growth rates are related over time. They regress growth in the period 1954 to 1960, on growth in the period 1948 to 1954, finding evidence of persistence of growth.[16]

'A large proportion of the positive relationship between size and growth is due to the positive serial correlation of growth rates. This does not affect our conclusion that the Law of Proportionate Effect is contradicted by the observed relationship between growth and opening

[14] The time period under investigation is 1948 to 1960 which is split into two sub-periods (1948 - 1954 and 1954 - 1960. The sample was drawn from manufacturing, construction, distribution and miscellaneous services, food, non-electrical engineering, clothing and footwear, and tobacco industries. Firm size is measured as net assets (with no adjustments made for inflation).

[15] This was tested by using the Spearman rank correlation coefficient to look at the correlation between the beta coefficients obtained for a given industry and mean industry growth rates.

[16] This is augmented by a rank correlation analysis which finds that the growth rate coefficients are positive in 17 of the 21 industries sampled.

size, but it does draw attention to the probability that serial correlation of growth rates is the main cause for this result.'[17]

The Singh and Whittington study also addresses the process of firm entry and exit. They find that the volume of firm entry tend to decline with size. They conclude by arguing that more attention should be paid to the process of entry and exit, and draw attention to the work of Ijiri and Simon (1964,1967).[18]

<u>Aaronvitch and Sawyer (1975)</u>

Aaronvitch and Sawyer (1975) present evidence for a sample of 233 large UK manufacturing firms covering the period 1958 to 1967. They test the LPE in three stages. In the first stage a regression of closing on opening size is carried out. The presence of heteroscedasticity is then tested. Finally, the regression is re-estimated adjusting the coefficients for the effects (if any) of heteroscedasticity. The results find no relationship between growth and size, and thus accept the LPE.

<u>Chesher (1979)</u>

Chesher (1979) draws on the arguments of Singh and Whittington (1975), to develop a methodology for testing the LPE incorporating persistence of growth rates within a firm's growth function. Normally, the LPE argues that if β_2 = 1 the law holds. This assumes that the error terms in the equations are independent over time. If this is not the case then there is serial correlation and the LPE is rejected. He contends that the LPE only operates if β_2 = 1 and the error term is white noise.

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[17] Ibid., p.22.
[18] Ijiri and Simon (1964, 1967) explicitly examine the effects of firm entry and exit on the size distribution of firms. This issue is explored further in chapter 8.

Davies and Lyons (1982)

Davies and Lyons (1982) attempt to combine the traditional and the stochastic explanations of concentration. In the former case the emphasis is on firm numbers, economies of scale and barriers to entry, and in the latter random factors.

The authors specify a model in which firms either operate at the minimum efficient scale, or expand output in order to reach this level. Once firms reach the minimum efficient scale, the LPE becomes operative. This means that a threshold exists below which the LPE is rejected.

Kumar (1985)

Kumar (1985) provides empirical evidence on the relationship between size, growth and acquisitions, for the period 1960 to 1976 for a sample of 2000 UK quoted firms. The data is split into three sub-periods.[19]

Kumar attempts to disentangle the relationship between growth due to random factors and growth due to external determinants (such as acquisition and merger). He tests three aspects of the LPE, examining whether firms of different size classes have the same average proportionate growth, whether the dispersion of firm growth rates around a common mean size is the same for all size classes, and whether growth rates are correlated over time.

Kumar uses five measures of firm size, namely net assets, physical assets, equity, employees and sales. Growth is calculated as size in period t+1 as a proportion of size in period t. Growth by acquisition is calculated as expenditure on acquisitions of new subsidiaries as a proportion of opening size.

[19] The sub-periods are 1960 - 1965, 1966 - 1971, and 1972 - 1976. The corresponding numbers of firms for each period was 1747, 1021 and 824 respectively.

Following Chesher (1979), Kumar tests for persistence in growth rates between two periods, (1960 to 1971, and 1966 to 1976). He finds that 12 per cent of growth in one period is carried into the subsequent period. This is lower than the previous results of Singh and Whittington (1975) where 30 per cent of growth is carried forward from one period to the next. The decline in growth persistence was perhaps a consequence of the increased levels of competition.

Kumar tests the LPE by regressing current size on initial size for each of the three sub-periods. He finds a significant negative relationship between size and growth for sub-period one and three, but cannot reject LPE for sub-period two. Kumar tests whether the results obtained for sub-period three are robust with respect to the size measure used. Using four other size measures, he finds a significant negative relationship between size and growth for physical assets and equity measures, but not for employees and sales.

A similar analysis finds a positive relationship between size and growth by acquisition for the period 1960-1971, but a negative one for 1966-1976. The author also finds that merger and acquisition activity causes larger firms to have less variable growth rates than their smaller counterparts.

Kumar concludes that firm growth is negatively related to size over the period as a whole, and that any observed persistence in growth rates is weaker than that found by Singh and Whittington (1975). In addition, there is a negative relationship between firm size and growth rates by acquisition, in earlier sub-periods, but not for the sample period as a whole. The dispersion of growth rates (associated with acquisition) tends to decline with firm size.

Evans (1987)

Evans (1987a) investigates the relationship between firm growth and age, and firm size and growth by industry. The methodological approach adopted controls for selection bias arising from attrition and heteroscedasticity.

Evans uses a sample of 42,339 small firms from 100 US manufacturing industries (drawn from the Small Business Administration Database), for the period 1976 to 1982. Firm size is measured by number of employees. Growth is measured as the annual logarithmic change in employment between 1976 and 1980.

Evans carries out a regression analysis using three equations to explain the determinants of survival, growth and the variability of firm growth. This analysis is undertaken for both young and old firms.[20]

In general, Evans finds that the probability of failure decreases with firm age, as does growth and variability of growth. He also finds that LPE fails for small and large firms, although failure is not severe for larger firms. This implies that there may be some mean firm size, above which the LPE holds.

Evans (1987b) extends previous work to examine the relationship between firm growth, size and age, for a sample of US manufacturing firms over the period 1976-1982. The sample consists of 17,339 firms drawn from the Small Business Administration Database. Evans measures size as number of employees per firm (as assets data are unavailable). Various indicators of corporate structure are also collected for 1976, 1978, 1980 and 1982. Growth rates are measured as the annual logarithmic change in employment between 1976 and 1982. Evans finds an inverse relationship between firm size and firm growth and age. This supports the findings of Jovanovic (1982). Overall, the LPE is rejected.[21]

<u>Hall (1987)</u>

Hall (1987) uses a sample of US manufacturing firms over the period 1972 to 1983. The data comprises two samples of firms. The first consists of 1,349 firms for 1972 to 1979, while the second includes 1,098 firms for 1976 to 1983.

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[20] Evans defines young firms as those which are six years old or less, while old firms are those which are seven years or older.

[21] Section 5.2 discusses Jovanovic's arguments, while chapter 7 presents new evidence on the effect of firm age on the growth of banks and manufacturing firms.

Hall examines the extent to which measurement error may affect the relationship between size and growth. She tests the LPE over 1972 to 1979, 1973 to 1979 and 1976 to 1983, 1977 to 1983, with and without industry dummy variables. She finds that in most cases the relationship between firm size and growth is negative and '*that uncorrelated errors of measurement in employment cannot be responsible for more than 10% of the observed relationship between firm size and growth.*'[22]

Hall examines the time series behaviour of employment growth using a first order autoregressive moving average model, or ARMA (1,1). She finds a significant negative relationship between firm size and growth. The variance of growth rates across firms changes significantly from year to year.

Hall tests the extent to which the observed results are robust in the presence of exit. She finds the probability of survival is related to firm size, but that growth is uncorrelated with survival.

Neither measurement error, nor sample attrition can account for the negative relationship between firm size and growth. The LPE is rejected as small firms grew faster than large firms.

Dunne, Roberts and Samualson (1989)

Dunne, Roberts and Samualson (1989) examine post entry employment growth and failure for over 200,000 manufacturing plants for the US covering the period 1967 to 1977. The authors examine patterns in employment growth and failure for plants, which were established in 1967, 1972 and 1977.

Dunne et al assign firms to size classes based on age, size, industry grouping and ownership structure.[23] For all plants, they find that mean growth rates decline with plant size. Mean growth

[22] Hall (1987), p.588.
[23] Dunne et al group the sample of firms on the following basis. Age is composed of three categories of plants from 1 to 5 years, 6 to 10 years and 11 to 15 years. Current size class consists of five categories, namely 5 to 19 employees, 20 to 49 employees, 50 to 99 employees, 100 to 249 employees, and greater than 250 employees. Manufacturing groups are defined by their standard industrial classification based on 22 manufacturing industries. Ownership category is split into two groups reflecting whether the plant is a single entity or whether it is part of a multi-plant operation.

tends to decline with age for multi-plant firms, but not for single plant firms. Differences in the variability of growth rates are small across size classes as plants become more established (i.e. get older). They also find failure rates decline with age and size.

Although small plants tend to grow faster than large plants, they also tend to fail more frequently. They argue that '*Policies designed to encourage the establishment of new plants may simply elevate the level of small plant failure if the policy-induced entrants are candidates who are less likely to succeed than their older competitors.*' [24]

<u>Contini and Revelli (1989)</u>

Contini and Revelli (1989) test the LPE for a sample of 467 Italian firms covering the period 1973 to 1986. They test for persistence in growth rates. They regress growth for the period 1983 to 1986 on growth in 1977 to 1980 and 1980 to 1983, and find a negative relationship. This implies that firms with above average growth in one period tend to experience below average growth in the next period.

The authors test the LPE for groups of large and small firms for the sub-periods 1973-1977 and 1977-1981. The LPE holds in many of the industries sampled for large firms, but is rejected for all industry groupings of small firms. They find $\hat{\beta}_2 < 1$, implying that the LPE does not hold.

<u>Acs and Audretsch (1990)</u>

Acs and Audretsch (1990) present evidence at the industry level for US manufacturing for the period 1976 to 1980. They use number of employees as their measure of firm size.

The authors examine the role of expansion and contraction of surviving firms, and the contraction of industry growth caused by firm exits. The authors exclude firms which entered during the sample period. Average growth for a given size class is decomposed as follows:

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[24] Dunne et al (1989), p.697.

$$S_{1980i} = f(S_{1976i} + EXP_i + CONTR_i - DEATH_i)$$

where: S_{1980i} is mean firm size, in 1980. S_{1976i} is mean firm size in 1976. EXP_i denotes the expansion of firms which survived the entire period. $CONTR_i$ is the contraction of surviving firms. $DEATH_i$ is the contraction in size caused by firms which exited. Growth is measured as the difference between size between 1980 and 1976, while explicitly taking account of exit.

They calculate the mean growth rate between 1976 and 1980 for four size classes in each of the 408, four digit industries sampled, and test for differences in growth rates between each of the four size classes for each industry. The LPE is accepted for 245 out of the 408 cases. These results contrast to those of Evans (1987a) who finds no support for LPE in 89 per cent of industries sampled. The main reason for the discrepancy is perhaps, that Evans excludes firms that exited the industry from his tests.

According to Acs and Audretsch,

'.... when we incorporate the impact of exits in our mean growth rate, the higher growth rate of small firms is apparently offset by their greater propensity to exit... Thus, incorporating the impact of exits tends to produce more support for the assumptions underlying Gibrat's law than would otherwise be found.' [25]

Reid (1992)

Reid (1992) describes the LPE as a mixed deterministic / stochastic model of firm growth. He tests the LPE for a sample of 73 small firms for the period 1985 to 1988. Using assets as a measure of firm size, Reid finds that there is a significant negative relationship between firm size and growth, implying that the smallest firms in the sample grew at the fastest rates.

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[25] Acs and Audretsch (1990), p.134.

Reid considers the problem of sample selection bias due to the deaths of small firms. Using a binary choice model in which the dependent variable is survival or non-survival, and the independent variable is size, Reid finds no relationship between survival and firm size. This suggests that the results do not suffer from sample selection bias.

Reid extends the analysis by including quadratic size and age variables (which capture any non-linear relationships in the data) to test for life cycle or learning effects on firm growth. He finds a negative relationship between growth and size, and growth and age, and a positive relationship between the interaction term between size and age. This implies that larger firms are likely to be older. Overall, Reid rejects the LPE, but finds substantial support for age as an important determinant of the growth prospects of small firms.

<u>Wagner (1992)</u>

Wagner (1992) estimates size-growth relationships using a sample of 7,000 small German firms, for the period 1978 to 1989. Firm size is measured by number of employees, while growth is the percentage change in firm size from one year to the next. Wagner only considers surviving firms. However, to minimise the survival bias he considers a sequence of overlapping three yearly periods beginning with 1978 to 1980 and ending in 1987 to 1989.

Wagner regresses closing size on size in the previous two periods. He divides the sample into four industry sub-groups, to include manufacture of capital goods; manufacture of consumer goods; and the manufacture of food, beverages and tobacco products. He tests the LPE for ten three-year periods for three different size groups of firms. He finds the LPE to be valid for only half of the three yearly time periods. Overall, he finds that $\hat{\beta}_2$ is close to one in nearly all cases, but that there is persistence of growth in many cases.

<u>Dunne and Hughes (1994)</u>

Dunne and Hughes (1994) test for differences in the mean and variance of growth rates across firm size classes using a sample of UK firms.

Dunne and Hughes add to the evidence on size-growth relationships using a large sample of comprising 2,149 firms. Firstly, for a sample of firms which had survived from 1975 to 1980, they trace the survival and growth prospects over the period 1980 to 1985. Secondly, they test for threshold effects by running an analysis within broad size classes as well as for the sample as a whole.[26] Thirdly, they investigate the effect of company age on patterns of growth and survival. Finally, they test for problems associated with serial correlation in growth rates, heteroscedasticity and sample attrition.

The size measure adopted for the study is net assets. Of the 2,149 firms which were live in 1980, 1,709 firms survived to 1985, while 440 exited. The smallest and largest classes had the smallest and largest survival rates.

Dunne and Hughes seek to investigate two aspects of the survival process, namely

1) Is the exit of a firm dependent on size?

2) Is exit dependent on slow growth?

They find that the smallest companies have the highest liquidation rates, but are more susceptible to exit by take-over than their larger counterparts. Slow growth increases the chances of exit for the sample as a whole, but this does not hold for the largest size class. This contrasts with earlier results of Dunne, Roberts and Samualson (1989) and Mansfield (1962), who find an inverse relationship between exit rates and size.

In addition, Dunne and Hughes examine the size and growth of surviving firms. They find that the mean and variance of growth both decline with firm size. The authors acknowledge that the results may be a consequence of aggregation bias brought about by grouping all industries in one sample. If some industries are characterised by large numbers of small but rapidly expanding

[26] This type of estimation draws on the insights of Simon and Bonnini (1958) and Davies and Lyons (1982) who contend that LPE may only hold for firms operating at, or above the minimum efficient scale.

firms, an analysis pooled across industries may produce an apparent negative relationship between size and growth even though within each industry a positive or no relationship may exist.

Using a log-linear model, the authors test the LPE for two sub-periods (1975 to 1980 and 1980 to 1985). These tests are carried out for different size classes and industry groupings. The LPE is accepted for the majority of classes for the period 1980 to 1985 (with the exception of the smallest categories of firms, and for the sample as a whole). They argue that this provides evidence of a size threshold below which the LPE does not hold. The LPE is rejected for all size classes for the period 1975 to 1980. They extend the analysis to examine the size-growth relationship within individual industries. For the period 1980 to 1985, small firms grew fastest in sixteen of the nineteen industries sampled. However, this relationship is only significant in four cases. For 1970 to 1975 small firms grew fastest in sixteen industries, and significantly so in eight.

The authors tackle several of the econometric problems encountered in earlier studies, including, serial correlation in growth rates; heteroscedasticity arising from inequality in growth rate variances across size classes; and sample attrition bias.

They argue that if there is serial correlation in growth rates, more weight is given to firms with higher growth rates that cause the estimated coefficient between growth and size to be biased upwards. To test this, they regress growth over the period 1970-1985 on growth in 1975-1980 for 935 surviving firms. In contrast to earlier findings of Kumar (1985) and Singh and Whittington (1975), they find little persistence in growth rates. This is attributed to increased take-over activity and globalisation, which made it difficult for firms to achieve persistently high growth rates.

Dunne and Hughes find that the variance of firm growth rates declines with size. They suggest that the source of heteroscedasticity is likely to lie in the stability of growth rates of large diversified firms which can spread risk across many product areas, making them less susceptible to large fluctuations in growth (Prais, 1976). On the other hand Jovanovic (1982), argues that small size classes contain a disproportionate number of younger firms, with inexperienced managerial teams which tend to make more mistakes. Therefore, greater instability of growth rates does not come from small size per se, but from age related effects.

Dunne and Hughes re-estimate their model including and excluding age variables. They find a negative relationship between firm size and age for the sample as a whole, and for 15 out of the 19 industries (significantly so in 3 cases). Therefore, although small firms grew faster than larger ones, there also seem to be life-cycle effects at work. Younger companies seem to be more dynamic in terms of experiencing faster growth, but their growth is also more variable. They argue that these observed size-age relationships are consistent with the model of Jovanovic (1982). Size effects appear more important for smaller firms, which implies some sort of threshold effect for the LPE (Simon and Bonnini, 1958).

The authors also examine whether any bias arises as a result of higher exit rates across smaller firms. To analyse this they re-estimate the model for all firms using a binary variable to denote surviving and non-surviving firms. Size and age variables, and size-age interaction terms are included. The results are consistent with previous estimates, implying that there is little or no evidence of attrition bias.

Overall, the results show that small firms grew faster than large firms, and have more variable growth rates. Small and large firms are less likely to be taken over than medium-sized firms. However, there is evidence of a threshold effect, and the LPE can be said to hold for firms above a certain size.

Hart and Oulton (1996)

Hart and Oulton (1996) add to the evidence on size-growth relationships for a sample of 87,109 independent firms for the period 1989-1993 (collected from the ONESOURCE database). They examine whether the observed size-growth relationship holds by individual size class. Splitting the sample into nine sub-classes based on initial size.[27] They find that $\hat{\beta}_2 < 1$ for all size bands of

[27] The number of employees in the opening period is used as the ranking measure. The size bands range from firms employing less than 4 employees to firms employing more than 1024 employees.

firms, but that the value of $\hat{\beta}_2$ tends to decline monotonically from largest to smallest size category of firm.

The authors conclude that the very smallest firms grew proportionately faster in terms of employment than their larger counterparts. However, the authors acknowledge that the results are for surviving enterprises only.[28]

From the evidence presented above, the LPE clearly has some merit as an explanation of firm growth and market concentration. Appendix 3 provides a summary of the studies reviewed above. The extent to which the LPE holds depends on attrition, age, size class, mergers and the persistence of growth rates through time. Although, there is some variation, there is a strong pattern of acceptance of the LPE up to the middle of the 1970s. Recent studies support the view that small firms grow faster, and experience more variable growth rates than large firms. This tends to be in line with long term trends in industrial concentration (Hart and Clarke, 1980). However, such evidence is presented for surviving firms only. The LPE appears to hold for larger sized firms. Evidence presented relating to sample attrition finds that exit is negatively related to size, but not growth. Other evidence suggests that even if the LPE does not hold, this is not because of a relationship between size and growth per se, but rather a relationship between growth through time. Mergers can also play an important role in determining growth patterns. Most recent studies of the LPE incorporate firm age as an explanatory variable. All evidence, without exception, supports the view that younger firms have more variable growth rates, attributed to the fact that inexperienced management is more likely to make mistakes. Overall, the balance of evidence suggests that small firms tend to grow faster and have more variable growth rates than large firms, and that growth prospects in one period tend to influence growth in future periods.

[28] The authors maintain that the smallest firms in the economy are more likely to go bankrupt than larger counterparts. Therefore the growth rates observed for the smallest surviving firms in the sample are likely to be inflated.

5.3.2 Goodness of Fit Tests of Firm Size Distributions

This section reviews briefly the empirical literature that has tested the LPE by examining how closely the observed distribution of firm sizes fits one of several theoretical probability distributions, including the lognormal, the Pareto and the Yule distribution

Hart and Prais (1956)

Hart and Prais examine the extent to which the sample firm size distribution approximates to the lognormal distribution.[29] They calculate the natural logarithm of firm size in the years 1885, 1896, 1907, 1924, 1939 and 1950, and carry out goodness of fit tests for skewness and kurtosis of the distribution of firm sizes. They find no departures from lognormality for the period up to 1907. However, from 1907 onwards departures from lognormality become significant.

Simon and Bonnini (1958)

Simon and Bonnini (1958) argue that LPE applies to firms that are operating above the minimum efficient scale required for long term survival. Firms operating below this size either grow faster to reach the minimum efficient scale or perish. As a result most firms will be operating at optimum size levels, and will have exhausted economies of scale.

' *Size has no effect upon the expected percentage growth of a firm. ...That is to say, we assume that a firm randomly selected from those with a billion dollars in assets has the same probability of growing, say, by 20%, as a firm selected from those with a million dollars in assets.*'[30]

They assume that any subsequent growth is likely to be randomly distributed across size class.

' *Whether sales, assets, number of employees, value added, or profits are used as a size measure, the observed distributions always belong to the class of highly skewed distributions that include the lognormal and the Yule. This is true of the data on individual industries and for all industries taken together. It holds for sizes of plants as well as firms.*' [31]

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[29] The sample used is described in section 5.3.1.
[30] Simon and Bonnini (1958), p.608-609.
[31] Simon and Bonnini (1958), p.611, footnote omitted.

Simon and Bonnini assume there is a constant entry rate into the lowest size class of firms. If this assumption holds, firm sizes will approximate the Yule distribution.

Simon and Bonnini test these arguments by fitting straight lines to the logarithms of cumulative distributions using UK and US data.[32] They allow for entry of new firms over time into the lower end of the size distribution. The authors find that the distributions of firm sizes tend to approximate closely to the Yule and Pareto distributions.[33]

Quandt (1966)

Quandt (1966) uses data on 30 US industries to test how well the observed size distributions fit variants of the Pareto distribution, and the lognormal distribution. In 66 per cent of the cases analysed, Quandt can accept the null hypothesis that the empirical distribution of firm sizes fits the theoretical distributions.[34] However, he is unable to discriminate between the various theoretical distributions as to which one best fitted the data.

Silberman (1967)

Silberman (1967) presents evidence for a sample of 90, four-digit industries in 1947 and 1958 for plant and firm level data. A goodness of fit test is used to test for consistency with the lognormal distribution. He compares actual and expected concentration measures based on the lognormal hypothesis. The results are mixed. For firms, the null can be accepted in half of the industries studied, but for plant size only 17 out of 79 industries pass the test.

[32] The data for UK firms is the same as used by Hart and Prais (1956), while the US data covers the top 500 firms 1954 to 1956.
[33] The Pareto distribution approximates the upper tail of the Yule distribution.
[34] Quandt argues that there are four main ways to carry out goodness of fit tests on firm sizes. These are: 1) The method of moments or quartiles; 2) maximum likelihood estimation; 3) fitting a straight line to the cumulative distribution of firm sizes; and 4) by qualitative methods such as the Lorenz curve.

Engwell (1973)

Engwell (1973) finds support for the lognormal hypothesis when applied to Swedish car and shoe manufacturing establishments for the period 1952-1966. Using a similar approach to the one adopted by Silberman, Engwell accepts that the lognormal distribution gives a good description of firm size distributions in these two industries. Engwell also carries out the same tests at establishment level for Poland, Yugoslavia, Romania and Czechoslovakia, and accepts the LPE. He surmises that the LPE can be accepted in industries that have undergone little change in patterns of demand and firm numbers. Engwell suggests that when systematic factors are absent, random influences are likely to pre-dominate.

Clarke (1979)

Clarke (1979) tests the usefulness of the lognormal distribution in characterising firm size distributions. The data set consists of 147 UK (three-digit) manufacturing industries in 1968. He tests each industry's plant and firm size distribution for normality by carrying out tests for skewness and kurtosis. He finds that 80 per cent of the industries fail tests for skewness and kurtosis. He finds the lognormal distribution fits only 9 of the 133 firm size distributions sampled. When applying the tests at the plant level, he finds that the hypothesis can be accepted in 25 per cent of cases. Clarke also finds large number of firms appearing in the upper end of the size distribution, which suggests that systematic factors may favour the growth of large firms.

Kwoka (1983)

Kwoka (1983) tests the goodness of fit of the Pareto distribution for 308 US manufacturing industries. Using data on the market shares of the top ten firms in each industry, Kwoka attempts to fit this data to the Pareto distribution. Although the Pareto distribution is rejected as an adequate explanation of the distribution of firm sizes, Kwoka does find some regularity in the distributions.

' *While stochastic growth processes may be at work in these data, many other factors play decisive roles in determining firm size distributions. Those factors - like serially correlated growth* *rates, mergers and acquisition, and other firm behaviour - deserve close examination in light of the particular empirical findings in this paper.* '[35]

Overall, research in this area is static in its approach and ignores influences on the size distributions of firms such as correlation of growth rates from period to period, the impact of managerial ability, and returns linked to process and product innovation.

Section 5.4 Conclusions

This chapter has examined previous empirical research that has explored the relationship between firm size and growth, and its consequences for industry structure. The results suggest that the LPE plays a substantial part in shaping firm size distributions, and may outweigh systematic explanations for firm growth. Future research is likely to search for ways to combine traditional explanations for firm growth with the LPE described above. This might be achieved by more comprehensive data sets or through the use of simulation techniques.

Drawing on this literature, the remainder of this thesis attempts to assess the extent to which size-growth relationships are instrumental in determining the size distribution for samples of European banks and manufacturing firms.

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[35] Kwoka (1982), p.395.

CHAPTER 6

METHODOLOGY AND DATA

6.1 Introduction

The chapter outlines the methodological approach used to investigate size-growth relationships across countries and firm types. Two models are presented. The first tests for the size-growth relation across countries and firm types, but makes no allowance for persistence of growth rates in successive periods. The second not only tests for the size-growth relation, but also for the persistence of growth rates over time.

The data set used to test the LPE consists of a banking sample drawn from eight EU countries, and a manufacturing sample drawn from five EU countries. The sample of banks represents the largest data set ever used to test the LPE in banking markets. As there is no previous evidence in the literature on whether the LPE holds in European banking markets, this study aims to fill this gap.

The manufacturing sample is included for several reasons. Firstly, there is a large body of literature (see chapter 5) which examines the relationship between the size and growth of manufacturing firms. However, all of these studies have examined the relationship for single countries. The following adds to the literature by studying the size-growth relationship at a European level. Secondly, the analysis of a manufacturing sample will enable comparisons to be drawn between the estimated size-growth relationships for the manufacturing and banking industries.

The main motivation for testing separately the LPE for the two samples is that on *a priori* grounds one would expect to find some differences in the size-growth relationship between banking and manufacturing, arising from differences between the competitive conditions in each case. Banks tend to be subject to a tighter regulatory framework than manufacturing firms, and so are often insulated from many of the competitive pressures faced by the latter (Tirole, 1994a). In contrast to manufacturing firms, the failure of one bank can lead to the failure of others (described in the literature as the domino effect). As a consequence regulation is geared to minimise the likelihood of bank failure. For instance regulatory authorities may 'bail out' failing banks in order to ensure the stability of the banking industry (Rose, 1987). Other differences between banking and manufacturing firms lie in the nature of the respective production technologies used to produce banking services and manufactured goods, and in the structural characteristics of the respective industries. Manufacturing generally involves large-scale (often standardised) production techniques aimed at exploiting technical economies of scale to yield storable outputs (Stanbeck, 1979). In contrast, banking (in common with many services) tends to be intangible and in many cases involves simultaneity in consumption and production which often requires a location close to the customer base (Akehurst, 1987 and Britton, Clark and Bell, 1992). Recent evidence for banking suggests that economies of scale are available to banks at low levels of output (Molyneux et al, 1996). Banks use the same inputs (deposits, labour and capital), and produce the same outputs (loans, assets and off balance sheet business) which are priced in response to prevailing market conditions.[1] This is not always the case for many less regulated manufacturing industries, where small firms can enter niche markets and sell differentiated products, often at low prices to capture market share from their larger counterparts. As a consequence, the extent to which competitive pressures affect the growth and the size distribution of firms differs between banking and manufacturing. Therefore size-growth relationships are tested separately across the two industries.

The rest of this chapter is structured as follows. Section 6.2 begins by describing the empirical model, which will be used to test for the relationship between firm size and growth, allowing for variations in these relationships across industries and countries. Section 6.3 describes the data sources and sample selection for the sample of EU banks. This section also examines the size

[1] Some controversy surrounds the appropriate measurement of bank inputs and outputs. Two main approaches underlie the measurement of inputs and outputs. In the production approach, banks are treated as firms which utilise capital and labour to produce various deposits or loan accounts. In the intermediation approach banks are seen as intermediaries rather than producers. In this case the appropriate input measures are deposits, labour and capital, while output is measured by the values of loans granted and investments made.

distribution of the banks over the period 1990 to 1994. Section 6.4 repeats this exercise for the sample of manufacturing firms. Section 6.5 provides a summary.

6.2 An Estimable Model of Firm Growth

In this section the model to be used in the estimation of size-growth relationships across European banking and manufacturing is described. The aim of this model is to capture any relationship between size and growth and between growth in successive periods. The data set, which includes details of firm size over the period 1990 to 1994 inclusive, allows us to estimate two formulations, expressed as follows:

(a) a model which tests for a relationship between growth over the period 1990-1994, and size in 1990; and

(b) a model which tests for relationships between growth over the period 1992-1994, and size in 1992 and growth over the period 1990-1992.

Formulation (a) benefits by measuring growth over a longer period (1990-1994), but does so at the cost of excluding the possibility of testing for persistence in growth rates. By using growth over a shorter period (1992-1994) as a dependent variable, formulation (b) allows testing for size effects and persistence in growth rates. It seems plausible to assume that firms' growth rates are likely to be related through time, perhaps through the effects of managerial decisions which may have consequences for a firm's growth for long periods of time (Kumar, 1985). On the other hand, the longer the period of observation, the less important we might expect persistence effects to be. In other words, 'managerial' benefits are likely to be short lived, and less evident if comparisons are made over longer observation periods. Therefore, both formulations (a) and (b) are justified to some extent. Previous studies which have used formulation (a) include Hart and Prais (1956), Samuals (1965) and Dunne and Hughes (1994). Studies which have used formulation (b) include Chesher (1979), Kumar (1985) and Wagner (1992).

Let s_{it} denote the size measure for an individual firm at some time period t, expressed in natural logarithm form. The presentation of the model that follows refers to formulation (b). The structure of formulation (a) is the same, but without the persistence of growth terms (β_3, δ_3^f and ρ_3^c).

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{f=2}^{F} \delta_3^f d_{3it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + \sum_{c=2}^{C} \rho_3^c e_{3it}^c + u_{it} \quad (1)$$

where $E(u_{it}) = 0$ and var. $(u_{it}) = \sigma_{it}^2$

The main parameters of interest in equation (1) are β_1, β_2, β_3 and σ_{it}^2 (see below), while δ_j^f and ρ_j^c (f = 2...F; c = 2...C; j = 1...3) are intercept and slope shift parameters. The intercept and slope dummies are defined as follows:

For firms, d_{1it}^f =1 if firm i is of type f and 0 if otherwise; for f = 2...F where F is the number of categories of firms, $d_{2it}^f = d_{1it}^f s_{it-1}$, and $d_{3it}^f = d_{1it}^f \Delta s_{it-1}$. e_{1it}^c =1 if firm i belongs to country c and 0 if otherwise for c=2...C where C is the number of countries; $e_{2it}^c = e_{1it}^c s_{it-1}$, and $e_{3it}^c = e_{1it}^c \Delta s_{it-1}$. For banks f=1 denotes commercial banks, f=2 denotes co-operative banks and f=3 denotes savings banks. c=1 denotes Belgium, c=2 denotes Denmark, c=3 denotes France, c=4 denotes Germany, c=5 denotes Italy, c=6 denotes Netherlands, c=7 denotes Spain and c=8 denotes the United Kingdom.

For manufacturing firms f=1 denotes Alcohol, f=2 denotes Building Materials, f=3 denotes Chemicals, f=4 denotes Diversified Industrials, f=5 denotes Electronics, f=6 denotes Engineering, f=7 denotes Food, f=8 denotes Household, f=9 denotes Pharmaceuticals, f=10 denotes Paper and f=11 denotes Textiles. c=1 denotes France, c=2 denotes Germany, c=3 denotes Italy, c=4 denotes Spain and c=5 denotes the UK.

The dummy variables allow for shifts in the intercept and slope coefficients by firm type and country, and so allows specific estimates of β_1, β_2 and β_3 to be obtained. For example, for the sample of banks, $\beta_2+\delta_2^1$ provides an estimate of the size-growth relationship for commercial banks, while $\beta_2+\rho_2^2$ does the same for banks located in Denmark. In a similar fashion $\beta_1+\delta_1^1$, $\beta_1+\rho_1^2$ and $\beta_3+\delta_3^1$, $\beta_3+\rho_3^2$ provide specific intercept and persistence of growth estimates for commercial and Danish banks.

If β_2<1, smaller firms tend to grow faster on average than their larger counterparts. s_{it} is stationary, possibly in relation to a deterministic trend which, in a cross-sectional estimation of equation (1), is indistinguishable from the intercept parameter. This suggests that over time the size of all firms will tend to converge toward some long run average value (Marshall, 1890, and Mueller, 1972), in which case there is no tendency for concentration to increase over time. If β_2=1, then firm size has no effect on growth, and the LPE holds. In this case s_{it} is non-stationary, and over time there is a tendency for concentration to increase as some firms come to fortuitously dominate the market, having enjoyed several periods of above average growth. Finally, if β_2>1, large firms grow proportionately faster than smaller firms, possibly through efficiency advantages arising from scale and scope economies, x-efficiency, or through the exercise of market power (Singh and Whittington, 1975). In this case the time path of s_{it} tends to be explosive. This seems unrealistic (a priori this case can be ruled out, at least over the long term). Therefore, the appropriate test of the LPE is H_0: $\beta_2 = 1$ against H_1: $\beta_2 < 1$.

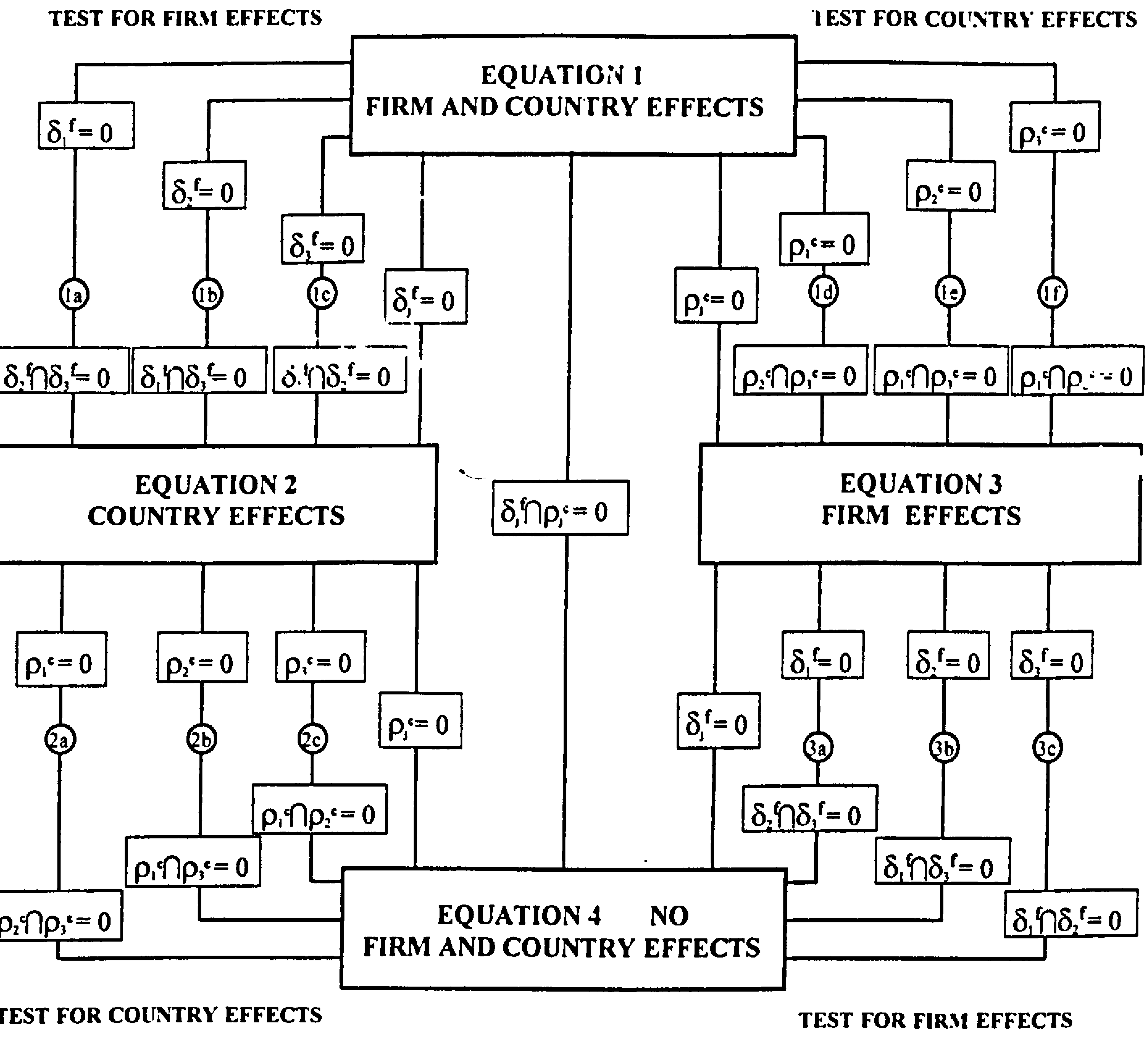
If β_2=1, the value of β_1 is important in determining whether the average size of firms is increasing or contracting. β_1>0 implies that on average, firms are tending to grow, while $\beta_1 < 0$ implies that on average, firms are tending to contract. β_1 therefore denotes the mean growth rate across firms. If $\beta_2 < 1$, the interpretation of β_1 is different. In this case, β_1 is relevant in determining the long run mean of s_{it} (as described above). The mean value towards which s_{it} is mean reverting is $\frac{-\beta_1}{(\beta_2 - 1)}$.

The value of β_3 determines the extent to which growth in any period is related to growth in the preceding period. β_3=0 implies that there is no relationship between growth in successive periods, $\beta_3 > 0$ implies that above or below average growth in the previous period has a tendency to be repeated in the current period. $\beta_3 < 0$ implies that above (below) average growth tends to lead to below (above) average growth in the next period.

Finally, σ_{it} measures the dispersion of growth rates relative to their mean values (conditional on s_{it-1} and Δs_{it-1}). If $\sigma_{it} = \sigma$, u_{it} is homoscedastic, and dispersion is the same for all banks of all sizes, at all times. On the other hand, heteroscedasticity of the form σ_{it} = f (s_{it-1}) may imply dispersion which is either directly or inversely related to size (Mansfield, 1962).

Firm type and country variations in β_1, β_2 and β_3 are tested systematically for the validity of all relevant permutations of exclusion restrictions on the dummies d^f_{jit} and e^c_{jit}. Figure 6.1 illustrates the procedure used to eliminate any unnecessary variables from equation (1) to achieve a final specification for formulation (b), which allows for persistence of growth. Thus in the upper left-hand corner of Figure 6.1, equation (1) is tested for the exclusion of various permutations of the firm type dummies. Acceptance of H_0: $\{\delta^f_1\} = 0$, H_0: $\{\delta^f_2\} = 0$ or H_0: $\{\delta^f_3\}$=0 leads to the intermediate nodes (1a), (1b) or (1c) respectively, from which the acceptance of further restrictions (H_0: $\{\delta^f_2 \cap \delta^f_3\} = 0$ and so on) leads to equation (2). In the lower left-hand sector, equation (2) is then tested for country effects in the same manner. In the upper and lower

Figure 6 1: Tests for significance of bank type and country effects



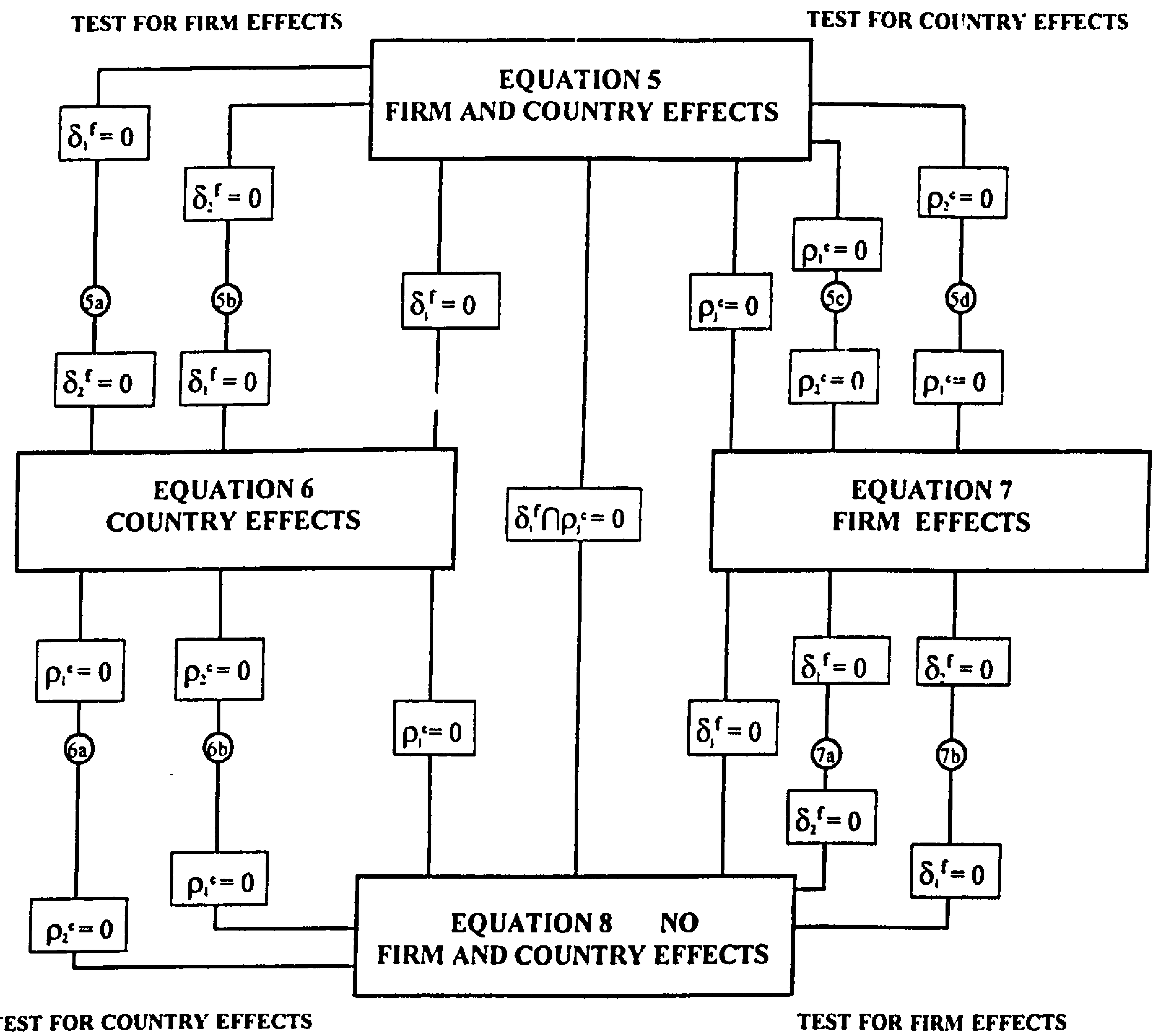
$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{f=2}^{F} \delta_3^f d_{3it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + \sum_{c=2}^{C} \rho_3^c e_{3it}^c + u_{it} \tag{1}$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + \sum_{c=2}^{C} \rho_3^c e_{3it}^c + u_{it} \tag{2}$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{f=2}^{F} \delta_3^f d_{3it}^f + u_{it} \tag{3}$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + u_{it} \tag{4}$$

Figure 6.2: Tests for significance of firm type and country effects



$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it} \quad (5)$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it} \quad (6)$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + u_{it} \quad (7)$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + u_{it} \quad (8)$$

right hand sectors, the same sets of tests are performed in the reverse order (i.e. country effects first, then firm type effects). The most parsimonious specification possible is equation (4).[2]

6.3 EU Banking Sample

The EU banking data was collected from the BANKSCOPE database, compiled by International Bank Credit Analysis Limited (IBCA). The database comprises accounts data on more than 8000 banks. The sample selection criteria were as follows. Any bank which operated in a country which was a member of the European Union in 1990, and was classified by the database as a commercial, savings or co-operative bank, and for which data for each of the years 1990 to 1994 inclusive was accessible was selected, with the following exceptions. Banks from Portugal, Ireland and Greece were excluded from the sample because there was insufficient data on banks from these countries.[3] Banks with operations in one country, which are centrally located in another country, posed particular problems in the data selection process. Firstly, many EU banks have subsidiaries located in other countries (e.g. Barclays Bank Espana). To include these subsidiaries would in effect lead to double counting within the sample. Secondly, subsidiaries of foreign banks from other countries are located in many countries. The extent to which these types of institutions grow is perhaps more affected by the corporate objectives of parent institutions than the competitive environment of the country in which the subsidiary is located. Therefore, these two types of banks were excluded from the sample. This problem was particularly acute in the case of Luxembourg, for which, once foreign subsidiaries were removed from the sample, only four banks remained. As a consequence Luxembourg banks were excluded altogether. The final

[2] In Figure 6.2, a similar process is carried out for formulation (a), which excludes the possibility of persistence of growth. In this case, equation (5) is tested for the exclusion of various permutations of the firm type dummies. Acceptance of H_0: $\{\delta_1^f\} = 0$ or H_0: $\{\delta_2^f\} = 0$ leads to the intermediate nodes (5a) or (5b), from which the acceptance of further restrictions (H_0: $\{\delta_2^f\} = 0$ and so on) leads to equation (6). In the lower left-hand sector, equation (6) is then tested for country effects in the same manner. In the upper and lower right hand sectors, the same sets of tests are performed for country effects, then firm type effects. The most parsimonious specification possible in Figure 6.2 is equation (8).

[3] Given that part of the analysis in the following chapter attempts to test for individual country effects in driving the size-growth relationship, it was decided to exclude these three countries for the small numbers of banks that would be yielded for estimation purposes.

sample consisted of indigenous banks drawn from eight EU countries: Belgium, Denmark, France, Germany, Italy, Netherlands, Spain and the UK.

Three measures of size are used in the empirical analysis, namely total assets, total equity and off balance sheet business. Following Tschoegl (1983), total assets and total equity were chosen since both of these measures represent widely accepted measures of bank size. Tschoegl argues that the equity measure circumvents some of the difficulties with the assets measure, which arise from differences in accounting practices across countries. In some countries, banks are permitted to keep hidden reserves, allowing them to smooth performance, but biasing the estimated coefficients towards an acceptance of the LPE. Off balance sheet business, although not a measure of overall bank size, is included because this type of business has become increasingly important for EU banks during the 1990s (EU, 1997a). In this case, the main aim of using such a measure is to assess whether off balance sheet business exhibits patterns of growth similar to those for total assets and equity.

The data for the study was collected in nominal terms in domestic currencies and converted into ECU's using an ECU exchange rate. The effects of inflation over the five-year sample period were removed by using an ECU GDP deflator.[4] This allows us to focus on real rather than nominal growth.

Tables 6.1-6.3, show the numbers of sample banks classified by country and bank type. Table 6.1, shows that the sample selection process yielded 617 banks for which total assets data was available for the entire sample period. Of these the largest numbers of banks came from the UK, Italy, Spain, Germany and France, with 108, 120, 117, 109 and 107 banks respectively. Overall, the total sample of 617 banks consists of 414 commercial, 157 savings and 46 co-operative

[4] This deflator was calculated from figures taken from the IMF (1995), *World Economic Outlook.*

Table 6.1: Sample of Banks in Assets Estimations

Sector Country	Commercial	Co-operative	Savings	Total
Belgium	18	-	-	18
Denmark	23	-	-	23
France	107	-	-	107
Germany	58	16	35	109
Italy	47	30	43	120
Netherlands	15	-	-	15
Spain	68	-	49	117
UK	78	-	30	108
Total	414	46	157	617

Table 6.2: Sample of Banks in Equity Estimations

Sector Country	Commercial	Co-operative	Savings	Total
Belgium	18	-	-	18
Denmark	23	-	-	23
France	98	-	-	107
Germany	58	16	35	109
Italy	47	30	43	120
Netherlands	15	-	-	15
Spain	67	-	49	116
UK	78	-	30	108
Total	404	46	157	607

Table 6.3: Sample of Banks in Off Balance Sheet Estimations

Sector Country	Commercial	Co-operative	Savings	Total
Denmark	22	-	-	22
France	94	-	-	94
Germany	55	12	32	99
Italy	18	15	30	63
Netherlands	15	-	-	15
Spain	58	-	45	103
UK	55	-	-	55
Total	317	27	107	451

banks.[5] In Tables 6.2 and 6.3, the equity and off balance sheet business size measures, yield smaller numbers of banks because there were some gaps in the data. When using the equity measure, ten banks with negative equity data were removed from the sample (since it is not possible to apply the logarithmic transformation to a negative size measure), leaving a total sample based on this measure of 607 banks. When collecting data on off balance sheet business, fewer banks reported such business either at the beginning or throughout the sample period. In particular the data coverage was poor for Belgian banks at the beginning of the sample period, and consequently this country was dropped from the OBS estimations. The final sample size for the off balance sheet measure is 451 banks.

6.3.1 The size of banks

Tables 6.4 to 6.6 show that the mean and standard deviation of bank size increased for each measure of size during the sample period. The median size of bank increased for equity and off balance sheet business, but not total assets. The growth in equity is indicative of the recent emphasis on capital growth as a strategy in the banking industry (Arthur Andersen, 1993). The increased average size of off balance sheet business can be explained by banks diversifying into new areas of business, as the process of de-regulation within the EU gathered momentum (Canals, 1993, 1997).

The bank size distribution, (using each measure of size) is summarised by the skewness coefficient, and reflects a positive skew (see Figure 6.3).[6] This indicates an industry where a few large banks may dominate, and perhaps confirms the predictions of the LPE that if growth is independent of size, a positively skewed distribution of firm size will emerge over time (Prais, 1976). Tables 6.4 to 6.6 also show size distribution descriptive statistics after applying the logarithmic transformation. It is notable that the skewness of the firm size distribution falls toward

[5] A priori one might expect differences in the size-growth relationship across bank types, which may arise as a consequence of differing business objectives. Commercial banks are more likely to aim to maximise shareholder value, while co-operative and savings banks may follow other types of objective.
[6] See Lewis and Pescetto (1996), chapter 1 for an extended discussion of size distributions of commercial banks within the EU.

Table 6.4: Total Asset Size of EU banks 1990 to 1994 (ECU million)

n = 617	1990	1991	1992	1993	1994
Mean	8426.53	8689.77	8729.28	9168.45	9123.83
Standard Deviation	24922.94	25241.46	26545.69	28347.58	27701.46
1st Quartile	431.3	458.07	410.59	410.74	390.59
Median	1205.1	1253.88	1173.16	1174.45	1160.47
3rd Quartile	3951.1	4033.1	3919.27	4216.79	4338.48
Kurtosis	35.35	33.30	38.57	37.94	34.41
Skewness	5.30	5.13	5.51	5.50	5.25
Log: Mean	7.29	7.32	7.26	7.25	7.25
Standard Deviation	1.76	1.75	1.79	1.82	1.83
Kurtosis	3.19	3.12	3.17	3.21	3.13
Skewness	0.45	0.49	0.45	0.42	0.43

Table 6.5: Total Equity Size of EU banks 1990 to 1994 (ECU million)

n = 607	1990	1991	1992	1993	1994
Mean	378.50	413.48	399.71	407.13	421.18
Standard Deviation	985.76	1035.09	1014.14	1061.74	1078.96
1st Quartile	28.35	30.68	30.26	30.37	29.06
Median	72.3	76.7	78.93	76.98	79.56
3rd Quartile	220.65	236.89	225.68	231.88	231.45
Kurtosis	35.17	26.74	28.55	26.85	24.00
Skewness	5.12	4.52	4.67	4.80	4.57
Log: Mean	4.48	4.54	4.52	4.53	4.54
Standard Deviation	1.61	1.63	1.61	1.62	1.62
Kurtosis	3.06	2.99	3.03	3.09	3.04
Skewness	0.50	0.51	0.52	0.51	0.52

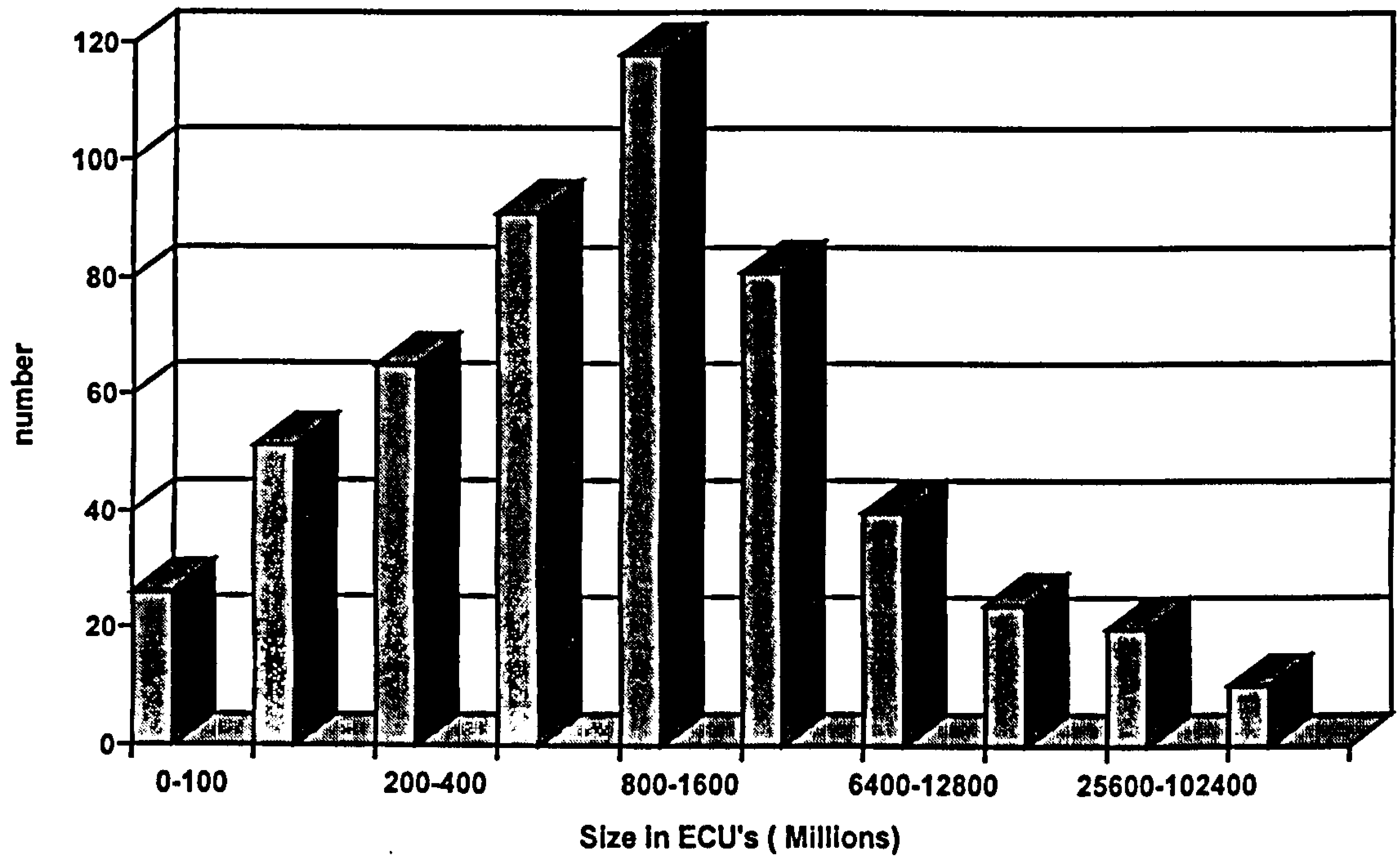
Table 6.6: Total Off Balance Sheet Asset Size of EU banks 1990 to 1994 (ECU million)

n = 451	1990	1991	1992	1993	1994
Mean	1351.92	1451.22	1747.80	2061.64	1997.28
Standard Deviation	5801.32	6573.10	7783.57	8672.53	8246.07
1st Quartile	22.87	24.74	28.27	26.51	27.01
Median	65.21	77.01	88.42	76.70	88.37
3rd Quartile	282.84	294.88	363.77	358.56	406.89
Kurtosis	67.54	80.08	54.76	47.61	44.62
Skewness	7.37	8.05	6.91	6.35	6.18
Log: Mean	4.48	4.58	4.70	4.70	4.76
Standard Deviation	2.15	2.11	2.14	2.20	2.19
Kurtosis	3.57	3.50	3.46	3.50	3.43
Skewness	0.48	0.53	0.53	0.64	0.57

Note: All figures are expressed in real terms (1990 as base).

zero when the logarithmic transformation is applied, suggesting that the lognormal distribution may provide a reasonable description of the data (Clarke, 1979).

Figure 6.3: The Size Distribution of EU Banks 1990



The size characteristics of the sample by bank ownership type and country are described in Tables 6.7 to 6.12. By country, the mean size of bank increased in most countries with the exception of Denmark and Italy. However, the median asset size fell in France, Italy, Spain and the UK. Median equity size increased in Belgium, France, Germany, Italy and the Netherlands. The median OBS size increased in all cases except Denmark and Italy.

The mean asset size increased for all bank types except co-operative banks, while the median size increases only for savings banks. The mean equity size increases for all bank types, while the median bank size increased for savings and co-operative banks, but not for commercial banks. Finally for OBS business, the mean bank size increased for commercial banks, but not for savings and co-operative banks, but the median size increased for all banks.

Table 6.7: Total Asset Size by Country 1990 and 1994 (real terms, 1990 base)

Total Sample = 617	Belgium		Denmark		France		Germany	
	1990	1994	1990	1994	1990	1994	1990	1994
Mean	8995.28	12413.09	2878.47	2745.29	10518.58	10714.87	8417.24	10972.26
Standard Deviation	18448.04	26058.40	9147.54	8064.11	33959.74	35220.60	26869.04	36161.50
1st Quartile	266	354.11	160.85	184.07	268	230.44	645	654.1
Median	776	908.81	280.90	311.30	916	719.99	1296.60	1589.36
3rd Quartile	3055.25	4268.74	587.95	617.59	3890.5	4321.63	3617.80	4699.80

Table 6.7: Total Asset Size by Country 1990 and 1994 (continued)

Total Sample = 617	Italy		Netherlands		Spain		United Kingdom	
	1990	1994	1990	1994	1990	1994	1990	1994
Mean	7699.86	6776.05	20109.79	23697.14	4386.9	4706.15	11010.99	11862.59
Standard Deviation	18659.23	16740.02	46324.73	54332.03	10626.59	12074.12	28066.90	28466.64
1st Quartile	616.1	486.82	190.90	200.72	485.9	344.04	582.95	504.99
Median	1182.95	953.33	1505.40	1781.03	1114.2	1106.84	2526.90	2072.35
3rd Quartile	3030.23	3145.52	3032.15	3272.00	2653.7	2721.26	6311.07	6752.79

Table 6.8: Total Equity Size by Country 1990 and 1994 (real terms, 1990 base)

Total Sample = 607	Belgium		Denmark		France		Germany	
	1990	1994	1990	1994	1990	1994	1990	1994
Mean	296.83	382.57	178.87	158.20	375.17	431.08	310.06	393.90
Standard Deviation	582.31	782.44	543.46	476.89	1048.84	1218.26	970.76	1214.56
1st Quartile	19	18.10	14.35	18.31	13.25	13.79	31.2	41.39
Median	47	59.63	32	29.05	32.50	34.05	55.2	73
3rd Quartile	110.5	121.38	65.65	43.66	156	165.26	147.8	191.3

Table 6.8: Total Equity Size by Country 1990 and 1994 (continued)

Total Sample = 607	Italy		Netherlands		Spain		United Kingdom	
	1990	1994	1990	1994	1990	1994	1990	1994
Mean	368.7	414.46	769.75	769.75	281.37	278.48	567.60	582.80
Standard Deviation	767.83	891.10	1734.50	1734.5	638.78	659.97	1367.54	1226.76
1st Quartile	42.98	49.57	34.45	34.45	40.33	35.13	42.87	36.67
Median	86.6	95.14	78.7	78.7	85.15	75.51	127.40	128.36
3rd Quartile	224.33	246.46	459.9	459.9	180.13	187.53	398.83	403.01

Table 6.9: Total Off Balance Sheet Asset Size by Country 1990 and 1994 (real terms, 1990 base)

Total Sample = 451	Denmark		France		Germany		Italy	
	1990	1994	1990	1994	1990	1994	1990	1994
Mean	335.06	387.56	2555.46	3129.01	660.51	2070.44	2342.05	977.56
Standard Deviation	1151.28	1378.74	8686.57	11081.43	2344.81	7768.68	8483.33	3236.13
1st Quartile	17.93	21.38	44.84	46.29	37.75	53.81	24.06	27.49
Median	37.02	34.86	181.7	209.84	84.25	141.05	62.46	55.75
3rd Quartile	97.76	77.63	823.9	958.74	202.97	423.04	347.58	195.45

Table 6.9: Total Off Balance Sheet Asset Size by Country 1990 and 1994 (continued)

	Netherlands		Spain		United Kingdom	
	1990	1994	1990	1994	1990	1994
Mean	3127.87	4020.30	110.60	147.15	1652.35	4656.37
Standard Deviation	9870.79	11968.58	247.16	538.94	4810.48	13259.25
1st Quartile	11.45	26.22	10.97	13.15	15.28	28.81
Median	111.07	112.17	29.52	38.4	116.2	254.4
3rd Quartile	314.81	973.60	77.21	92.32	1007.73	1570.44

Table 6.10: Total Asset Size by Bank Type 1990 and 1994 (real terms, 1990 base)

Total Sample = 617	Commercial Banks		Co-operative Banks		Savings Banks	
	1990	1994	1990	1994	1990	1994
Mean	10476.03	11406.96	2217.22	2035.59	4841.40	5180.19
Standard Deviation	29593.97	32994.99	4845.26	3730.77	9586.59	9981.63
1st Quartile	316	305.85	528.8	573.82	1030.2	957.58
Median	948.5	805.67	1055.3	983.88	1827.9	1850.93
3rd Quartile	4515.83	4553.58	1517.03	1533.70	3950.30	4904.03

Table 6.11: Total Equity Size by Bank Type 1990 and 1994 (real terms, 1990 base)

Total Sample = 607	Commercial Banks		Co-operative Banks		Savings Banks	
	1990	1994	1990	1994	1990	1994
Mean	461.67	99.87	123.83	128.11	239.11	304.56
Standard Deviation	1160.27	1259.54	246.71	199.48	472.09	597.88
1st Quartile	22.93	23.19	29	4.05	51.5	69.93
Median	57.35	49.91	49	71.63	96.9	126.14
3rd Quartile	250.53	260.47	108.83	109.23	202.80	244.70

Table 6.12: Total Off Balance Sheet Asset Size by Bank Type 1990 and 1994 (real terms, 1990 base)

Total Sample = 451	Commercial Banks		Co-operative Banks		Savings Banks	
	1990	1994	1990	1994	1990	1994
Mean	1751.19	2755.11	1209.96	262.94	204.84	189.77
Standard Deviation	6660.32	9737.76	5694.41	589.36	932.79	346.58
1st Quartile	25.49	26.15	25.02	32.29	20.42	32.15
Median	88.28	103.11	47.48	77.03	42.39	58.39
3rd Quartile	484.82	624.95	106.71	254.26	113.66	177.97

6.3.2 The Growth Of Banks

Tables 6.13 - 6.15 show the mean and standard deviations of the logarithmic growth rates over the period 1990-94 by bank type and country for each size measure separately. For the entire sample on average, size measured by equity and off balance sheet business grew slightly, and size measured by total assets declined slightly. There was positive growth in all size measures for all countries except France, Italy and Spain, which each experienced negative growth in two of the three size measures used. These banking markets were the among the most regulated in the EU during the 1980s, and thus may have suffered more as de-regulation, increased competition and a deterioration in their respective domestic macroeconomic conditions impinged on their growth prospects (EU, 1997a).[7]

On average, savings and co-operative banks experienced positive real growth over the period on all measures, while commercial banks, experienced slightly negative growth measured by assets. The negative asset growth of commercial banks may be indicative of a greater focus of commercial banks on equity growth, along with increasing importance of off balance sheet business (Metais, 1997).

The evolution of the banking industry over the period 1990 to 1994 can be described by comparing the size distribution at the start and end of the period. Tables 6.16 - 6.18 show the size distributions of banking firms in 1990 and 1994, in the form of transition matrices which also illustrate the mobility of the sample between different size bands. The sample is divided into five size bands based on size in 1990.

For assets, Table 6.16 shows that more banks fell in the ECU < 500 million size class in 1994 than in 1990. Fewer banks appeared in the ECU 200-400 million and ECU 400 - 800 million class, while greater numbers of banks fell into > ECU 800 million size class in 1994 than in 1990. Overall, the distribution of firm sizes has become more dispersed over the sample period. For equity, Table 6.17 tends to show a pattern of overall growth in the average size of firm with fewer

[7] See chapter 2 for an extended discussion of these arguments.

Table 6.13: Mean, Standard Deviation and Coefficient of Variation For Assets Growth 1990-1994 (ECU Millions)

Country	Commercial			Co-operative			Savings			All Banks		
	Mean	Std	C.V.	Mean	Std	C.V.	Mean	Std	C.V.	Mean	Std	C.V.
Belgium	0.218	0.181	1.20	-	-	-	-	-	-	0.218	0.181	1.20
Denmark	0.074	0.377	0.20	-	-	-	-	-	-	0.074	0.377	0.20
France	-0.124	0.400	0.31	-	-	-	-	-	-	-0.124	0.400	0.31
Germany	0.128	0.299	0.43	0.197	0.202	0.975	0.218	0.159	1.37	0.167	0.250	0.668
Italy	-0.147	0.211	-0.70	-0.130	0.184	-0.706	-0.281	0.166	-1.69	-0.191	0.199	0.96
Netherlands	0.157	0.354	0.44	-	-	-	-	-	-	0.157	0.354	0.44
Spain	-0.217	0.898	-0.24	-	-	-	0.071	0.126	0.56	-0.096	0.702	0.014
United Kingdom	-0.040	0.766	0.05	-	-	-	0.104	0.178	0.584	0.000	0.660	0
Total	-0.055	0.574	0.09	-0.016	0.246	-0.065	0.014	0.244	0.06	-0.034	0.490	0.07

Note:
- Denotes no banks in the sample falling into this particular category
Figures expressed in real terms (1990 as base).

Table 6.14: Mean, Standard Deviation and Coefficient of Variation For Equity Growth 1990-1994 (ECU Millions)

Country	Commercial			Co-operative			Savings			All Banks		
	Mean	Std	C.V.	Mean	Std	C.V.	Mean	Std	C.V.	Mean	Std	C.V.
Belgium	0.102	0.210	0.486	-	-	-	-	-	-	0.102	0.210	0.49
Denmark	-0.063	0.426	-0.148	-	-	-	-	-	-	-0.063	0.426	-0.15
France	0.054	0.411	0.13	-	-	-	-	-	-	0.054	0.411	0.13
Germany	0.164	0.310	0.53	0.408	0.199		0.253	0.154	1.64	0.238	0.279	0.85
Italy	-0.019	0.371	0.05	0.107	0.224		0.371	0.301	1.23	0.149	0.359	0.42
Netherlands	0.212	0.119	1.78	-	-	-	-	-	-	0.212	0.118	1.80
Spain	-0.246	0.507	-0.49	-	-	-	0.173	0.164	1.05	-0.069	0.450	-0.15
United Kingdom	-0.009	0.566	-0.02	-	-	-	0.243	0.178	1.37	0.061	0.502	0.12
Total	0.003	0.453	0.01	0.211	0.258	0.82	0.258	0.224	1.15	0.085	0.410	0.21

- Denotes no banks in the sample falling into this particular category

Table 6.15: Mean, Standard Deviation and Coefficient of Variation For Off Balance Sheet Growth 1990-1994 (ECU Millions)

Country	Commercial			Co-operative			Savings			All Banks		
	Mean	Std	C.V.	Mean	Std	C.V.	Mean	Std	C.V.	Mean	Std	C.V.
Denmark	0.023	0.479	0.05	-	-	-	-	-	-	0.023	0.479	0.05
France	0.195	1.08	0.18	-	-	-	-	-	-	0.195	1.08	0.18
Germany	0.269	0.907	0.30	0.558	0.541	1.03	0.857	0.359	2.39	0.494	0.774	0.0.64
Italy	-0.445	0.994	-0.44	0.253	1.00	0.25	-0.136	1.254	0.101	-0.132	1.14	0.12
Netherlands	0.549	1.04	0.53	-	-	-	-	-	-	0.549	1.04	0.53
Spain	0.030	0.981	0.03	-	-	-	0.317	0.577	0.55	0.156	0.837	0.19
United Kingdom	0.739	1.29	0.57	-	-	-	-	-	-	0.739	1.29	0.57
Total	0.240	1.07	0.22	0.389	0.831	0.47	0.352	0.866	0.41	0.275	1.01	0.27

- Denotes no banks in the sample falling into this particular category

Table 6.16: Transition Matrix for EU Banks 1990 to 1994 (based on real total assets)

Size class (millions ECU's) 1990 Prices	<500	500-1000	1000-2000	2000-4000	>4000	1990 total
<500	157	15	1	0	0	173
500-1000	26	56	17	0	0	97
1000-2000	1	26	69	15	0	111
2000-4000	2	0	14	46	19	81
>4000	0	0	1	7	145	153
1994 totals	186	97	102	68	164	617

Table 6.17: Transition Matrix for EU Banks 1990 to 1994 (based on real total equity)

size class (millions ECU's) 1990 Prices	<30	30-60	60-120	120-240	>240	1990 total
< 30	136	23	1	0	0	160
30-60	13	71	38	1	0	123
60-120	5	14	55	25	1	100
120-240	1	3	2	63	14	83
>240	0	0	1	6	134	141
1994 total	155	111	97	95	149	607

Table 6.18: Transition Matrix for EU Banks 1990 to 1994 (based on real off balance sheet assets)

Size class (millions ECU's) 1990 Prices	<50	50-100	100-200	200-400	>400	1990 total
<50	153	29	7	4	2	195
50-100	17	24	19	6	2	68
100-200	6	3	16	20	9	54
200-400	2	4	7	14	12	39
> 400	2	0	1	3	89	95
1994 total	180	60	50	47	114	451

banks falling into the three lower size bands, and greater numbers falling into the two highest size bands in 1994 than in 1990. This pattern is repeated for off balance sheet business in Table 6.18.

6.4 EU Manufacturing Sample

The data for the empirical investigation of manufacturing firms was collected from the DATASTREAM accounts database. The sample period is 1990-1994. The sample comprises manufacturing firms from five EU countries, namely UK, Germany, France, Italy and Spain.[8] The firms were classified into eleven broadly defined manufacturing industries: alcoholic beverages, building materials, chemicals, diversified industrials, electronics, engineering, food, household products, pharmaceuticals, paper and packaging and textiles.

The size measure is net assets, defined as fixed assets plus current assets minus current liabilities. This measure was chosen partly because it was available for more firms than other possible measures (such as turnover and employment), and partly to allow comparisons with other studies which have adopted this measure. In any case, evidence suggests that most commonly used measures of size tend to be highly correlated (Hart and Oulton, 1996). The sample selection procedure yielded 757 firms, for which five years of complete data was available covering the period 1990-1994. Table 6.19 classifies the sample firms by industrial group and country.

6.4.1 The Size of Manufacturing Firms

Table 6.20 provides summary statistics relating to firm sizes. The mean firm size, along with the standard deviation and median size increased over the sample period. The size distribution of firms also exhibits a positive skew indicating a few large firms and numerous smaller firms characterise all manufacturing industries (see Figure 6.4). The distribution is more skewed than that observed for banks, suggesting a greater dispersion of firm size in manufacturing. However, as before, the firm size distribution exhibits near normality when a logarithmic transformation is carried out.

[8] It was initially hoped to collect data on the same countries from which the sample of banks were drawn. However, the coverage of the DATASTREAM database did not permit such a selection.

Table 6.19: The Sample of Manufacturing Firms

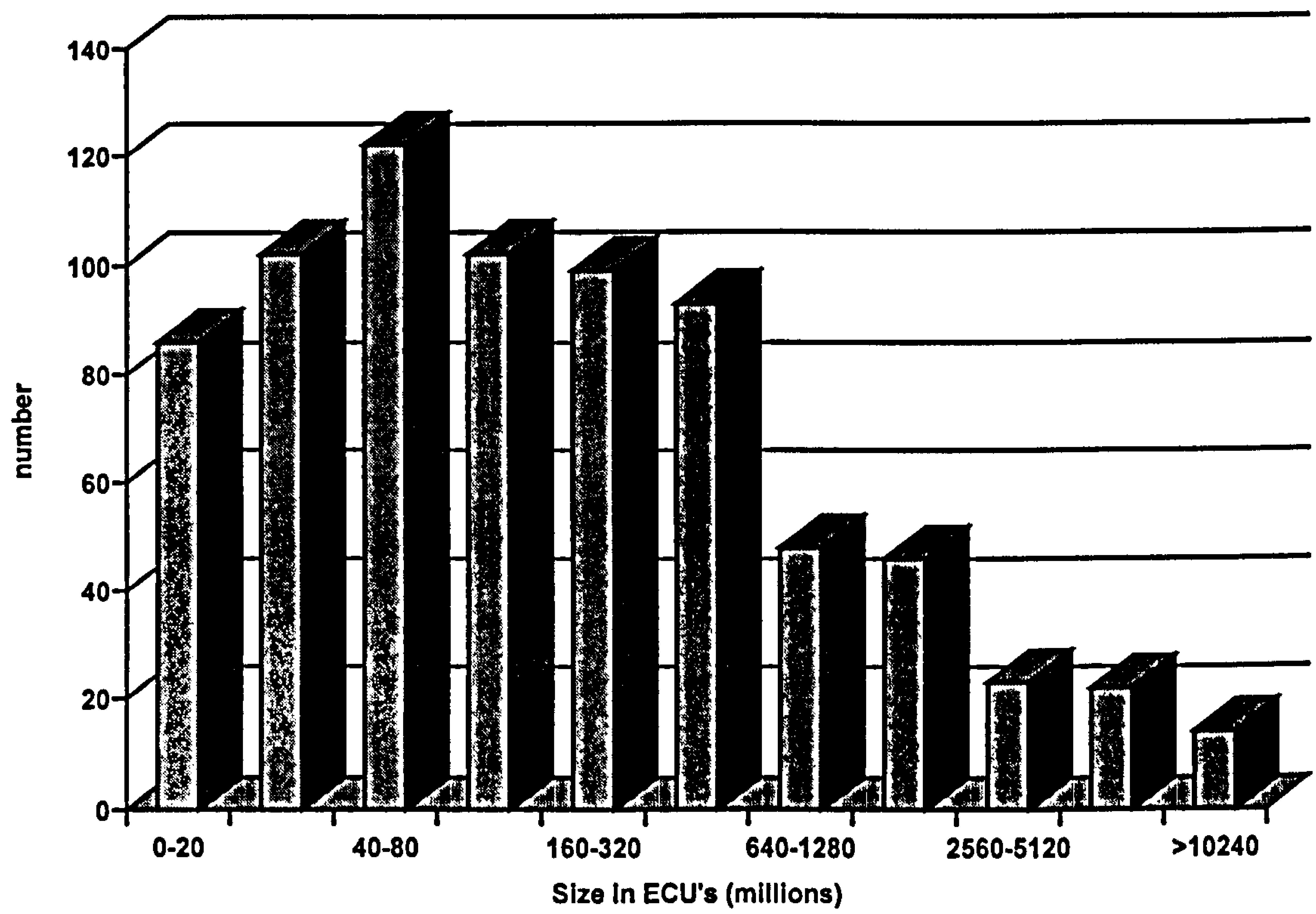
Sector	France	Germany	Italy	Spain	UK	Total
Alcoholic beverages	7	32	0	3	9	51
Building materials	11	31	5	4	25	76
Chemicals	10	19	3	2	19	53
Diversified Industrials	14	30	3	2	18	67
Electricals and office equipment	19	35	3	1	27	85
Engineering	21	95	8	7	75	206
Food producers	13	12	1	2	20	48
Household goods	4	12	0	0	11	27
Pharmaceuticals	7	11	0	0	17	35
Paper and Packaging	5	14	3	1	22	45
Textiles and apparel	5	38	3	0	18	64
Total	116	329	29	22	261	757

Table 6.20: Net Asset Size of EU firms 1990 to 1994 (ECU million)

n = 757	1990	1991	1992	1993	1994
Mean	906.33	932.02	927.30	967.04	967.61
Standard Deviation	2692.82	2775.28	2791.78	3006.42	2972.63
1st Quartile	40.6	42.7	41.65	45.67	47.41
Median	122.48	129.46	127.62	141.38	142.88
3rd Quartile	495.81	523.63	496.87	482.66	493.68
Kurtosis	51.54	52.87	54.63	63.44	58.08
Skewness	6.21	6.29	6.42	6.99	6.75
Log: Mean	5.03	5.08	5.07	5.12	5.14
Standard Deviation	1.81	1.81	1.81	1.80	1.77
Kurtosis	2.80	2.79	2.83	2.96	2.88
Skewness	0.41	0.39	0.39	0.37	0.44

Note:
Figures expressed in real terms (1990 as base).

Figure 6.4: The Size Distribution of EU Manufacturing Firms



By country, the mean asset size increased for French, German and UK manufacturing firms over the sample period, but not for Italian and Spanish firms (see Table 6.21), while the median firm size increased in France and Germany only. By manufacturing industry, the mean size increased in all industries except chemicals. However, median firm size fell in seven of the eleven industries sampled (see Table 6.22).

6.4.2 The Growth Of Manufacturing Firms

This section adopts the same method as section 6.3.2, to examine the growth of manufacturing firms. Table 6.23, shows average net asset growth between 1990 to 1994. Taking the sample as a whole, mean growth over the period 1990 to 1994 was positive. By country, for the UK, German and French samples, growth was positive, while for Italy and Spain mean growth was negative. On average, German firms experienced the fastest growth over the period.

Table 6.21: Net Asset Size by Country 1990 and 1994 (real terms)

total sample = 757	France		Germany		Italy		Spain		United Kingdom	
	1990	1994	1990	1994	1990	1994	1990	1994	1990	1994
Mean	1399.79	1588.34	703.29	805.68	2425.77	2059.48	711.48	629.39	790.54	803.03
Standard Deviation	2540.94	2848.27	2622.64	3052.19	4917.23	4139.47	949.70	1102.33	2537.69	2834.59
1st Quartile	109.28	137.1	27.27	32.78	377.72	388.32	200.12	176.18	46.66	50.79
Median	333.13	386.45	71.14	79.72	630.01	550.07	427.56	343.96	116.89	115.41
3rd Quartile	1123.45	1430.50	253.89	307.37	1497.54	2170.13	670.17	572.29	458.49	428.52

Table 6.22: Net Asset Size by Industry 1990 and 1994 (real terms)

total sample = 757	Alcohol		Building Materials		Chemicals		Diversified Industrials	
	1990	1994	1990	1994	1990	1994	1990	1994
Mean	1277.18	1450.71	725.30	789.35	1825.52	1723.15	1192.77	1373.81
Standard Deviation	4610.03	5476.97	1344.19	1406.77	3650.97	3589.72	2585.22	3035.36
1st Quartile	24.97	26.04	47.07	63.18	80.63	82.46	67.26	65.04
Median	64.41	76.53	245.65	263.03	231.17	244.54	170.26	171.41
3rd Quartile	155.32	263.90	634.99	628.26	1068.02	894.94	703.20	921.20

Table 6.22: Net Asset Size by Industry 1990 and 1994 (continued) (real terms)

total sample = 757	Electricals		Engineering		Food		Household	
	1990	1994	1990	1994	1990	1994	1990	1994
Mean	926.85	953.62	1014.86	1031.43	851.95	1080.88	311.14	388.11
Standard Deviation	3187.51	3514.53	3049.81	3284.68	1750.80	2156.33	508.86	713.03
1st Quartile	27.70	32.51	50.05	55.36	90.38	103.63	20.63	37.72
Median	69.96	69.72	155.39	149.88	228.11	258.97	91.29	74.38
3rd Quartile	387.33	369.45	492.75	471.34	869.03	694.84	283.09	400.53

Table 6.22: Net Asset Size by Industry 1990 and 1994 (continued) (real terms)

total sample = 757	Pharmaceuticals		Paper and Packaging		Textiles	
	1990	1994	1990	1994	1990	1994
Mean	493.58	638.26	376.99	379.30	277.91	309.83
Standard Deviation	964.61	1219.26	554.84	544.77	1109.72	1234.75
1st Quartile	53.22	82.97	46.69	54.16	20.8	28.65
Median	109.32	163.82	140.59	132.81	44.92	62.91
3rd Quartile	313.33	559.99	467	401.3	107.87	175.22

Table 6.23: Mean, Standard Deviation and Coefficient of Variation For Net Asset Growth in 1990-1994 (in natural logs)

	France			Germany			Italy			Spain			United Kingdom			All Firms		
	Mean	Std	C.V.	Mean	Std	C.V.	Mean	Std	C.V.	Mean	Std	C.V.	Mean	Std	C.V.	Mean	Std	C.V.
Alcoholic Beverages	0.223	0.161	1.39	0.185	0.346	0.53	-	-	-	-0.188	0.231	-0.81	0.215	0.342	0.63	0.174	0.327	0.54
Building Materials	0.095	0.243	0.39	0.265	0.538	0.49	0.266	0.417	0.64	0.078	0.658	0.12	-0.011	0.345	0.03	0.140	0.452	0.31
Chemicals	0.102	0.268	0.38	0.087	0.273	0.32	-0.434	0.190	-2.28	-1.13	0.808	-1.36	0.034	0.473	0.07	-0.005	0.442	-0.01
Diversified Industrials	0.177	0.418	0.42	0.237	0.908	0.26	-0.127	0.450	-0.28	-0.05	0.346	-0.14	0.055	0.634	0.09	0.151	0.720	0.209
Electricals	0.062	0.529	0.12	0.135	0.485	0.28	-0.169	0.406	-0.42	-1.41	n/a	n/a	0.094	0.562	0.16	0.077	0.534	0.144
Engineering	-0.099	0.301	-0.33	0.059	0.527	0.11	-0.053	0.356	-0.148	-0.167	0.475	-0.35	0.019	0.531	0.04	0.017	0.502	0.03
Food Producers	0.215	0.493	0.44	0.298	0.429	0.69	-0.696	n/a	n/a	0.382	0.608	0.63	0.141	0.391	0.36	0.193	0.444	0.435
Households Goods	0.503	0.268	1.88	0.255	0.460	0.55	-	-	-	-	-	-	0.034	0.285	0.12	0.201	0.395	0.51
Pharmaceuticals	0.388	0.280	1.39	0.421	0.682	0.62	-	-	-	-	-	-	0.227	0.631	0.37	0.320	0.588	0.54
Paper and Packaging	-0.154	0.320	-0.48	0.034	0.536	0.06	0.217	0.940	0.23	-0.570	n/a	n/a	0.194	0.422	0.46	0.090	0.494	0.18
Textiles	-0.012	0.323	0.04	0.257	0.812	0.32	0.098	0.302	0.32	-	-	-	0.164	0.555	0.29	0.202	0.697	0.29
All Firms	0.102	0.393	0.26	0.167	0.584	0.29	-0.04	0.464	-0.09	-0.228	0.628	-0.36	0.083	0.498	0.17	0.109	0.531	0.21

N/A denotes no observations from a particular industry grouping by country
N/C denotes insufficient observations to enable calculations

By manufacturing industry, all industries experienced positive mean growth. Firms operating in the pharmaceuticals industry enjoyed the fastest mean growth, and chemical firms on average experienced the slowest growth. Within countries, some industries experienced negative growth, including building materials in the UK; engineering in Italy, France and Spain; paper in France and Spain; and chemicals, diversified industrials and electronics in Italy and Spain.

Table 6.24 shows the size distribution of firms by size class in 1990 and 1994. The sample was split into five size bands based on initial size. These size bands ranged from firms with net assets of less than ECU 60 million to firms with net assets greater than ECU 480 million. Over the period 1990 to 1994, the numbers of firms in both the smallest and largest size classes decreased, while the numbers operating in the three middle size bands increased. Such a pattern of mobility through the size classes suggests that sizes were converging toward some average level. This is perhaps consistent with the notion that firms must aim to produce at a critical scale in order to survive (Stigler, 1968), and that there are diseconomies of scale at the top end of the size distribution.

6.5 Conclusions

This chapter has described the sources and characteristics of data to be used in the present study of the size and growth of EU banks along with a comparative sample of manufacturing firms during the period 1990 to 1994.

Between 1990 and 1994, the average bank size has increased when measured using total assets, equity and off balance sheet business. Average bank growth, however, is negative for total assets over the period 1990 to 1994 and positive for equity and off balance sheet business. There also appears to be some mobility of banks through the size classes over this period, with the firm size distribution becoming more dispersed.

By country, banks in Germany, Netherlands and the United Kingdom enjoyed positive mean growth in assets, equity and off balance sheet business, while banks located in France, Italy and

Table 6.24: Transition Matrix for European Manufacturing Firms 1990 to 1994 (real net assets)

size class millions (ECU's) 1990 Prices	<60	60-120	120-240	240-480	>480	opening total
<60	204	42	9	0	1	256
60-120	22	68	19	8	0	117
120-240	3	18	54	24	1	100
240-480	0	0	16	56	17	89
>480	0	1	0	20	174	195
closing totals	229	129	98	108	193	757

Spain tended to fair less well. Co-operative and savings banks tended on the whole to enjoy higher growth than commercial banks. However, these differences appear to be relatively small.

From the discussion of the manufacturing sample, the average manufacturing firm increased in size over the sample period. Mean growth was generally positive over the period. However, the UK, and German firms experienced higher growth, while many French, Spanish and Italian firms experienced negative growth. There appears to be some mobility in the sample, with firms initially in the lower size classes moving into higher size classes, while some firms in higher size bands moved down the size distribution. This perhaps suggests a convergence in firm sizes toward some average level.

The descriptive statistics presented above help identify differences in the growth characteristics of the sample. For example, it may be significant that sample banks and manufacturing firms based in the UK and Germany tended to enjoy higher growth than their counterparts in France, Italy and Spain. This may suggest that the fortunes of banks might be closely linked to the success or failure of manufacturing firms, or that macroeconomic conditions differ across countries.

CHAPTER 7

TESTING THE LAW OF PROPORTIONATE EFFECT FOR EU BANKING AND MANUFACTURING FIRMS

7.1 Introduction

Drawing on the methodology described in chapter 6, this chapter tests the Law of Proportionate Effect (LPE) for samples consisting of EU banking and manufacturing firms. Several contributions are made to existing knowledge. Firstly, no study to date has explicitly examined the relationship between size and growth of firms for the EU banking industry, and this study fills this void. Secondly, the results analyse the similarities or differences in the size-growth relationship between manufacturing and banking firms. Thirdly, the evidence on the size-growth relationship for EU manufacturing firms augments previous manufacturing evidence, which to my knowledge is based on data restricted to single countries.

The rest of the chapter is structured as follows. Section 7.2 tests the LPE for a sample of banks drawn from eight EU countries. Section 7.3 does the same for a sample of manufacturing firms drawn from five EU countries. Section 7.4 examines differences between the results for banking and manufacturing. In section 7.5 the influence of age on bank and manufacturing firm growth is analysed. Conclusions are drawn in section 7.6.

7.2 Testing the LPE for EU Banks

This section presents tests of the LPE for the sample of EU banks. The model of bank growth is estimated in two ways, with and without persistence in growth rates. Section 7.2.1 presents the results for the model of firm growth with persistence of growth, while section 7.2.2 discusses the results for the model without persistence of growth. Given the empirical importance of persistence of growth, the majority of the commentary is based on the results presented in section 7.2.1.

7.2.1 A Model of Bank Growth Including Persistence of Growth

The method for testing the LPE was discussed in detail in the previous chapter. In general, it involves starting with a general model of the form

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{f=2}^{F} \delta_3^f d_{3it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + \sum_{c=2}^{C} \rho_3^c e_{3it}^c + u_{it} \qquad (1)$$

Equation (1) allows for the presence of a full set of bank type and country effects on all three coefficients, i.e. β_1, β_2 and β_3. In order to arrive (where possible) at a more parsimonious specification, Wald tests for exclusion restrictions on the bank type and country effect dummies are carried out along the lines described in Figure 6.1. The final model is the one used to test the LPE.

The results of the tests for the joint significance of different permutations of bank type and country dummies, presented in the form of probability values (i.e. minimum significance levels at which the exclusion restriction specified in the null hypothesis can be accepted) for the Wald tests are shown in Table 7.1 for each of the three size measures. Small probability-values (i.e. of less than 0.05) in Table 7.1 indicate rejection of the exclusion restriction for the set of dummies concerned. The results for each of the three size measures are now discussed.

Assets

The tests for bank type effects in equation (1) suggest that the null hypotheses of $\{\delta_1^f\}$=0, $\{\delta_2^f\}$=0 and $\{\delta_3^f\}$=0 can be accepted, along with $\{\delta_2^f \cap \delta_3^f\}$ = 0, $\{\delta_1^f \cap \delta_3^f\}$=0, $\{\delta_1^f \cap \delta_2^f\}$=0 and $\{\delta_j^f\}$=0. Given that all bank type effects are insignificant, equation (2) can be accepted. When examining country effects, it is possible to eliminate either ρ_1^c, ρ_2^c, or ρ_3^c individually from equations (1) and (2), but not all three together. Further tests on the intermediate nodes between

Table 7.1: Tests For Bank Type and Country Effects 1992 - 1994

Null	Eq'n	p-values Assets	Equity	OBS	Null	Eq'n	p-values Assets	Equity	OBS
Bank Type Effects					Country Effects				
$\delta_1^f = 0$	1	0.789	0.357	0.002	$\rho_1^c = 0$	1	0.307	0.266	0.026
$\delta_2^f = 0$	1	0.923	0.764	0.048	$\rho_2^c = 0$	1	0.183	0.740	0.000
$\delta_3^f = 0$	1	0.858	0.833	0.971	$\rho_3^c = 0$	1	0.535	0.365	0.398
$\delta_2^f \cap \delta_3^f = 0$	1a	0.475	0.004	0.492	$\rho_2^c \cap \rho_3^c = 0$	1d	0.000	0.000	0.000
$\delta_1^f \cap \delta_3^f = 0$	1b	0.429	0.002	0.051	$\rho_1^c \cap \rho_3^c = 0$	1e	0.000	0.000	0.000
$\delta_1^f \cap \delta_2^f = 0$	1c	0.449	0.002	0.003	$\rho_1^c \cap \rho_2^c = 0$	1f	0.000	0.000	0.000
$\delta_j^f = 0$	1	0.679	0.007	0.014	$\rho_j^c = 0$	1	0.000	0.000	0.000
Country Effects					Bank Type Effects				
$\rho_1^c = 0$	2	0.375	0.233	0.205	$\delta_1^f = 0$	3	0.918	0.185	0.001
$\rho_2^c = 0$	2	0.204	0.628	0.000	$\delta_2^f = 0$	3	0.862	0.500	0.001
$\rho_3^c = 0$	2	0.553	0.246	0.228	$\delta_3^f = 0$	3	0.377	0.129	0.019
$\rho_2^c \cap \rho_3^c = 0$	2a	0.000	0.000	0.000	$\delta_2^f \cap \delta_3^f = 0$	3a	0.547	0.001	0.005
$\rho_1^c \cap \rho_3^c = 0$	2b	0.000	0.000	0.000	$\delta_1^f \cap \delta_3^f = 0$	3b	0.568	0.001	0.005
$\rho_1^c \cap \rho_2^c = 0$	2c	0.000	0.000	0.000	$\delta_1^f \cap \delta_2^f = 0$	3c	0.865	0.002	0.000
$\rho_j^c = 0$	2	0.000	0.000	0.000	$\delta_j^f = 0$	3	0.780	0.002	0.000
Bank Type and Country Effects									
$\delta_j^f \cap \rho_j^c = 0$	1	0.000	0.000	0.000					
Heteroscedasticity									
$\sigma_{it}^2 = \sigma^2$	1	0.667	0.745	0.495					

Note: The heteroscedasticity tests report p-values from tests carried out by obtaining nR^2 from an auxiliary regression of the residuals on the squares of s_{it-1}. The test statistic is distributed $\chi^2(1)$ under the null hypothesis of homoscedasticity.

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{f=2}^{F} \delta_3^f d_{3it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + \sum_{c=2}^{C} \rho_3^c e_{3it}^c + u_{it} \quad (1)$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + \sum_{c=2}^{C} \rho_3^c e_{3it}^c + u_{it} \quad (2)$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{f=2}^{F} \delta_3^f d_{3it}^f + u_{it} \quad (3)$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + u_{it} \quad (4)$$

equation (2) and equation (4) accepted $\{\rho_1^c\} = 0$ in equation (2c) and $\{\rho_3^c\}=0$ in equation (2a), but rejected any attempts to exclude ρ_2^c. Therefore, the final model specification for the assets equation is as follows:

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it}$$

The estimation results are shown in Table 7.2. For the purposes of presentation, the sums of $\hat{\beta}_2$ and its shift parameter $\hat{\rho}_2^c$ together with associated standard errors are shown for each country. Therefore, these reported values are interpreted as bank type specific estimates of the slope coefficients on s_{it-1}. The coefficients $\hat{\beta}_1$ and $\hat{\beta}_3$ are common to all banks in the sample.

The tests reject the LPE for French, Italian and Spanish banks, for which $\hat{\beta}_2 + \hat{\rho}_2^c$ is significantly less than one, implying that smaller banks grew faster than larger banks, with the estimated coefficients significantly smaller than one at the 5% level for Italy, and at the 10% level for France and Spain. This implies that for these countries, there was some tendency for bank sizes to revert towards a long run equilibrium value. Individual growth rates for 1990-1992 appear to have persisted significantly into 1992-1994 ($\hat{\beta}_3$>0) in a pattern which did not differ significantly between countries; i.e. banks which grew faster (slower) than average in 1990-1992 tended to repeat this performance again in 1992-1994. There is no evidence of heteroscedasticity in growth rates across the sample.

The finding that the LPE does not hold for Italian and Spanish banks may be a reflection of the substantial restructuring which took place in these banking markets in the response to the EU's Single Market programme (which came into force in 1992). Italian and Spanish banks may have had to make more sweeping regulatory changes than was the case in other EU countries, in order

Table 7.2: Estimation Results 1992-1994

Assets								
$\hat{\beta}_1$	0.0275 (0.0588)							
	Bel	Den	Fra	Ger	Ita	Net	Spa	UK
$\hat{\beta}_2 + \hat{\rho}_2^c$	1.008 (0.0132)	1.0071 (0.0144)	0.9878^{+} (0.0088)	1.0119 (0.0087)	0.9819^{x} (0.0086)	1.0131 (0.0130)	0.9861^{+} (0.0089)	1.0049 (0.0083)
$\hat{\beta}_3$	0.1248^{*} (0.0459)							
	n = 617	$\hat{\sigma}$ =0.34		R^2 =0.08		$\overline{R}^2$ =0.07		Het =0.31
Equity								
$\hat{\beta}_1$	0.0566^{+} (0.0337)							
	Comm	Coop	Savings					
$\hat{\beta}_2 + \hat{\delta}_2^f$	1.0017 (0.0159)	1.0286 (0.0196)	1.0238 (0.0169)					
	Bel	Den	Fra	Ger	Ita	Net	Spa	UK
$\hat{\beta}_2 + \hat{\rho}_2^c$	1.0017 (0.0159)	0.9960 (0.0169)	0.9756^{*} (0.0092)	1.0095 (0.0092)	0.9662^{*} (0.0085)	1.0166 (0.0147)	0.9588^{*} (0.0088)	1.0093 (0.0083)
$\hat{\beta}_3$	-0.0095 (0.0405)							
	n = 607	$\hat{\sigma}$ =0.27		R^2 =0.15		$\overline{R}^2$ =0.13		Het =0.17
Off Balance Sheet Business								
	Comm	Coop	Savings					
$\hat{\beta}_1 + \hat{\delta}_1^f$	0.0997 (0.3731)	1.234^{x} (0.539)	0.7714^{+} (0.4510)					
	Comm	Coop	Savings					
$\hat{\beta}_2 + \hat{\delta}_2^f$	0.9760 (0.0884)	0.7971^{+} (0.1178)	0.8774 (0.1043)					
	Den	Fra	Ger	Ita	Net	Spa	UK	
$\hat{\beta}_1 + \hat{\rho}_1^c$	0.0997 (0.3731)	0.2581 (0.1894)	-0.5451^{x} (0.2301)	-0.3839 (0.2813)	0.5510^{+} (0.3156)	-0.0365 (0.1957)	0.4826^{x} (0.1942)	
	Den	Fra	Ger	Ita	Net	Spa	UK	
$\hat{\beta}_2 + \hat{\rho}_2^c$	0.9760 (0.0884)	0.9518^{+} (0.0318)	1.1809^{*} (0.0449)	0.9051^{x} (0.0486)	0.9437 (0.0575)	0.9905 (0.0464)	1.0159 (0.0345)	
$\hat{\beta}_3$	-0.1353^{*} (0.0409)							
	n = 451	$\hat{\sigma}$ =0.67		R^2 =0.36		$\overline{R}^2$ =0.33		Het =0.29

* = significant at 1% level ^{x} = significant at 5% level $^{+}$ = significant at 10% level

Notes: Tests for significance of $\hat{\beta}_2$ are one tail (i.e. H_0: $\beta_2 = 1$ against H_1: $\beta_2 < 1$).

Tests for significance for $\hat{\beta}_1$ and $\hat{\beta}_3$ are two tail.

Standard errors of estimated coefficients are shown beneath in parentheses.

The heteroscedasticity tests (Het) are nR^2 from an auxiliary regression of the residuals on the squares of s_{it-1}. The test statistic is distributed χ^2 (1) under the null hypothesis of homoscedasticity.

to comply with the 1992 legislation (EU, 1997a).[1] The EU study also notes that the largest banks had to adjust their operations more significantly than the smaller banks because of the threat of potential competition from foreign banks.[2] These adjustments may perhaps have acted as a drag on the growth of large banks relative to their smaller counterparts. For France, the rejection of the LPE may be explained by the adjustments by larger banks to the sluggish performance of the national economy in the early 1990s (Morgan Stanley, 1995), which again may have inhibited the growth of the banks concerned.

Equity

The tests for the significance of the various groups of dummies in equation (1) for the equity estimations reported in Table 7.1, did not provide a clear indication of the most appropriate model specification. For country effects, the restrictions $\{\rho_1^c\}=0$, $\{\rho_2^c\}=0$ and $\{\rho_3^c\}=0$ can be accepted individually in equations (1), but are rejected in pairs in equations (1d), (1e) and (1f) and collectively ($\rho_j^c = 0$). For bank type effects, the restrictions $\{\delta_1^f\}=0$, $\{\delta_2^f\}=0$ and $\{\delta_3^f\}=0$ can be accepted, when tested individually in equation (1). However, these types of effects are rejected in pairs in equations (1a), (1b) and (1c), and collectively in equation (1). Further testing which experimented with various permutations of bank type and country effects accepted a specification, which included bank type and country slope dummies, but excluded all other dummies, as follows:

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it}$$

The estimation results are shown in Table 7.2. Two complete sets of bank type and country slope coefficients are included, $\hat{\beta}_2 + \hat{\rho}_2^c$ and $\hat{\beta}_2 + \hat{\delta}_2^f$ respectively, along with values for $\hat{\beta}_1$ and $\hat{\beta}_3$ which are common to all banks.

[1] Chapter 2 provides a detailed discussion of the regulatory changes across EU member states.
[2] Baumol, Panzar and Willig (1982) and chapter 3 of this thesis provide a detailed discussion of the effects of potential competition on incumbent firms.

The results indicate rejection of the LPE in three cases, with values of $\hat{\beta}_2 + \hat{\rho}_2^c$ significantly below one recorded for France, Italy and Spain. The pattern of results is therefore very similar to those obtained for assets. However, for the equity measure, there is no evidence of serial correlation in growth rates. While the impact of the EU's Single Market Programme perhaps accounts for the faster growth of smaller banks than their larger counterparts in Italy and Spain, (as with the assets results), the French results for equity may reflect the substantial downturn in the domestic economy, which was especially marked between 1992 and 1995. Many large French banks were forced to make substantial provisions for bad and doubtful debts over this period, causing profits and growth to suffer (Morgan Stanley, 1995, 1996), with one of France's largest banks, Credit Lyonnais, being bailed out by the government. This example reflects the general poor performance of many of France's largest banks during this period. However, across the other five countries in the sample the LPE holds. Once again, no evidence of heteroscedasticity in growth rates is found over the sample of banks.

Off Balance Sheet Business (OBS)

For off balance sheet business, the results of the tests for bank type effects in equation (1), which are reported in Table 7.1, are slightly ambiguous. Several of the restrictions are close to the border between acceptance and rejection, depending on whether the significance level chosen is 5% or 10%. At the 5% level, the tests suggest that bank type intercept and slope dummies, and country intercept and slope dummies should be included. The tests allow the acceptance of the null hypotheses of $\{\rho_3^c\}$=0 and $\{\delta_3^f\}$=0. Therefore, the final model specification for off balance sheet business is as follows:

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it}$$

In Table 7.2, separate values of $\hat{\beta}_1 + \hat{\delta}_1^f$, $\hat{\beta}_1 + \hat{\rho}_1^c$, $\hat{\beta}_2 + \hat{\delta}_2^f$ and $\hat{\beta}_2 + \hat{\rho}_2^c$ are shown for each bank type and each country.

The results for off balance sheet business generally show greater variation between different types of banks and between different countries in patterns of growth, than is the case for assets and equity. $\hat{\beta}_2 + \hat{\delta}_2^f$ is less than one for all bank types, and significantly so for co-operative banks. $\hat{\beta}_2 + \hat{\rho}_2^c$ is less than one for all countries except UK and Germany, and is significantly so for France and Italy. In these cases there is some evidence of an inverse relationship between size and growth. However, the highly significant value of $\hat{\beta}_2 + \hat{\rho}_2^c$ greater than one for Germany suggests that larger German banks expanded their OBS portfolios faster than smaller banks over the sample period. The pattern for Germany therefore appears to be markedly different to that for other countries. This is perhaps because smaller banks in the savings and co-operative segments of the German banking market still earn most of their revenue from net interest income, and as such are not heavily involved in off balance sheet business. In contrast, large German banks now earn a higher proportion of their total revenues from off balance sheet activities than was the case at the beginning of the 1990s (Morgan Stanley Dean Witter, 1998a).

Finally, there is evidence of negative persistence between growth rates in 1992-1994 and 1990-1992, which does not differ significantly between countries and bank types. This suggests that banks which expanded their off balance sheet business rapidly in 1990-1992 experienced slower than average growth in 1992-1994, and conversely, those which grew more slowly during the former period tended to catch up during the latter. This finding is confirmed by EU (1997a), which notes that the fee and non-interest incomes of large European banks grew substantially between 1990 and 1993, but thereafter the ratio of non-interest incomes to total income decreased.[3] No evidence of heteroscedasticity in bank growth rates is detected. The off-balance sheet estimations yield little evidence in support of the LPE.

Overall, for the conventional asset and equity measures of bank size, the evidence tends to favour acceptance of the LPE, with the exceptions of Italy, Spain and France, where smaller banks grew faster than their larger counterparts. Evidence is found for some persistence of

[3] See Table 2.13, chapter 2.

growth in total assets, and off balance sheet business, but not for equity. Finally, no evidence is found of heteroscedasticity in growth rates for any of the size measures.

7.2.2 A Model of Bank Growth Excluding Persistence of Growth

This section discusses the results from estimating the model specification, which does not allow for the possibility of persistence of growth. The testing procedure starts from the following specification

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it} \quad (5)$$

The same process as above is followed in testing for bank type and country effects on β_1 and β_2, by testing the validity of exclusion restrictions on d_{jit}^f and e_{jit}^c. Recalling Figure 6.2, the aim of these tests is to arrive at a more parsimonious estimable model, from which unnecessary dummy variables are omitted. The results of these tests are shown in Table 7.3. The results for each size measure are now discussed.

Assets

The tests on bank type effects in equation (5) allowed the restrictions $\{\delta_1^f\}$=0, $\{\delta_2^f\}$=0 and $\{\delta_j^f\}$=0 to be accepted, so equation (6) with no bank type effects is accepted. Testing the country effects in equation (6), it is possible to eliminate either ρ_1^c or ρ_2^c individually, but $\{\rho_j^c\}$ =0 is rejected. Further testing which experimented with the intermediate specifications between equation (6) and (8) accepted a model that included country slope shifts, but excluded all other dummies, as follows:

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it}$$

Table 7.3: Tests For Bank Type and Country Effects 1990 – 1994

Null	Eq'n	p-values Assets	Equity	OBS	Null	Eq'n	p-values Assets	Equity	OBS
Bank Type Effects					Country Effects				
$\delta_1^f = 0$	5	0.736	0.080	0.044	$\rho_1^c = 0$	5	0.128	0.383	0.013
$\delta_2^f = 0$	5	0.644	0.803	0.327	$\rho_2^c = 0$	5	0.302	0.477	0.001
$\delta_2^f = 0$	5a	0.038	0.000	0.157	$\rho_2^c = 0$	5c	0.000	0.000	0.000
$\delta_1^f = 0$	5b	0.044	0.000	0.022	$\rho_1^c = 0$	5d	0.000	0.000	0.000
$\delta_j^f = 0$	5	0.129	0.000	0.040	$\rho_j^c = 0$	5	0.000	0.000	0.000
Country Effects					Bank Type Effects				
$\rho_1^c = 0$	6	0.218	0.250	0.067	$\delta_1^f = 0$	7	0.730	0.040	0.083
$\rho_2^c = 0$	6	0.436	0.526	0.001	$\delta_2^f = 0$	7	0.570	0.668	0.082
$\rho_2^c = 0$	6a	0.000	0.000	0.000	$\delta_2^f = 0$	7a	0.256	0.000	0.875
$\rho_1^c = 0$	6b	0.000	0.000	0.000	$\delta_1^f = 0$	7b	0.328	0.000	0.895
$\rho_j^c = 0$	6	0.000	0.000	0.000	$\delta_j^f = 0$	7	0.501	0.000	0.265
Bank Type and Country Effects									
$\delta_j^f \cap \rho_j^c = 0$	5	0.0000	0.000	0.000					
Heteroscedasticity									
$\sigma_{it}^2 = \sigma^2$	5	0.100	0.296	0.143					

Note: The heteroscedasticity tests report p-values from tests carried out by obtaining nR^2 from an auxiliary regression of the residuals on the squares of s_{it-1}. The test statistic is distributed $\chi^2(1)$ under the null hypothesis of homoscedasticity.

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it} \tag{5}$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it} \tag{6}$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + u_{it} \tag{7}$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + u_{it} \tag{8}$$

The estimation results are shown in Table 7.4. The LPE is accepted for all countries except Belgium, Germany, Italy and Spain. In Belgium and Germany, larger banks grew proportionately faster than smaller banks, while for Italy and Spain the opposite was true.

Equity

For equity, tests on equation (5) revealed that the exclusion restrictions on the bank type $\{\delta_1^f\}=0$ and $\{\delta_2^f\} = 0$ and country dummies $\{\rho_1^c\} = 0$ and $\{\rho_2^c\} =0$ could be accepted. However, it was not possible to accept the exclusion of all bank type effects ($\delta_j^f = 0$), nor all country effects ($\rho_j^c=0$). Further tests on various combinations of bank type and country effects allowed the acceptance of a model, which included the bank type and country slope dummies, and excluded all intercept dummies. Therefore, the final model is

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it}$$

The estimation results are shown in Table 7.4. For bank types $\hat{\beta}_2$ is found to be greater than one and significant for savings banks. The LPE is rejected for Denmark, France, Italy, Spain, and the UK, where smaller banks grew faster than larger banks.

Off Balance Sheet Business (OBS)

Finally, for the OBS measure, $\{\delta_2^f\} = 0$ is accepted in equation (5), but $\{\delta_1^f\}=0$, $\{\rho_1^c\}=0$ and $\{\rho_2^c\}= 0$ are all rejected. The final model is

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it}$$

Table 7.4: Estimation Results 1990-1994

Assets								
$\hat{\beta}_1$	-0.0473 (0.0833)							
	Bel	Den	Fra	Ger	Ita	Net	Spa	UK
$\hat{\beta}_2 + \hat{\rho}_2^c$	1.0377 (0.0188)	1.0159 (0.0204)	0.9921 (0.0126)	1.0285 (0.0123)	0.9817⁺ (0.0122)	1.0248 (0.0185)	0.9352* (0.0128)	1.0031 (0.0118)
	n =617	$\hat{\sigma}$ =0.48		R^2 =0.07		$\bar{R}^2$ =0.06		Het = 3.08
Equity								
$\hat{\beta}_1$	0.1769* (0.0466)							
	Comm	Coop	Savings					
$\hat{\beta}_2 + \hat{\delta}_2^b$	0.9891 (0.0224)	1.0207 (0.0278)	1.0479 ˣ (0.0240)					
	Bel	Den	Fra	Ger	Ita	Net	Spa	UK
$\hat{\beta}_2 + \hat{\rho}_2^c$	0.9891 (0.0224)	0.9343* (0.0229)	0.9752 ˣ (0.0131)	0.9867 (0.0128)	0.9641* (0.0119)	1.007 (0.021)	0.9244* (0.0123)	0.9560* (0.0112)
	n = 607	$\hat{\sigma}$ =0.38		R^2 =0.15		$\bar{R}^2$ =0.13		Het = 0.85
Off Balance Sheet Business								
	Comm	Coop	Savings					
$\hat{\beta}_1 + \hat{\delta}_1^b$	0.1378 (0.525)	0.5027 (0.5667)	0.4601 (0.5401)					
	Den	Fra	Ger	Ita	Net	Spa	UK	
$\hat{\beta}_1 + \hat{\rho}_1^c$	0.1378 (0.5255)	1.0948* (0.2396)	-0.2471 (0.3129)	0.7281 ˣ (0.2826)	0.9505 ˣ (0.4199)	0.4646 ˣ (0.2385)	0.9154* (0.2633)	
	Den	Fra	Ger	Ita	Net	Spa	UK	
$\hat{\beta}_2 + \hat{\rho}_2^c$	0.9704 (0.1254)	0.8298* (0.041)	1.1259 ˣ (0.0613)	0.7603* (0.0501)	0.9066 (0.0802)	0.8693 ˣ (0.0597)	0.9632 (0.0483)	
	n = 451	$\hat{\sigma}$ =0.93		R^2 =0.19		$\bar{R}^2$ =0.16		Het = 1.36
* = significant at 1% level			ˣ = significant at 5% level			⁺ = significant at 10% level		

Notes: Tests for significance of $\hat{\beta}_2$ are one tail (i.e. H_0: $\beta_2 = 1$ against H_1: $\beta_2 < 1$).

Tests for significance for $\hat{\beta}_1$ is two tail.

Standard errors of estimated coefficients are shown beneath in parentheses.

The heteroscedasticity tests (Het) are nR^2 from an auxiliary regression of the residuals on the squares of S_{it-1}. The test statistic is distributed χ^2 (1) under the null hypothesis of homoscedasticity.

The estimation results are shown in Table 7.4. Values of $\hat{\beta}_2 + \hat{\rho}_2^c$ are less than one for all countries except Germany, and significantly so for France, Italy and Spain, implying that smaller banks grew faster than larger banks in these countries in terms of their off balance sheet business. $\hat{\beta}_2 + \hat{\rho}_2^c$ is greater than one and significant for Germany, implying that larger banks grew proportionately faster than smaller banks.

Taking all the results together for banking, the following conclusions can be drawn. Using the conventional assets and equity size measures, in the majority of countries sampled, the distribution of growth rates across banks appears to be independent of bank size. When using the preferred estimates (i.e. model(s) which allow for persistence in growth rates), the only countries for which there is evidence that small banks grew faster than their larger counterparts are France, Italy and Spain. For France, this phenomenon may reflect the adjustment by larger banks to the difficulties experienced by the national economy in the early 1990s. In the case of Italy and Spain, the EU's Single Market programme may have impinged on the growth of large banks in these two countries. Using the assets measure of bank size, there was significant evidence of persistence in growth performance across all countries. In other words there was a tendency for banks which experienced above average growth performance in 1990-1992 to do so again in 1992-1994. However, no evidence of persistence in growth rates was found when using total equity as a size measure.

Tests of the LPE based on the size of banks' reported off balance sheet business were also carried out. The LPE is rejected in a number of cases, specifically for co-operative banks and for French and Italian banks, with the off balance sheet business of smaller banks tending to grow faster than their larger counterparts in these cases. For off balance sheet business, there was strong evidence of negative serial correlation in growth rates between the periods 1990-1992 and 1992-1994. This suggests that a catching up process may have been operating, whereby banks with large off balance sheet positions in 1992 typically experienced difficulties in expanding further during the next two years, while those which started from a lower base in 1992 subsequently tended to grow faster.

Comparing these results with those of previous banking studies, Alhadeff and Alhadeff (1964) investigate the growth rates of the largest 200 US banks between 1930 and 1960, and found that smaller banks tended to enjoy higher growth, thus rejecting the LPE. Rhoades and Yeats (1974) for a sample of large US banks find that overall smaller banks grew faster than larger banks, leading to declining levels of concentration. Tschoegl (1983) finds that the LPE holds for a sample of 100 large international banks. He also finds that variability in growth declined with size, implying that smaller banks exhibited more variable growth rates than large banks, which he suggests, is an indication that large banks are less risky than smaller banks. He also finds a weak positive, but insignificant relationship between growth rates in successive periods, implying that growth in one period does not act as a good predictor of growth in subsequent periods. Consequently, banks found it difficult to sustain above average growth over long periods.

In terms of mean growth rates in total assets and equity, the results reported above suggest that in some countries such as France, Italy and Spain smaller banks tended to grow faster than larger banks. This finding is similar to the results of Alhadeff and Alhadeff (1964), and Rhoades and Yeats (1974) who find smaller banks grew faster than larger banks in their sample. However, the present analysis also finds that the LPE holds across other countries such as Denmark, Netherlands, Germany and the UK, thus sharing similarities to the findings of Tschoegl, who finds that larger and smaller banks grew at the same rates over the period examined.

In contrast to Tschoegl (1983) and Alhadeff and Alhadeff (1964), this study finds no evidence of heteroscedasticity in growth rates. However, some evidence of persistence in growth of total assets and off balance sheet business is detected, suggesting that some banks can maintain above average performance from one period to the next. This may be due to advantages arising from financial, managerial or technological innovation.

7.3 Testing The LPE for Manufacturing Firms

This section presents the results of tests of the LPE for the sample of 757 manufacturing firms drawn from five EU countries including France, Germany, Italy, Spain and the UK. Firm growth is again modelled in two ways, namely with and without persistence of growth. The results for the model allowing for serial correlation in growth rates are discussed in section 7.3.1, while the results for the model with no serial correlation are discussed in section 7.3.2.

7.3.1 A Model of Manufacturing Firm Growth Including Persistence of Growth

As before, the most general form of model is:

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{f=2}^{F} \delta_3^f d_{3it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + \sum_{c=2}^{C} \rho_3^c e_{3it}^c + u_{it} \quad (1)$$

The dummies variables d_{1it}^f, d_{2it}^f and d_{3it}^f allow for variations in β_1, β_2 and β_3 respectively between manufacturing firms of different types (f = 1... 11 for alcohol, building materials, chemicals, diversified industrials, electricals, engineering, food, household, pharmaceuticals, paper and textiles), while the dummies e_{1it}^c, e_{2it}^c and e_{3it}^c allow for variations in β_1, β_2 and β_3 respectively between countries (c = 1...5 for France, Germany, Italy, Spain and the United Kingdom). The test procedures for eliminating unnecessary sets of intercept and slope dummies follow those set out in Figure 6.1. The results of the Wald tests are shown in Table 7.5.

Estimation of equation (1) revealed the presence of heteroscedasticity in firm growth rates. Therefore, the quoted p-values are adjusted for heteroscedasticity (White, 1980). The results in Table 7.5 suggest that none of the firm type or country dummies can be omitted from equation (1). Therefore, Table 7.6 reports the results of estimating equation (1) with a full set of intercept and slope dummies included.

Values of $\hat{\beta}_2 + \hat{\rho}_2^c$ which are significantly smaller than one are recorded for the UK, Spain and Germany, implying that the LPE is rejected in these cases. However, the LPE holds for France and Italy. A recent EC study notes that there has been a decline in concentration in many national

Table 7.5: Tests For Firm Type and Country Effects For Manufacturing 1992-1994.

Firm Type Effects			Country Effects		
Null	Equ'n	P-values	Null	Equ'n	P-values
$\delta_1^f = 0$	1	0.011	$\rho_1^c = 0$	1	0.002
$\delta_2^f = 0$	1	0.001	$\rho_2^c = 0$	1	0.018
$\delta_3^f = 0$	1	0.000	$\rho_3^c = 0$	1	0.000
$\delta_2^f \cap \delta_3^f = 0$	1a	0.002	$\rho_2^c \cap \rho_3^c = 0$	1d	0.000
$\delta_1^f \cap \delta_3^f = 0$	1b	0.018	$\rho_1^c \cap \rho_3^c = 0$	1e	0.000
$\delta_1^f \cap \delta_2^f = 0$	1c	0.001	$\rho_1^c \cap \rho_2^c = 0$	1f	0.000
$\delta_j^f = 0$	1	0.000	$\rho_j^c = 0$	1	0.000
Country Effects			Firm Type Effects		
$\rho_1^c = 0$	2	0.001	$\delta_1^f = 0$	3	0.108
$\rho_2^c = 0$	2	0.005	$\delta_2^f = 0$	3	0.012
$\rho_3^c = 0$	2	0.000	$\delta_3^f = 0$	3	0.021
$\rho_2^c \cap \rho_3^c = 0$	2a	0.000	$\delta_2^f \cap \delta_3^f = 0$	3a	0.012
$\rho_1^c \cap \rho_3^c = 0$	2b	0.000	$\delta_1^f \cap \delta_3^f = 0$	3b	0.107
$\rho_1^c \cap \rho_2^c = 0$	2c	0.000	$\delta_1^f \cap \delta_2^f = 0$	3c	0.005
$\rho_j^c = 0$	2	0.000	$\delta_j^f = 0$	3	0.001
Firm Type and Country Effects					
$\delta_j^f \cap \rho_j^c = 0$	1	0.000			
Heteroscedasticity					
$\sigma_{it}^2 = \sigma^2$	1	0.007			

Note: The heteroscedasticity tests report p-values from tests carried out by obtaining nR^2 from an auxiliary regression of the residuals on the squares of s_{it-1}. The test statistic is distributed $\chi^2(1)$ under the null hypothesis of homoscedasticity.

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{f=2}^{F} \delta_3^f d_{3it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + \sum_{c=2}^{C} \rho_3^c e_{3it}^c + u_{it} \quad (1)$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + \sum_{c=2}^{C} \rho_3^c e_{3it}^c + u_{it} \quad (2)$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{f=2}^{F} \delta_3^f d_{3it}^f + u_{it} \quad (3)$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + u_{it} \quad (4)$$

Table 7.6: Net Assets Estimations For Manufacturing Firms 1992-1994

	France	Germany	Italy	Spain	UK						
$\hat{\beta}_1 + \hat{\rho}_1^c$	-0.0816 (0.1247)	0.1667^{x} (0.0872)	0.0554 (0.2914)	0.3972 (0.3634)	0.3375* (0.1147)						
	France	Germany	Italy	Spain	UK						
$\hat{\beta}_2 + \hat{\rho}_2^c$	0.9853 (0.0253)	0.9538^{x} (0.0164)	0.9691 (0.0472)	0.8886^{x} (0.0644)	0.9316* (0.0253)						
	France	Germany	Italy	Spain	UK						
$\hat{\beta}_3 + \hat{\rho}_3^c$	0.1859 (0.1254)	0.1005 (0.0652)	-0.3356* (0.1875)	1.078* (0.2332)	-0.0059 (0.0957)						
	Alcohol	Building Materials	Chemicals	Diversified Industrials	Electricals	Engineering	Food	Household	Pharma-ceuticals	Paper	Textiles
$\hat{\beta}_1 + \hat{\delta}_1^f$	0.3375* (0.1147)	0.3195^{x} (0.1503)	0.3264* (0.1047)	0.0714 (0.1312)	0.4141* (0.1211)	0.5614* (0.1039)	0.3769* (0.1354)	0.1893* (0.0675)	0.1935 (0.3534)	0.5563* (0.1706)	0.4558* (0.1379)
	Alcohol	Building Materials	Chemicals	Diversified Industrials	Electricals	Engineering	Food	Household	Pharma-ceuticals	Paper	Textiles
$\hat{\beta}_2 + \hat{\delta}_2^f$	0.9693^{x} (0.0167)	0.9643^{+} (0.0254)	0.9510* (0.0172)	0.9999 (0.0244)	0.9447* (0.0206)	0.9074* (0.0184)	0.9535^{x} (0.0223)	0.9949 (0.0142)	0.9910 (0.056)	0.9080* (0.0295)	0.9320* (0.0253)
	Alcohol	Building Materials	Chemicals	Diversified Industrials	Electricals	Engineering	Food	Household	Pharma-ceuticals	Paper	Textiles
$\hat{\beta}_3 + \hat{\delta}_3^f$	-0.4826* (0.1895)	0.0627 (0.1320)	0.7222* (0.1569)	0.0196 (0.1290)	0.1339 (0.1525)	-0.0781 (0.1276)	-0.0145 (0.1201)	-0.0119 (0.0980)	0.0671 (0.223)	0.2059 (0.1349)	0.0059 (0.0958)
n = 757			$\hat{\sigma} = 0.33$			R^2 =0.16			$\bar{R}^2$ =0.11		Het =7.31

* = significant at 1% level ^{x} = significant at 5% level $^{+}$ = significant at 10% level

Notes: Tests for significance of $\hat{\beta}_2$ are one tail (i.e. H₀: $\beta_2 = 1$ against H₁: $\beta_2 < 1$). Tests for significance for $\hat{\beta}_1$ and $\hat{\beta}_3$ are two tail.

Standard errors of estimated coefficients are shown beneath in parentheses. The heteroscedasticity tests (Het) are nR^2 from an auxiliary regression of the residuals on the squares of S_{it-1}.

The test statistic is distributed $\chi^2(1)$ under the null hypothesis of homoscedasticity. The quoted standard errors are adjusted for heteroscedasticity.

Auxiliary regression was $\hat{u}_{it}^2 = 0.1534^* - 0.0017^* \Delta\hat{s}_{it}^2$ $R^2 = 0.009$.

(0.0224) (0.0006)

economies as a result of intensifying levels of competition (EC, 1997). Among the values of $\hat{\beta}_3 + \hat{\rho}_3^c$, there is evidence of negative persistence of growth for Italy and positive persistence of growth for Spain.

$\hat{\beta}_2 + \hat{\delta}_2^f$ is less than one for all eleven industries, and significantly so for alcohol, building materials, electricals, engineering, food, household, paper and textiles. This implies a rejection of the LPE in these industries, where smaller firms grew faster than their larger counterparts. In the case of alcohol, the industry tends not to be technologically advanced, making it difficult for large firms to obtain any advantages associated with technical economies of scale (EU, 1997b). For building materials, household and engineering industries, small firms have tended to perform better by operating in more specialised areas of production, and have been flexible enough to cope with wide fluctuations in demand (EU, 1997c). In food and textiles, rapidly changing consumer tastes have given smaller firms opportunities to produce highly differentiated products to satisfy demand in increasingly specialised consumer markets (EU, 1997d). In food, there has also been an increase in the bargaining power of major distribution chains, a proliferation in retail formats and a slowing down in the growth of many product areas. As a consequence this had led to many producers having to cut prices, which has resulted in falling levels of profitability and growth. In the paper and packaging industry, the market is generally fragmented, and increased environmental regulation may have affected the growth prospects of many firms (EU, 1997b). Finally, in electricals, the growth of demand for hi-tech specialist computer and electronic products have led to many small firms enjoying high growth over the period, relative to larger, more established firms (EC, 1997).

The LPE is found to hold for pharmaceuticals industry. This industry has undergone substantial change, emanating from intensified competition from non-EU countries, downward pressures on prices and profits (as governments have attempted to keep down spending on health), and the loss of many patent protections which previously gave some types of firms in this industry a competitive advantage (EC, 1997).

Significantly positive persistence of growth is found for chemicals, implying that above average growth in one two year period tends to carry forward into the next two year period. This in part may be due to management strategies aimed at increasing productivity and profits. The industry has also seen a rationalisation in research and development activity with the formation of strategic alliances between many firms. These strategies have in part been a response to increased competitive pressures from emerging markets in Asia (EU, 1997e).

Significantly negative persistence of growth is found for alcohol. This may in part reflect the low-tech nature of the industry which makes it difficult for firms to obtain advantages from product and process innovations (EC, 1997).

Finally, there is evidence of heteroscedasticity in growth rates, with smaller firms found to have experienced more variable growth rates than larger firms. This may result from the fact that smaller firms tend to be less diversified, and so are more likely to be affected if the demand for any particular product increases or decreases. Heteroscedasticity in growth rates has also been found in recent country specific studies of manufacturing (Dunne and Hughes, 1994).

Overall, by country, the LPE is rejected for Germany, Spain and the UK, in which smaller firms grew faster than larger firms. By industry the LPE is rejected for over half of the industries sampled.

7.3.2 A Model of Manufacturing Firm Growth Excluding Persistence of Growth

A similar process is repeated for models with no persistence of growth. The initial model is:

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it} \qquad (5)$$

The results of tests for the exclusion of the sets of country and industry intercept and slope dummies are shown in Table 7.7. The p-values quoted are corrected for heteroscedasticity. The tests carried out in equation (5) accept the restriction $\{\delta_1^f\}$=0, but nothing else. Further

Table 7.7: Tests For Firm Type and Country Effects 1990-1994

Firm Type Effects			Country Effects		
Null	Equ'n	P-values	Null	Equ'n	P-values
$\delta_1^f = 0$	5	0.573	$\rho_1^c = 0$	5	0.026
$\delta_2^f = 0$	5	0.049	$\rho_2^c = 0$	5	0.002
$\delta_2^f = 0$	5a	0.003	$\rho_2^c = 0$	5c	0.003
$\delta_1^f = 0$	5b	0.044	$\rho_1^c = 0$	5d	0.083
$\delta_j^f = 0$	5	0.000	$\rho_j^c = 0$	5	0.000
Country Type Effects			Firm Type Effects		
$\rho_1^c = 0$	6	0.043	$\delta_1^f = 0$	7	0.616
$\rho_2^c = 0$	6	0.004	$\delta_2^f = 0$	7	0.181
$\rho_2^c = 0$	6a	0.005	$\delta_2^f = 0$	7a	0.003
$\rho_1^c = 0$	6b	0.084	$\delta_1^f = 0$	7b	0.049
$\rho_j^c = 0$	6	0.000	$\delta_j^f = 0$	7	0.004
Firm Type and Country Effects					
$\delta_j^f \cap \rho_j^c = 0$	5	0.000			
Heteroscedasticity					
$\sigma_{it}^2 = \sigma^2$	5	0.000			

Notes: The heteroscedasticity tests report p-values from tests carried out by obtaining nR^2 from an auxiliary regression of the residuals on the squares of s_{it-1}. The test statistic is distributed $\chi^2(1)$ under the null hypothesis of homoscedasticity. Quoted P-values are adjusted for heteroscedasticity.

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it} \quad (5)$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it} \quad (6)$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{f=2}^{F} \delta_1^f d_{1it}^f + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + u_{it} \quad (7)$$

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + u_{it} \quad (8)$$

experimentation suggested that $\{\rho_1^c\}$=0 could be accepted. It was therefore possible to reach a final specification that included industry and country specific slope shifts, but excluded all intercept dummies, as follows:

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \sum_{f=2}^{F} \delta_2^f d_{2it}^f + \sum_{c=2}^{C} \rho_2^c e_{2it}^c + u_{it}$$

The estimation results are shown in Table 7.8.

$\hat{\beta}_2 + \hat{\rho}_2^c$ is significantly smaller than one in all of the five countries, implying consistent rejection of the LPE. $\hat{\beta}_2 + \hat{\delta}_2^f$ is less than one in all eleven industries, and significantly so in all cases except pharmaceuticals, again implying a rejection of the LPE. Evidence is found of heteroscedasticity in growth rates, with greater variability for small firms than their larger counterparts.

Overall, the manufacturing results suggest that in many industries and countries, smaller firms grew faster than their larger counterparts and experienced greater variability in their growth rates. The results also suggest that the extent to which the LPE holds for EU manufacturing firms is dependent on the individual country or industry under consideration. By country, the LPE is rejected for three of the five countries in the model which allows for persistence of growth. The finding that smaller firms grew faster than their larger counterparts in the UK is consistent with the results of Dunne and Hughes (1994), and Hart and Oulton (1996). The present study also finds no significant relationship between growth rates over successive time periods, which is also consistent with Dunne and Hughes (1994).

Using Italian data for the period 1980-1986, Contini and Revelli (1989) found that small firms grew faster than larger firms. However, when the sample was disaggregated by size, the LPE was accepted for the largest firms in the sample. For Germany, the present results are similar to those

Table 7.8: Net Assets Estimations For Manufacturing Firms 1990-1994

$\hat{\beta}_1$	0.4433* (0.0702)										
	France	Germany	Italy	Spain	UK						
$\hat{\beta}_2 + \hat{\rho}_2^c$	0.9609* (0.0148)	0.9580* (0.0163)	0.9465* (0.0177)	0.9039* (0.0243)	0.9405* (0.0155)						
	Alcohol	Building Materials	Chemicals	Diversified Industrials	Electronics	Engineering	Food	Household	Pharma-ceuticals	Paper	Textiles
$\hat{\beta}_2 + \hat{\delta}_2^f$	0.9609* (0.0148)	0.9566* (0.0141)	0.9349* (0.0137)	0.9508* (0.0157)	0.9324* (0.0154)	0.9298* (0.0124)	0.9674^x (0.0159)	0.9526* (0.0179)	0.9831 (0.0188)	0.9370* (0.0178)	0.9461* (0.0182)
n = 757			$\hat{\sigma}$ = 0.51			R^2 = 0.1			$\overline{R}^2$ =0.08		Het = 14.38*

* = significant at 1% level; ^{x} = significant at 5% level; $^+$ = significant at 10% level

Note: Tests for significance of $\hat{\beta}_2$ are one tail (i.e. H_0: $\beta_2 = 1$ against H_1: $\beta_2 < 1$). Tests for significance for $\hat{\beta}_1$ is two tail.

Standard errors of estimated coefficients are shown beneath in parentheses.

The heteroscedasticity tests (Het) are nR^2 from an auxiliary regression of the residuals on the squares of S_{it-1}. The test statistic is distributed χ^2 (1) under the null hypothesis of homoscedasticity.

The quoted standard errors are adjusted for heteroscedasticity.

Auxiliary regression was $u_{it}^2 = 0.4074 - 0.0053\,\Delta\hat{s}_{it}^2$ $\qquad R^2 = 0.020$.

(0.048) (0.0013)*

of Wagner (1992), who also found no relationship between size and growth. However, in contrast to Wagner, no evidence of persistence in growth rates is found in the present study.

Finally, the results also suggest that smaller firms have more variable growth rates than large firms. This is in line with much other empirical evidence for manufacturing, including Mansfield (1962), Hall (1987), Evans (1987a,b) and Dunne and Hughes (1994).

7.4 Banking and Manufacturing Compared

This section compares the results of the estimations for the banking and manufacturing samples. Overall, the LPE holds for most countries in EU banking markets when the preferred models are estimated. However, this is not the case for manufacturing. Table 7.9 compares the results for both industries.

Table 7.9: Testing LPE for EU Banking and Manufacturing

Country	Banking (Equity and Assets measure)	Manufacturing (Assets Measure)
Belgium	Accept	N/A
Denmark	Accept	N/A
France	Reject (Smaller banks grew proportionately faster than larger banks)	Accept
Germany	Accept	Reject (Smaller firms grew proportionately faster than larger firms)
Italy	Reject (Smaller banks grew proportionately faster than larger banks)	Accept
Netherlands	Accept	N/A
Spain	Reject (Smaller banks grew proportionately faster than larger banks)	Reject (Smaller firms grew proportionately faster than larger firms)
United Kingdom	Accept	Reject (Smaller firms grew proportionately faster than larger firms)

Note: N/A denotes not available.

Country effects appear to pre-dominate in banking where most rejections of the LPE occur. In manufacturing the pattern is less clear. However, the LPE is rejected for eight industries in the model which allows for persistence of growth (see Table 7.6). There is evidence of persistence of growth above or below average from one period to the next in both banking and manufacturing. However, the size of the persistence coefficient varies across countries and industries for manufacturing, but not for banking. Persistence of growth in manufacturing is generally positive and significant. Small firms have more variable growth rates than large firms in manufacturing, as was also found by Dunne and Hughes (1994). However, there is no evidence of heteroscedasticity for European banking, in contrast to the findings of Tschoegl (1983) for his study on the growth characteristics of international banks.

Overall, the differences between the banking and manufacturing results perhaps arise from fundamental differences between the competitive conditions in these industries. For example, given that banks often sell homogenous products, raise funds in a similar manner and set rates on deposits and loans determined by the market, they are likely to grow at similar rates. Barriers to entry are higher in banking than manufacturing as a consequence of structural and conduct regulation (Tirole, 1994a). This means that small banks must satisfy regulatory requirements before trading can commence, and perhaps have less flexibility in offering products and services at different prices to their larger competitors. This is likely to lead to small and large banks growing at the same proportionate rates. In contrast, small firms can enter most manufacturing industries without the hindrance of government regulations, and produce differentiated products at competitive prices to capture market share. This often results in small manufacturing firms growing faster than their larger counterparts.

7.5 Effects of Age on the Size and Growth of Banking and Manufacturing Firms

The LPE assumes that growth is independent of size. However, the results thus far suggest that smaller firms have faster growth rates than larger firms in several countries for both banking and manufacturing. Furthermore, small firms have more variable growth rates than their larger counterparts in manufacturing. The reason why smaller firms grow faster than larger firms is perhaps that smaller firms are only likely to survive if they can achieve efficient scale rapidly

(Simon and Bonnini, 1958). Available empirical evidence suggests that European manufacturing firms which produce output at levels less than the minimum efficient scale incur substantial cost disadvantages relative to large firms (Emerson et al, 1988). Therefore, if smaller firms are observed to enjoy above average growth, this could be indicative of a form of survivorship bias, in the sense that only the fastest growing small firms survive and therefore become included in the sample. However, the reason why small firms have more variable growth rates than large firms for manufacturing remains less clear. Some evidence suggests that larger firms are more diversified than smaller firms and so are less vulnerable to large fluctuations in growth (Singh and Whittington, 1975). Other authors suggest that smaller firms also tend to be younger than their larger counterparts, tend to employ less experienced managers, and have had less time to acquire learning economies of scale. As a consequence these firms make more mistakes, and so have greater variability in their growth prospects (Jovanovic, 1982). These arguments have been supported empirically by Evans (1987a,b) and Reid (1992).

Mueller (1972) argues that firms go through a life cycle of growth and profitability which can be split into four main phases: the emergent, growth, maturity and declining phases. In the emergent phase, firms are often small entities reliant on single products, and under the control of owner-managers. At this stage the firm often charges low prices to gain market share, and re-invests profits to facilitate expansion. At this stage it is critical that the firm makes enough revenue to meet immediate liabilities, otherwise it may decline and die. Marshall (1890) likens young firms to young trees in the forest '*... as they struggle upwards through the benumbing age of their old rivals. Many succumb on the way, and only a few survive.*'[4]

In the growth phase of the life cycle, firms raise finance on the capital markets to aid further expansion. This expansion gives the firm access to scale economies, which leads to increased efficiency. Furthermore, the firm may often diversify into new product areas in order to reduce the risks associated with any single product or service. During the maturity phase growth and profits

[4] Marshall (1890), p.317.

level off as markets reach saturation point, and the firm encounters diseconomies associated with problems of managerial coordination (Penrose, 1959). In the declining phase, the firm's sales and profits fall, leading to a loss of confidence on the part of investors, falling share prices and eventually bankruptcy.

The life cycle model leads to a testable proposition, that age (as well as size) may be a relevant explanatory variable in any model of growth. In this section, tests for any relationship between both size and age and growth are carried out. A slightly less formal procedure than the one adopted in the previous section is used to determine the specification of the model. Following earlier work by Evans (1987a,b) and Reid (1992), the estimated model is:

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \beta_4 a_{it-1} + \beta_5 s_{it-1}^2 + \beta_6 s_{it-1} a_{it-1} + \sum_{b=2}^{F} \delta_1^f d_{1it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + u_{it} \tag{9}$$

where $E(u_{it}) = 0$ and $var(u_{it}) = \sigma_{it}^2$

a_{it-1} is firm i's age in 1990 in years, expressed in natural logarithmic form, and $s_{it-1}a_{it-1}$ is an interaction term which is included to test whether the relationship between age and growth varies with firm size. The remaining variables are defined as before (see above). The model tests for any linear and non-linear relationship between size in 1990 and growth over the period 1990-1994, while allowing for differences across countries and industries through the inclusion of sets of industry and country specific intercept dummies. Slope dummies for the coefficients on the size and age variables, are not included. The data on bank ages was collected from the Bankers' Almanac, while manufacturing firm ages was collected from the MacMillan UK Stock Exchange Yearbook and Dun and Bradstreet's Europa Publication. Due to missing information on firm ages, 63 banks and 7 manufacturing firms were dropped from the sample. This left a sample of 554 banks and 750 manufacturing firms for which data on firm age was available. The results for banking and manufacturing are now discussed in turn.

Banking

The results of estimating equation (9) for banks are reported in Table 7.10. The estimation results suggest that the relationship between growth and size is non-linear, with both coefficients on s_{it-1} and s_{it-1}^2 found to be significant. The signs of the estimated coefficients indicate that the relationship between size and growth is negative for smaller banks and positive for larger banks. Using the appropriate terms in the estimated model, bank growth can be differentiated with respect to initial size, in order to determine the value of initial size beyond which the relationship between size and growth becomes positive; i.e. the turning point in the size-growth relationship.

$$\Delta s_{it} = -0.0380 - 0.1358 s_{it-1} + 0.007 s_{it-1}^2 + 0.0041 a_{it} s_{it-1} + \ldots\ldots\ldots\ldots$$

$$\Rightarrow \frac{\partial \Delta s_{it}}{\partial s_{it-1}} = -0.1358 + 0.014\, s_{it-1} + 0.0041\, a_{it-1} = 0$$

$\Rightarrow s_{it-1}^{\bullet} = \dfrac{0.1358 - 0.0041\, a_{it-1}}{0.014} = 9.7 - 0.293\, a_{it-1}$, where $s_{it-1}^{\bullet}$ is the value of s_{it-1} at which Δs_{it} achieves a turning point.

$\dfrac{\partial^2 \Delta s_{it}}{\partial s_{it-1}^2} = 0.014 > 0$, implying the point at which $\dfrac{\partial \Delta s_{it}}{\partial s_{it-1}} = 0$ minimises growth.

Therefore, for a bank with age = 20 years (a_{it-1} = 2.9957), s_{it-1} = 8.82, or actual size = 6783.6.

For a bank with age = 50 (a_{it-1} = 3.9120), s_{it-1} = 8.55, or actual size = 5186.3.

For a 20 year old firm, the relationship between size and growth is positive for banks bigger than ECU 6783.6 million. For a 50 year old firm, the relationship is positive for firms bigger than ECU 5186.3 million.

Although the size-age interaction term is included in the above discussion, statistically it is not significantly different from zero, and in general the empirical results suggest that there is no relationship between bank age and growth. This contrasts with Yeats et al (1975), who find a positive relationship between bank growth and age. Overall, our findings suggest that the

Table 7.10: Tests For Size and Age Effects on Growth For Banks

$\hat{\beta}_1$ (Constant)	0.7412* (0.2632)						
($\hat{\beta}_2$ -1) (initial size)	-0.1358* (0.0545)						
$\hat{\beta}_3$ (previous growth)	0.1498* (0.049)						
$\hat{\beta}_4$ (age)	-0.0380 (0.0504)						
$\hat{\beta}_5$ (initial size ^2)	0.0073* (0.0033)						
$\hat{\beta}_6$ (initial size * age)	0.0041 (0.006)						
	Belgium	Denmark	France	Germany	Italy	Netherlands	Spain
$\hat{\rho}_1^c$	0.0234 (0.0857)	-0.0070 (0.0786)	-0.1064ˣ (0.0496)	0.0276 (0.0489)	-0.2103* (0.0499)	0.0844 (0.0917)	-0.1487* (0.0481)
	Commercial	Savings					
$\hat{\delta}_1^f$	-0.0782ˣ (0.0384)	0.0105 (0.0604)					
n = 554	R^2 =0.11	$\overline{R}^2$ =0.08	$\hat{\sigma}$ = 0.33	F (14, 539) = 4.53*	Het =0.13		

The estimated equation is:

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \beta_4 a_{it-1} + \beta_5 s_{it-1}^2 + \beta_6 s_{it-1} a_{it-1} + \sum_{b=2}^{F} \delta_1^f d_{1it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + u_{it}$$

UK was used as base for the country dummies, while savings banks were used as the base for the industry dummies.

* denotes significant at the 1% level, while ˣ denotes significant at the 5% level.

arguments of Mueller (1972) and Jovanovic (1982) do not apply to the growth processes of European banks. Possibly, banks may face flat long run average cost curves, and so can operate at various levels of production without incurring substantially higher or lower average costs. Therefore, small banks do not have to grow rapidly to reach the minimum efficient scale of production, to ensure survival.

Manufacturing

The results of estimating equation (9) for manufacturing are reported in Table 7.11. The results suggest that the relationship between size and growth is again non-linear. As before, the signs of the estimated coefficients indicate that the relationship between size and growth is negative for smaller banks and positive for larger banks. There is also a significant relationship between age and growth, so younger firms tend to grow faster than older firms. The results may also suggest that younger firms grow faster than their older counterparts as are at an earlier stage of their firm life-cycle (Mueller, 1972). The interaction term between size and age, $s_{it-1}a_{it-1}$ is found to be positive and significant. Again, the turning point in the size-growth relationship can be determined, using the same method as before.

$$\Delta s_{it} = -0.0899 - 0.2463 s_{it-1} + 0.0138 s_{it-1}^2 + 0.0155 a_{it} s_{it-1} + \dots\dots\dots$$

$$\Rightarrow \frac{\partial \Delta s_{it}}{\partial s_{it-1}} = -0.2463 + 0.0276 s_{it-1} + 0.0155 a_{it-1} = 0$$

$\Rightarrow s^{\bullet}_{it-1} = \dfrac{0.2463 - 0.0155 a_{it-1}}{0.0276} = 8.924 - 0.562 a_{it-1}$, where $s^{\bullet}_{it-1}$ is the value of s_{it-1} at which Δs_{it} achieves a turning point.

$\Rightarrow \dfrac{\partial^2 \Delta s_{it}}{\partial s_{it-1}^2} = 0.0276 > 0$, implying the point at which $\dfrac{\partial \Delta s_{it}}{\partial s_{it-1}} = 0$ minimises growth.

Therefore, for a firm with age = 20 years (a_{it-1} = 2.9957), s_{it-1} = 7.2404, or actual size = 1394.6.

For a firm with age = 50 (a_{it-1} = 3.9120), s_{it-1} = 6.7255, or actual size = 833.4.

Table 7.11: Tests For Size and Age Effects on Growth For Manufacturing Firms

$\hat{\beta}_1$ (Constant)	1.0133* (0.2118)									
$(\hat{\beta}_2 -1)$ (initial size)	-0.2463* (0.0617)									
$\hat{\beta}_3$ (previous growth)	0.0676 (0.0443)									
$\hat{\beta}_4$ (age)	-0.0899* (0.0402)									
$\hat{\beta}_5$ (initial size ^2)	0.01378* (0.0047)									
$\hat{\beta}_6$ (initial size * age)	0.01553* (0.0069)									
	France	Germany	Italy	Spain						
$\hat{\rho}_1^c$	-0.0954* (0.0341)	-0.0779* (0.0308)	-0.0675 (0.0655)	-0.2445* (0.0891)						
	Alcohol	Building Materials	Chemicals	Diversified Industrials	Electricals	Engineering	Food	Household	Pharmaceu-ticlas	Paper
$\hat{\delta}_1^f$	0.0197 (0.0610)	0.0494 (0.0548)	-0.0452 (0.0563)	-0.0057 (0.0659)	-0.0154 (0.0560)	-0.0092 (0.0500)	0.0494 (0.0591)	0.0519 (0.0508)	0.0407 (0.091)	-0.0246 (0.0610)
n = 750		R^2=0.12		$\overline{R}^2$=0.09		$\hat{\sigma}$ = 0.33		F (19, 730) = 4.95*		Het =7.50*

The estimated equation is:

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \beta_4 a_{it-1} + \beta_5 s_{it-1}^2 + \beta_6 s_{it-1} a_{it-1} + \sum_{b=2}^{F} \delta_1^f d_{1it}^f + \sum_{c=2}^{C} \rho_1^c e_{1it}^c + u_{it}$$

The standard errors of coefficients are shown in brackets, and are adjusted for heteroscedasticity.

Auxiliary regression was $u_{it}^2 = 0.1599^* - 0.00175^* \hat{s}_{it-1}^2$ $\quad R^2 = 0.01.$
(0.224) (0.00064)

UK was used as base for the country dummies, while textiles are used as the base for the industry dummies.

For a 20 year old firm, the relationship between size and growth is positive for firms bigger than ECU1394.6 million. For a 50 year old firm, the relationship is positive for firms bigger than ECU 833.4 million.

There is evidence of heteroscedasticity in growth rates, with more variable growth for small firms than large firms. A regression of the squared residuals on a_{it-1}^2 finds no relationship between growth variability and age, implying that younger firms do not have more variable growth rates than their older counterparts. The dummies are generally significant by country and generally insignificant by industry.

The results suggest that a manufacturing firm's age does influence its growth prospects. This lends some support to the view that either young firms are at an early stage of their life-cycle and must grow to become established, or that younger or smaller firms may actively pursue growth in an attempt to reach the minimum efficient scale. Finally, no evidence is found to suggest that younger firms have more variable growth rates than their older counterparts.

7.6 Conclusions

This chapter has investigated the nature and strength of size-growth relationships for the EU banking and manufacturing industries from 1990 to 1994. In both cases, tests have been carried out to assess whether the LPE holds.

For banks, the finding that the LPE generally holds (using the assets and equity size measures) in the majority of cases suggests that a pattern of increased concentration in European banking markets could develop over time. There may be a tendency for concentration to increase, even in the absence of factors such as the superior efficiency of large banks, merger activity or the implementation of entry deterring strategies by incumbent banks. Such a pattern suggests that bank growth is determined in a random fashion, independent of bank size.

In contrast, the results for manufacturing firms generally suggest that growth is inversely related to firm size, thus contradicting the LPE. This means that there is no long-term tendency for concentration to increase. This is perhaps a consequence of managerial or demand constraints which are often encountered by firms seeking to grow past a certain critical size (Penrose, 1959 and Marris, 1964). Furthermore, smaller firms have more variable growth than their larger counterparts. This is perhaps due to the diversification of large scale operations which allow large firms to spread risks over a number of product areas, and so smooth their growth rates over time (Singh and Whittington, 1968).

Finally, the relationship between age and growth has been examined for both banking and manufacturing. The overall finding is that age appears to be an important determinant of growth in manufacturing, where younger firms tend to enjoy faster rates of growth than older firms. However, this is not the case for banks.

There are several limitations to the empirical analysis. In particular, the results are based on samples of manufacturing and banking firms that have survived over the entire period of the investigation. Consequently, the estimations take no account of the relationship between a firm's growth and its chances of survival. Assuming that the chances of survival are related to slow growth, death rates are likely to be higher across smaller firms as they are at the upper end of the size distribution. Large firms are likely to decline for long periods as they fall through the size distribution and eventually die (Mansfield, 1962). In other words there is an inverse relationship between firm size and the probability of survival. If small surviving firms have faster growth rates than non-surviving firms, there exists the possibility of bias in favour of finding $\hat{\beta}_2 < 1$, as the small firms sampled are unrepresentative of a population of small firms in general. However, the present data set does not allow the exploration of the possibility of such a bias to any great extent.[5] The effects of acquisition and merger on size-growth relationship has also been ignored, primarily because identifying these events and quantifying their effects was problematic given the

[5] However, the extent to which slow growth may lead to the failure of banks is somewhat questionable.

data sets available. The possibility of any bias in the results from ignoring entry, exit and merger may, however provide a fruitful area for future research.

Overall, the results give valuable insights into the size-growth relationships for European banks and manufacturing firms over the period 1990-1994. An interesting, if somewhat speculative extension of this work is to use the estimated parameters derived from the empirical investigation to build stochastic simulation model(s) to predict the future evolution of the EU banking industry. This is developed in chapter 8.

CHAPTER 8

THE EVOLUTION OF MARKET STRUCTURE: A SIMULATIONS EXERCISE

8.1 Introduction

In its strictest form the LPE applies to a cohort of surviving firms whose membership remains constant over time. The empirical model(s) estimated previously (in this thesis and elsewhere in the industrial organisation literature) make no allowance for factors other than shocks which are independent of firm size, and therefore 'random', and which determine the evolution of the size distribution of firms over time. However, in practice it is certain that there are other factors which are also instrumental in shaping market structures. Such factors include the entry of new firms, the exit of existing firms and mergers between existing firms. In this chapter the method of stochastic simulation is used to investigate the impact of such factors. Stochastic simulation is a flexible approach that uses randomly generated numbers to test hypotheses relating to an underlying theoretical model.

This chapter discusses the methodology and results of a simulation exercise, which examines the implications for market structure of various scenarios regarding bank growth, as well as entry, exit and merger over fifty time periods. This model is then extended to introduce assumptions about entry, exit and merger activity. The rest of the chapter is structured as follows. Section 8.2 discusses previous work in the industrial organisation literature that has used stochastic simulation to model firm growth. Section 8.3 describes the construction of a simulation model for a constant population of banks, and considers the implications for the size distributions of banks of various assumptions regarding growth. Section 8.4 repeats this exercise, but in addition allows the population of banks to vary through entry, exit and merger. Section 8.5 uses official sources and other evidence to calibrate simulation models of industry structure for the banking markets of France, Germany, Italy, Spain and the United Kingdom. Section 8.6 provides a summary.

8.2 Previous Research

Ijiri and Simon (1964), Engwell (1973), Scherer (1980) and McGloughan (1995) have examined the extent to which simple theoretical models of firm growth can generate firm size distributions similar to those which are observed empirically.

Ijiri and Simon (1964) carry out Monte Carlo simulations to assess whether stochastic models of firm growth lead to skewed distributions of firm sizes. They develop a model in which the growth of a firm is influenced partly by random factors, and partly by previous growth, the influence of which declines as time proceeds. The authors allow for entry into the lowest size class of firms only. To generate a distribution of firm sizes, they begin with an industry consisting of 247 firms of approximately equal size, which comprise 1000 asset units (approximately 4 units for each firm). They simulate the model over 1000 time periods, and find that 75 per cent of growth is attributed to existing firms and 25 per cent to entrants. Ijiri and Simon find a relationship between firm size and age, where older firms tend to become (and remain) larger than younger firms. The larger firms' advantages are augmented when there is positive serial correlation in growth rates, and when the rate of entry is low. They show that their simulations generate a lognormal distribution of firm sizes.

' We can now confidently predict that many other processes, incorporating comparably weak forms of the law of proportionate effects, will lead to a highly similar distribution. Thus our analysis greatly increases the plausibility of a stochastic explanation of firm sizes.'[1]

Engwell (1973) uses a simulation approach to examine the size distribution of firms in Sweden, based on data for the car and shoe industries. He develops a model which postulates that the size distribution of firms is determined by: the growth rates of individual firms; the entry of new firms; and the exit of existing firms.[2] Using theoretical assumptions regarding growth rates, and empirical facts on previous entry and exit to and from the two industries sampled, Engwell finds

[1] Ijiri and Simon (1964), p.89.
[2] Entry and exit in the Engwell model follows a two step process. In the first step, a random draw is made from a suitable probability distribution to establish whether a new firm enters or an established firm exits from the market. In the second step, a random draw is made from a second probability distribution to establish the size of the entering or exiting firm.

that the size distributions of firms generated by the simulation model fit reasonably well with the actual distribution of firm sizes in both cases.

Scherer (1980) tests the LPE by constructing a hypothetical industry made up of 50 equal sized firms. Each firm's growth rate in each year is drawn from an identical normal probability distribution whose parameters (mean and variance) are calibrated using a sample of 369 firms drawn from the 500 largest US firms over the period 1954-1960. Scherer runs the growth process 16 times over a 140 year time period and calculates the average concentration ratio. He finds that CR4 increases from 8 per cent in year 1 to approximately 58 per cent in year 140.

McGloughan (1995) extends the assumptions underlying a stochastic model of growth to produce a model that incorporates growth, entry and exit processes. He sets up five types of model to mimic the findings of previous studies. These are models in which (i) the LPE holds; (ii) small firms grow faster than large firms; (iii) large firms grow faster than small firms; (iv) there is serial correlation in growth rates; and (v) there is heteroscedasticity with the growth of small firms more variable than that of large firms. To allow for entry, McGloughan assumes that entrants are smaller than incumbent firms, and that the probability of exit is the same for all firm sizes.

McGloughan develops fourteen different industry types, based on different assumptions about entry, exit, serial correlation and heteroscedasticity. He finds that in industries in which larger firms grow faster than small firms, a high rate of entry has no effect on concentration, while for industries in which smaller firms grow faster, a high rate of entry leads to de-concentration.

Overall, McGloughan argues that differences in the mean growth rates of firms play a more important role in determining industry concentration than entry, exit or heteroscedasticity in growth rates. However, he acknowledges that the results are subject to some limitations.
' *Stochastic simulation lacks the generality of asymptotic theory and the results generated are much less robust than those from analytical techniques, in that they tend to be sensitive to the way in which the underlying parameters are calibrated.*'[3]

[3] McGloughan (1995), p.431.

8.3 A Stochastic Model of Bank Growth for a Fixed Population of Banks

This section outlines the assumptions underlying the simulation model of bank growth. The simulation exercise seeks to examine the sensitivity of industry structure to changes in assumptions regarding bank growth. The key indicators which are used to reflect outcomes in terms of industry structure are: the evolution of market concentration; changes in the distribution of bank sizes; and the persistence of dominance, measured by the extent to which one bank retains the largest market share through time.

The assumptions which determine the evolution of market concentration for a fixed population of banks concern the following: (i) The relationship between a bank's current size and its growth rate; (ii) the relationship (if any) between a bank's growth rates in successive periods (serial correlation in growth rates); and (iii) the relationship (if any) between a bank's current size and the variance or standard deviation of the probability distribution from which its growth rate is drawn (heteroscedasticity in growth rates).

For the purposes of the simulation exercise, the mean growth rate across banks is assumed to be zero; i.e. there is no deterministic trend in the evolution of bank size through time. The possibility of a deterministic trend is ignored because its inclusion would not affect the results concerning the relative distribution of bank sizes, the evolution of concentration or the persistence of dominance.

Defining s_{it} as the natural logarithm of the size of bank i at time t as before, the most general form which the model specifying the evolution of bank size over time could take is:

$$\Delta s_{it} = \beta_1 + (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + \beta_4 t + u_{it} \quad \text{where } E(u_{it}) = 0 \text{ and } var(u_{it}) = \sigma_{it}^2 \qquad (1)$$

A deterministic trend component would be incorporated by assuming that $\beta_4 \neq 0$ if $\beta_2 < 1$; or $\beta_1 \neq 0$ and $\beta_4 = 0$ if $\beta_2 = 1$. In order to exclude the deterministic trend, it is assumed that

$\beta_1 = \beta_4 = 0$. $\beta_1 = 0$ ensures that mean logarithmic size is zero whenever $\beta_2 < 1$. By setting initial logarithmic size, s_{i0}, to zero in all simulations, a zero mean logarithmic size is also ensured for the case $\beta_2 = 1$. The simulation model adopted is therefore:

$$\Delta s_{it} = (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + u_{it} \quad \text{where: } E(u_{it}) = 0 \text{ and } var(u_{it}) = \sigma_{it}^2 \tag{2}$$

The relationship between current size and growth is controlled by the parameter β_2; serial correlation in growth rates by the parameter β_3; and heteroscedasticity in growth rates by the parameter σ_{it}. It is assumed that u_{it} are drawn from a normal distribution.

The simulations will examine the implications for the evolution of the size distribution of banks of seven alternative sets of assumptions concerning these parameters. These are as follows:

- Industry 1: All banks grow at the same proportionate rate, and there is no serial correlation or heteroscedasticity. In other words the LPE holds. This implies that $\beta_2 = 1$, $\beta_3 = 0$, and $\sigma_{it} = \sigma$.

- Industry 2: Small banks tend to grow faster than large banks, and there is no serial correlation or heteroscedasticity, in which case $\beta_2 < 1$, $\beta_3 = 0$, and $\sigma_{it} = \sigma$.

- Industry 3: Large banks tend to grow faster than small banks, and there is no serial correlation or heteroscedasticity, in which case $\beta_2 > 1$, $\beta_3 = 0$, and $\sigma_{it} = \sigma$.

- Industry 4: Large banks have more variable growth rates than small banks (i.e. there is heteroscedasticity, but no serial correlation), in which case $\beta_2 = 1$, $\beta_3 = 0$, and $\sigma_{it} = f(s_{it-1})$, where $f' > 0$.

- Industry 5: Small banks have more variable growth rates than large banks (i.e. there is heteroscedasticity, but no serial correlation), in which case β_2 = 1, β_3 = 0, and σ_{it}=g(s_{it-1}), where g ' < 0.

- Industry 6: Banks that enjoyed above average (below average) growth in the previous period tend to do so again in the current period (i.e. there is positive serial correlation, but no heteroscedasticity), in which case β_2 = 1, β_3 > 0, and $\sigma_{it} = \sigma$.

- Industry 7: Banks that enjoyed above average (below average) growth in the previous period tend to have below average (above average) growth in the current period (i.e. there is negative serial correlation, but no heteroscedasticity), in which case β_2 = 1, β_3 < 0, and $\sigma_{it} = \sigma$.

The simulation results are reported using three sets of measures reflecting the evolution of the size distribution of banks:

(i) mean and standard deviation of bank size; (ii) one, two and five bank concentration ratios and the numbers equivalent of the Herfindahl-Hirschman Index;[4] and (iii) the persistence of dominance, measured by the average number of time periods as market leader achieved by the bank with most periods as market leader.

Table 8.1 reports the average results across 20 simulations of the evolution over 50 time periods of the sizes of a group of 20 banks for Industries 1 to 7. The banks begin equal in size at time 0. Their subsequent evolution is driven by equation (2).

[4] Chapter 3 provides a discussion of the relative merits of each of these measures for the analysis of market concentration.

Table 8.1: Evolution of Market Structure: No Entry Exit or Merger

Type	Mean	St.Dev	CR1	CR2	CR5	Num Equiv
Industry 1: $\beta_2 = 1,\ \beta_3 = 0,\ \sigma_{it} = 0.1$						
t =10	1.03	0.33	8.7	16.1	35.4	18.2
t=20	1.10	0.49	10.5	19.1	40.0	16.7
t= 50	1.26	0.91	15.1	25.7	49.0	13.2
Top	26.7					
Industry 2: $\beta_2 = 0.95,\ \beta_3 = 0,\ \sigma_{it} = 0.1$						
t=10	1.05	0.27	8.2	15.1	33.4	18.9
t=20	1.09	0.34	8.6	16.0	35.3	18.2
t=50	1.05	0.33	8.8	16.2	35.4	18.2
Top	18.4					
Industry 3: $\beta_2 = 1.02, \beta_3 = 0,\ \sigma_{it} = 0.1$						
t=10	1.08	0.37	9.0	16.8	36.4	17.9
t=20	1.19	0.64	11.6	21.1	43.0	15.6
t=50	2.10	2.83	27.2	40.0	64.8	7.3
Top	30.5					
Industry 4: $\beta_2 = 1,\ \beta_3 = 0,\ \sigma_{it} = 0.1{+}0.02\,s_{it-1}$						
t=10	1.07	0.35	9.0	16.5	34.2	18.2
t=20	1.15	0.59	11.7	20.8	42.0	15.9
t=50	1.38	1.20	18.2	29.1	51.7	11.5
Top	25.2					
Industry 5: $\beta_2 = 1,\ \beta_3 = 0,\ \sigma_{it} = 0.1{-}0.02\,s_{it-1}$						
t=10	1.05	0.34	8.6	16.0	35.6	18.2
t=20	1.09	0.48	10.1	18.8	39.3	16.7
t=50	1.28	0.86	13.2	23.2	47.5	13.9
Top	26.5					
Industry 6: $\beta_2 = 1,\ \beta_3 = 0.1,\ \sigma_{it} = 0.1$						
t=10	1.07	0.39	9.5	17.3	36.9	17.9
t=20	1.12	0.56	11.3	20.0	41.6	16.1
t=50	1.30	1.03	16.3	27.0	50.8	12.5
Top	26.3					
Industry 7: $\beta_2 = 1,\ \beta_3 = -0.1,\ \sigma_{it} = -0.1$						
t=10	1.04	0.31	8.4	15.7	34.8	18.5
t=20	1.08	0.45	10.1	18.3	39.1	16.9
t=50	1.23	0.83	14.2	24.8	47.6	13.7
Top	23.6					

Notes:

In each panel, the results are generated from 20 replications of the development over 10, 20 and 50 time periods of a market comprising of 20 banks, each of which starts from an initial size of 1 unit, and whose subsequent evolution is driven by the model: $\Delta s_{it} = (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + u_{it}$. $u_{it} \sim N(0,\ \sigma_{it}^2)$ $\sigma_{it} = 0.1$

Mean and st.dev denote the mean and standard deviation of actual bank size.

CR.1, CR.2 AND CR.5 are concentration ratios measuring the market share of the top 1, 2, and 5 banks respectively.

Num.equiv is the numbers equivalent version of the Herfindahl - Hirschman Index.

Top denotes the number of periods in which one bank retains the largest market share through time.

Industry 1 is the case in which the LPE holds in its strictest form, and therefore represents a benchmark against which to compare the other panels (each of which represents some form of departure from the LPE). s_{it} (for each bank i) follows a random walk, with a homoscedastic disturbance term. As before, lower case symbols are used to denote the natural logarithm of bank size, so s_{it} = size of bank i at time t, and $\bar{s}_t = \sum_{i=1}^{N} s_{it}/N$ = arithmetic mean of s_{it}; and upper case symbols are used to denote actual bank size, so $S_{it} = e^{s_{it}}$, and $\bar{S}_t = \sum_{i=1}^{N} S_{it}/N$ = arithmetic mean of S_{it}. While $\bar{s}_t$ (not shown in Table 8.1) remains zero over all time periods, Table 8.1 shows that $\bar{S}_t$ tends to increase over time starting at 1.0 at t = 0 and reaching 1.03 by t = 10, 1.10 by t = 20 and 1.26 by t = 50, because the dispersion of s_{it} around $\bar{s}_t$ also tends to increase (Prais, 1976). The reasons for this phenomenon can be illustrated as follows.

Suppose there are two banks, each with $s_{i0} = 0$, so $S_{i0} = 1$ for i =1, 2; and $\bar{s}_0 = 0$, $\bar{S}_0 = 1$. Suppose in period 1, $u_{11} = s_{11} = 0.2$ and $u_{21} = s_{21} = -0.2$, so $S_{11} = 1.2214$ and $S_{21} = 0.8187$. Then $\bar{s}_1 = 0$, but $\bar{S}_1 = 1.0201$; i.e. average size has increased, due to the dispersion of s_{11} and s_{21} around the logarithmic mean of $\bar{s}_1 = 0$. Banks with $s_{it} > 0$ ($S_{it} > 1$) contribute more to $\bar{S}_t$ than banks with $s_{it} < 0$ ($S_{it} < 1$), due to the effects of the application of the exponential function to s_{it} to obtain S_{it}. A similar phenomenon also explains the progressive increases in the concentration ratios CR1, CR2 and CR5 reported in Table 8.1, which for Industry 1 start from 5.0, 10.0 and 25.0 respectively at t = 0, and reach 15.1, 25.7 and 49.0 respectively by t = 50. Likewise the H-H numbers equivalent falls from 20.0 at t = 0 to 13.2 at t = 50. Finally, for Industry 1 the average number of time periods (out of 50) over which the firm with the longest duration as the largest firm held this position was 26.7.

Industry 2 represents the case where smaller banks grow faster than larger banks, so the LPE does not hold. In this case β_2 is set to 0.95. From an initial position in which all banks are of equal size, random fluctuations from year to year in logarithmic size around its mean size cause the average bank size and the concentration ratios to increase slightly above their initial values. However, once the equilibrium level of dispersion around the logarithmic mean is achieved, the proportionately faster growth of small banks slows and eventually halts the rate at which average bank size and concentration increase. As a consequence, there is no further tendency for average bank size or concentration to increase, as evidenced by the similarities in structure at t=10, 20 and 50.

Industry 3 represents the case where large banks grow faster than small banks. In this case β_2 is set to 1.02. For values of β_2 greater than 1.02, the growth of the larger banks become sufficiently explosive to make the model unstable and unrealistic over 50 time periods. In Industry 3, the pattern of growth in s_{it} leads to a wide divergence in bank sizes, which increases exponentially over the 50 time periods. As a consequence average bank size and the dispersion of sizes increase much faster than under the LPE, leading to substantially higher rates of concentration at t = 50 (CR1=27.2%, CR2=40.0% and CR5 = 64.8% in Industry 3 compared with 15.1%, 25.7% and 49% respectively in Industry 1). The differential growth advantages enjoyed by large banks results in the top bank enjoying market leadership for 30.8 periods on average. Although such a pattern is possible in theory, it is unlikely to be observed in practice for a sustained period of time. However, some of the early empirical evidence on the LPE suggests that this type of growth process may be observed over finite time periods (e.g. from 1950 to 1960 for Samuals, 1965 and from 1948 to 1960 for Singh and Whittington, 1975).

Industry 4 illustrates the effects of heteroscedasticity in the disturbance term when σ_{it} is positively related to s_{it-1}. If σ_{it} increases with s_{it-1}, a bank which is fortunate to draw its growth rate (randomly) from the top end of the appropriate probability distribution in one period will become bigger, and will therefore draw its growth rate for the next period from a probability distribution with a larger variance. If it is fortunate again and draws from the top end of the distribution, it will have grown faster over the two time periods than a bank which experienced two 'good' draws in successive periods from distributions whose variances do not increase with bank size. In Industry 4, the pattern of growth in s_{it} leads to larger average values of bank size, than was the case under the LPE, leading to increasing levels of concentration over the 50 periods. The tendency towards increased concentration over time is therefore accentuated. At t = 50, CR1=18.2%, CR2=29.1% and CR5=51.7% for Industry 4, compared with 15.1%, 25.7%, 49% respectively in Industry 1.

In contrast, Industry 5 illustrates the effects of heteroscedasticity in the disturbance term when σ_{it} is negatively related to s_{it-1}. In this case the long-term tendency towards increased concentration implied by the LPE, is offset to some extent by the effects of the heteroscedasticity. A bank that achieves growth rates from the top end of the distribution in two successive periods will tend to grow at a slower rate than it would under the LPE. This is because in the second period, the growth rate will be drawn from the top end of a distribution with a smaller variance, as a result of an increase in size achieved in the first period. Heteroscedasticity that follows this pattern does not bring convergence in bank size (the tendency toward increased concentration still continues in the long term), but it does slow the rate at which divergence takes place. At t=50, CR1=13.2%, CR2=23.2% and CR5=47.5% in Industry 5, compared with 15.1%, 25.7% and 49% respectively under Industry 1. Mansfield (1962), Singh and Whittington (1975), Evans (1987a,b), Hall (1987), Dunne and Hughes (1994), and Hart and Oulton (1996) have all found evidence of heteroscedasticity of the type modelled in Industry 5. The latter is likely to be more typical than in Industry 4, because large banks often enjoy advantages associated with diversified operations which make them less susceptible to periods of extremely high or low growth, than small banks whose business may be located in one or two areas of banking activity. However, no evidence of heteroscedasticity was found in the current investigation of European banks (chapter 7).

Industry 6 illustrates the effects of positive serial correlation in rates of growth. Positive serial correlation (β_3 = 0.1), by tending to prolong the advantages of banks which are initially fortuitous in drawing a positive growth rate (i.e. for which success leads to further success), speeds up the rate at which there is upward drift in average bank sizes, and increases in market concentration

(Chesher, 1979). At t = 50, CR1=16.3%, CR2=27.0% and CR5 =52.8% in Industry 6, compared with 15.1%, 25.7% and 49% respectively in Industry 1.

Finally, Industry 7 illustrates the effects of negative serial correlation in rates of growth. Negative serial correlation (β_3 = -0.1), by ensuring that the periods of positive and negative growth tend to be distributed more evenly across banks and tend to offset one another over time, has the effect of reducing the speed at which market concentration increases, although without halting it completely. At t = 50, CR1=14.2%, CR2=24.8% and CR5 = 47.6% in Industry 7 compared with 15.1%, 25.7% and 49% respectively in Industry 1.

For manufacturing industries Singh and Whittington (1975), Kumar (1985) and Dunne and Hughes (1994) have all found evidence of persistence of growth as modelled in Industry 6. With the exception of the present study (which found a positive relationship between growth rates in previous periods using a total assets measure of bank size), no evidence of growth persistence in banking markets has been presented.

Figure 8.1 presents a diagrammatic summary and comparison of the results for Industries 1 to 7, in a different form to the results presented in Table 8.1. For each industry, $M_t = e^{\bar{s}_t}$; $L_t = e^{\bar{s}_t - v_t}$ and $U_t = e^{\bar{s}_t + v_t}$ where $v_t = \sqrt{\sum (s_{it} - \bar{s}_t)^2 / (N-1)}$. M_t therefore represents the actual size of a bank whose logarithmic size is the mean for the population of 20, and L_t and U_t represent the actual sizes of banks whose logarithmic size is one standard deviation below and above the mean logarithmic size respectively. As before, $\overline{S}_t$ is the mean actual size, which is generally higher than M_t because of the effects of the application of the exponential function as discussed previously. In each case, around two thirds of the population of banks are typically located within the range of values identified between U_t and L_t, while M_t typically approximates the median bank size. The diagrams illustrate clearly the extent to which relatively small changes in assumptions about the parameter values (from one Industry to another) can have major implications for the evolution of market structure over time.

Figure 8.1 Evolution of Bank Size for Seven Simulated Industries

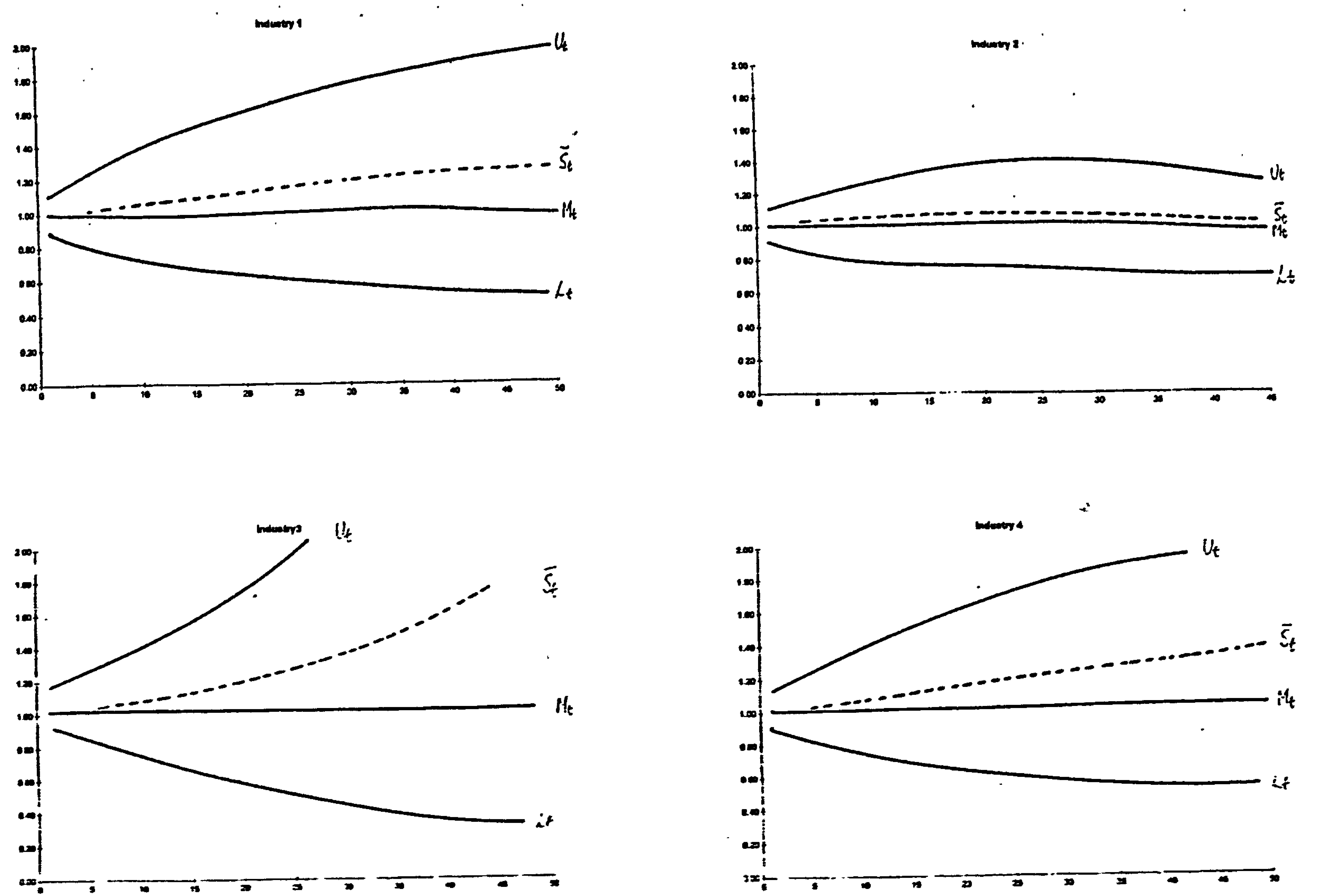
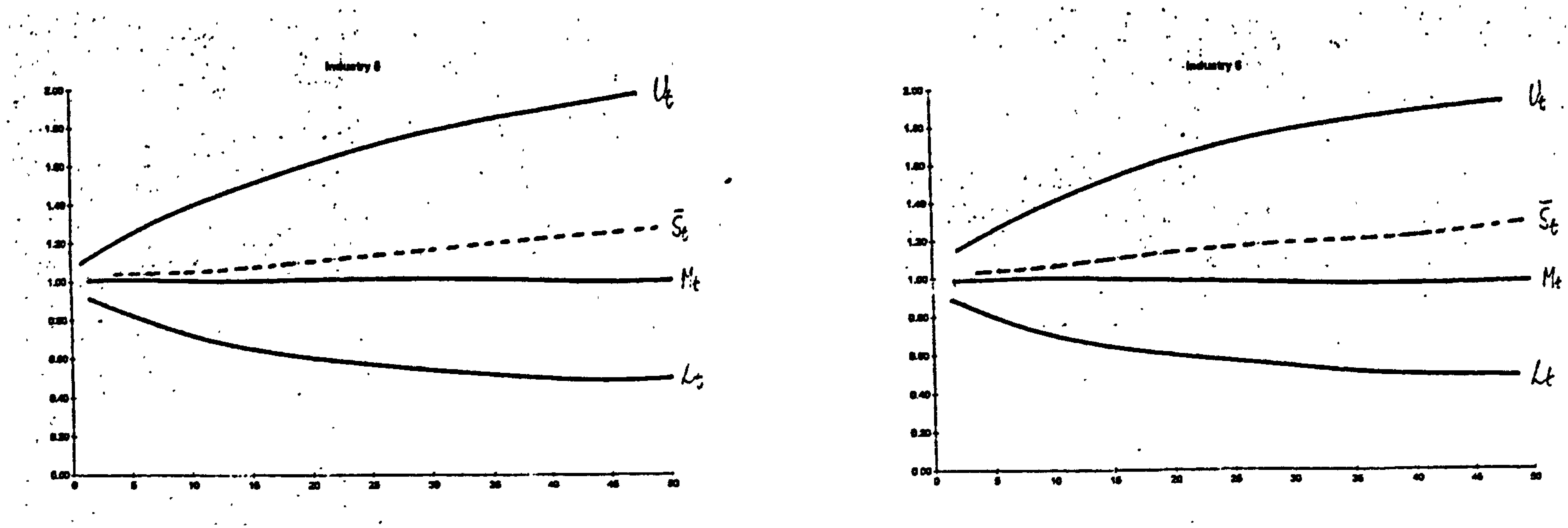
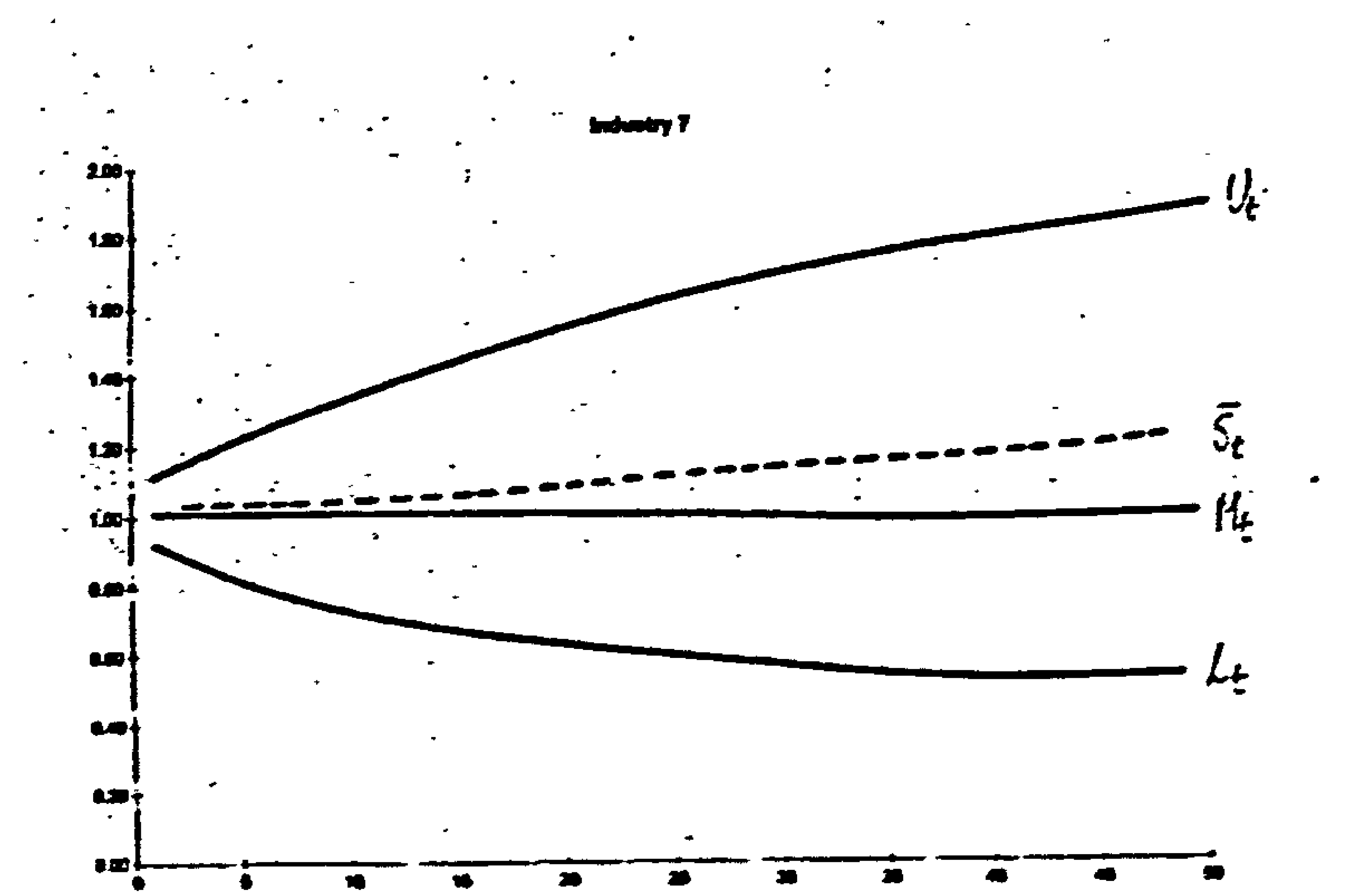


Figure 8.1 Evolution of Bank Size for Seven Simulated Industries





Notes: M_t denotes the actual size of a bank whose logarithmic size is the mean for the population of banks, U_t and L_t denote the actual size of banks whose logarithmic size is one standard deviation above and below the mean logarithmic size respectively. $\bar{S}_t$ denotes the mean of actual bank size.

Tables 8.2 to 8.4 present the simulation results in the form of a sensitivity analysis showing the effects of variation in each of the parameters β_2, β_3 and σ_{it} respectively, while holding all the parameters and assumptions constant. Table 8.5 shows the sensitivity of industry evolution to changes in the functional relationship between σ_{it} and s_{it-1} in the case where σ_{it} is heteroscedastic.

Table 8.2 shows the implications for the evolution of market structure of various values of β_2. The row for β_2 = 0.95 reproduces the results for Industry 2. β_2 = 1 is Industry 1 and β_2=1.02 is Industry 3. For β_2 < 1, the random component of bank growth ensures there is a distribution of values of s_{it} around 0 (S_{it} around 1), which opens out during the first few time periods, before settling down and eventually reaching a level of dispersion which does not increase further. The closer to 1 is the value of β_2, the larger the variance of the equilibrium distribution, and the longer it takes for the distribution to reach its equilibrium. When β_2 = 1 concentration goes on increasing indefinitely, and there is no equilibrium distribution of bank sizes. If β_2 > 1, there is explosive growth in s_{it} leading to large increases in average bank size and market concentration.

Table 8.3 shows the implications of variation in the strength of serial correlation for various values of β_3 on either side of zero. The rows for β_3 = 0.1 and β_3 = -0.1 reproduce the results for Industries 6 and 7 in Table 8.1, while the row for β_3 = 0 represents Industry 1. Table 8.3 shows that the tendencies revealed in Table 8.1 are simply accentuated if there is a stronger pattern of positive or negative serial correlation; i.e. the former tends to strengthen the drift towards higher concentration, while the latter tends to offset (but not to halt) the same tendency.

Table 8.4 shows the implications of variation in the parameter σ_{it}, assuming homoscedasticity. The row for σ_{it} = 0.1 reproduces the results for Industry 1. Increases in σ_{it} impact primarily on

Table 8.2: Sensitivity Analysis for Variation in β_2

β_2	Mean	St.Dev	CR1	CR2	CR5	Num Equiv	Top
	(i) t=10						
0.5	1.01	0.12	6.3	11.9	28.7	19.6	
0.75	1.01	0.15	6.5	12.6	29.6	19.6	
0.90	1.03	0.22	7.5	14.0	31.8	19.2	
0.95	1.05	0.27	8.2	15.1	33.4	18.9	
0.97	1.03	0.27	8.2	15.1	33.3	18.9	
0.99	1.05	0.30	8.2	15.4	34.5	18.5	
1	1.03	0.33	8.7	16.1	35.4	18.2	
1.02	1.08	0.37	9.0	16.8	36.4	17.9	
	(ii) t=20						
0.5	1.01	0.11	6.1	11.9	28.4	19.6	
0.75	1.01	0.14	6.4	12.4	29.5	19.6	
0.90	1.01	0.24	7.9	14.6	32.8	18.9	
0.95	1.09	0.34	8.6	16.0	35.3	18.2	
0.97	1.05	0.34	8.7	16.2	35.5	18.2	
0.99	1.12	0.48	10.4	18.7	39.3	16.9	
1	1.10	0.49	10.5	19.1	40.0	16.7	
1.02	1.19	0.64	11.6	21.1	43.0	15.6	
	(iii)t=50						
0.5	1.00	0.12	6.2	12.1	28.8	19.6	6.7
0.75	1.01	0.14	6.5	12.5	29.5	19.6	8.8
0.90	1.01	0.23	7.4	14.2	32.3	18.9	14.1
0.95	1.05	0.33	8.8	16.2	35.4	18.2	18.4
0.97	1.10	0.43	9.8	18.0	37.6	17.2	18.9
0.99	1.21	0.67	11.5	21.3	43.7	15.4	22.8
1	1.26	0.91	15.1	25.7	49.0	13.2	26.6
1.02	2.10	2.83	27.2	40.0	64.8	7.3	30.2

Notes:
In each panel, the results are generated from 20 replications of the development over 10, 20 and 50 time periods of a market comprising of 20 banks, each of which starts from an initial size of 1 unit, and whose subsequent evolution is driven by the model: $\Delta s_{it} = (\beta_2 - 1)s_{it-1} + u_{it}$; β_2 as shown $u_{it} \sim N(0, \sigma_{it}^2)$ $\sigma_{it} = 0.1$.

Mean and st.dev denote the mean and standard deviation of actual bank size.
CR.1, CR.2 AND CR.5 are concentration ratios measuring the market share of the top 1, 2, and 5 banks respectively.
Num.equiv is the numbers equivalent version of the Herfindahl - Hirschman index.
Top denotes the number of periods in which one bank retains the largest market share through time.

Table 8.3: Sensitivity Analysis For Variation In β_3

β_3	Mean	St.Dev	CR1	CR2	CR5	Num Equiv	Top
	(i) t=10						
0.4	1.13	0.52	10.6	19.8	40.6	16.4	
0.2	1.08	0.44	10.2	18.3	38.6	17.2	
0.1	1.07	0.39	9.5	17.3	36.9	17.9	
0	1.03	0.33	8.7	16.1	35.4	18.2	
-0.1	1.04	0.31	8.4	15.7	34.8	18.5	
-0.2	1.03	0.28	8.2	15.4	33.8	18.5	
-0.4	1.02	0.22	7.4	14.0	32.0	19.2	
	(ii) t=20						
0.4	1.30	0.92	14.2	25.3	49.4	13.5	
0.2	1.16	0.66	12.1	22.0	44.8	15.2	
0.1	1.12	0.56	11.3	20.0	41.6	16.1	
0	1.10	0.49	10.5	19.1	40.0	16.6	
-0.1	1.08	0.45	10.1	18.3	39.1	16.9	
-0.2	1.09	0.44	10.1	18.6	39.6	17.2	
-0.4	1.04	0.31	8.3	15.8	34.5	18.5	
	(iii) t=50						
0.4	1.93	2.30	23.2	38.0	63.7	8.6	25.8
0.2	1.51	1.58	20.9	32.9	57.8	9.90	27.6
0.1	1.30	1.03	16.3	27.0	50.8	12.5	26.3
0	1.27	0.91	15.1	25.7	49.0	13.2	26.7
-0.1	1.23	0.83	14.2	24.8	47.6	13.7	23.6
-0.2	1.20	0.78	14	24.8	46.3	14.1	24.7
-0.4	1.12	0.55	11.2	20.4	41.5	16.1	20.8

Notes:
In each panel, the results are generated from 20 replications of the development over 10, 20 and 50 time periods of a market comprising of 20 banks, each of which starts from an initial size of 1 unit, and whose subsequent evolution is driven by the model: $\Delta s_{it} = \beta_3 \Delta s_{it-1} + u_{it}$ β_3 as shown $u_{it} \sim N(0, \sigma_{it}^2)$. $\sigma_{it} = 0.1$.

Mean and st.dev denote the mean and standard deviation of actual bank size.
CR.1, CR.2 AND CR.5 are concentration ratios measuring the market share of the top 1, 2, and 5 banks respectively.
Num.equiv is the numbers equivalent version of the Herfindahl - Hirschman Index.
Top denotes the number of periods in which one bank retains the largest market share through time.

Table 8.4: Sensitivity Analysis for variation in σ_{it}

σ_{it}	Mean	St.Dev	CR1	CR2	CR5	Num Equiv	Top
	(i) t=10						
0.025	1.00	0.08	5.8	11.4	27.5	20	
0.05	1.00	0.16	6.7	12.8	30	19.6	
0.10	1.03	0.33	8.7	16.1	35.4	18.2	
0.15	1.08	0.52	11.1	19.9	41.1	16.4	
0.20	1.17	0.76	13.9	24.0	46.8	14.3	
0.25	1.28	1.07	17.1	28.5	52.5	12.0	
	(ii) t=20						
0.025	1.00	0.11	6.1	11.9	28.5	19.6	
0.05	1.02	0.23	7.4	14.1	32.2	19.2	
0.10	1.10	0.49	10.5	19.1	40.0	16.7	
0.15	1.24	0.85	14.3	24.9	48.0	13.7	
0.20	1.46	1.38	18.7	31.2	55.9	10.8	
0.25	1.80	2.18	23.4	37.7	63.2	8.3	
	(iii) t=50						
0.025	1.01	0.18	6.8	13.1	30.6	19.2	26.7
0.05	1.06	0.37	9.1	16.8	36.5	17.9	26.7
0.10	1.26	0.91	15.1	25.7	49.0	13.2	26.7
0.15	1.67	1.90	22.5	35.8	60.8	8.9	26.7
0.20	2.48	3.89	30.6	45.9	70.9	6.0	26.7
0.25	4.01	8.01	38.4	55.0	78.8	4.3	26.7

Notes:
In each panel, the results are generated from 20 replications of the development over 10, 20 and 50 time periods of a market comprising of 20 banks, each of which starts from an initial size of 1 unit, and whose subsequent evolution is driven by the model: $\Delta s_{it} = s_{it-1} + u_{it}$; $u_{it} \sim N(0, \sigma_{it}^2)$ σ_{it} as shown.

Mean and st.dev denote the mean and standard deviation of actual bank size.
CR.1, CR.2 AND CR.5 are concentration ratios measuring the market share of the top 1, 2, and 5 banks respectively.
Num.equiv is the numbers equivalent version of the Herfindahl - Hirschman Index.
Top denotes the number of periods in which one bank retains the largest market share through time.

Table 8.5: Sensitivity Analysis for the functional relationship between σ_{it} and s_{it-1}

σ_{it}	Mean	St.Dev	CR1	CR2	CR5	Num Equiv	Top
	(i) t=10						
$0.1+0.03\,s_{it-1}$	1.05	0.36	9.1	16.9	35.9	17.9	
$0.1+0.02\,s_{it-1}$	1.07	0.35	9.0	16.5	34.2	18.2	
0.1	1.03	0.33	8.7	16.1	35.4	18.2	
$0.1-0.02\,s_{it-1}$	1.05	0.34	8.6	16.0	35.6	18.2	
$0.1-0.03\,s_{it-1}$	1.06	0.34	7.9	16.0	34.6	18.2	
	(ii) t=20						
$0.1+0.03\,s_{it-1}$	1.09	0.52	11.6	20.2	40.7	16.1	
$0.1+0.02\,s_{it-1}$	1.15	0.59	11.7	20.8	42.0	15.9	
0.1	1.10	0.49	10.5	19.1	40.0	16.7	
$0.1-0.02\,s_{it-1}$	1.09	0.48	10.1	18.8	39.3	16.7	
$0.1-0.03\,s_{it-1}$	1.13	0.47	9.5	17.5	37.6	17.2	
	(iii) t=50						
$0.1+0.03\,s_{it-1}$	1.38	1.19	17.2	29.0	50.8	11.8	24.3
$0.1+0.02\,s_{it-1}$	1.38	1.20	18.2	29.1	51.7	11.5	25.2
0.1	1.26	0.91	15.1	25.7	49.0	13.2	26.7
$0.1-0.02\,s_{it-1}$	1.28	0.86	13.2	23.2	47.5	13.9	26.5
$0.1-0.03\,s_{it-1}$	1.24	0.80	12.6	23.1	46.2	14.3	25.9

Notes:
In each panel, the results are generated from 20 replications of the development over 10, 20 and 50 time periods of a market comprising of 20 banks, each of which starts from an initial size of 1 unit, and whose subsequent evolution is driven by the model: $\Delta s_{it} = s_{it-1} + u_{it}$; $u_{it} \sim N(0, \sigma_{it}^2)$ σ_{it} as shown.

Mean and st.dev denote the mean and standard deviation of actual bank size.
CR.1, CR.2 AND CR.5 are concentration ratios measuring the market share of the top 1, 2, and 5 banks respectively.
Num.equiv is the numbers equivalent version of the Herfindahl - Hirschman Index.
Top denotes the number of periods in which one bank retains the largest market share through time.

the dispersion of the firm size distribution, but also indirectly on mean firm size and concentration, because the wider the size distribution, the greater will be the accentuation of the effects of the exponential function in determining the latter. It is interesting to note, however, that the average number of periods over which the largest bank remains the top position is invariant to changes in σ_{it}.

Finally, Table 8.5 shows the implications of variation in the extent of heteroscedasticity, reflected in changes in the parameters which express the functional relationship between σ_{it} and s_{it-1}. The rows for $\sigma_{it} = 0.1 + 0.02 s_{it-1}$ and $\sigma_{it} = 0.1 - 0.02 s_{it-1}$ reproduce the results for Industries 4 and 5, while $\sigma_{it} = 0.1$ represents Industry 1. A positive functional relationship between σ_{it} and s_{it-1} leads to greater increases in the mean and standard deviation of bank size, along with industry concentration than is the case in Industry 1. A negative functional relationship tends to slow the rate at which concentration increases over time. The results reported in Table 8.5 contain quite a lot of noise, which makes the relationship between the extent of heteroscedasticity and the firm size distribution appear to be erratic. It is to be expected however that the noise would disappear if more than 20 replications were carried out. Computationally, this was judged to be impractical due to the heavy computing time requirements of the simulations with heteroscedasticity.

Overall, the LPE leads to increases in the average and standard deviation of bank size, and increased concentration (Industry 1). These tendencies develop more quickly when large firms grow proportionately faster or experience more variable growth rates than their smaller counterparts, and when there is positive persistence of growth (Industries 3, 4, and 6). The same tendencies develop more slowly when small firms have more variable growth rates than their larger counterparts, and when there is negative persistence of growth (Industries 5 and 7). There is no sustained tendency towards increased average and standard deviation of firm size or increased concentration if smaller firms grow faster than larger firms (Industry 2).

8.4 A Stochastic Model of Bank Growth For a Population of Banks Which Changes Over Time

This section extends the previous models by developing a simulation model in which the population of banks is allowed to vary. In turn, processes allowing for entry, exit and merger are introduced. Each such process is superimposed onto each of the seven industry types to investigate how the tendencies towards increased concentration identified in Table 8.1 are altered according to different entry, exit and merger assumptions.

Entry

Traditional microeconomic literature views entry as an important component in the process of market price adjustment towards equilibrium. More dynamic views (e.g. the Schumpeterian and Austrian schools) see entry as an innovative process reflecting the interaction of decisions made by consumers, entrepreneurs and resource owners. Central to this role is the entrepreneur, who plays a crucial role by noticing unexploited opportunities. Entrepreneurs discover new pieces of information, which by their actions, they can transmit to other decision-makers, who can adjust their plans in order to improve on past performance. Kirzner (1973) argues that entry is instrumental in driving industry evolution.

'*The overambitous plans of one period will be replaced by more realistic ones; market opportunities overlooked in one period will be exploited in the next. In other words, even without changes in the basic data of the market (i.e. in consumer tastes, technological possibilities, and resource availabilities), the decisions made in one period of time generate systematic alterations in the corresponding decisions for the succeeding period. Taken over time, this series of systematic changes in the interconnected network of market conditions constitutes the market process.*'[5]

Empirical evidence on the determinants of entry for manufacturing industries now forms a substantial literature.[6] Most research suggests that entry is higher in profitable industries or in industries enjoying high average growth rates (Geroski, 1991; Baldwin and Gorecki, 1987). In

[5] Kirzner (1973), p.10.
[6] See Siegfried and Evans (1994) for an excellent survey on empirical studies of entry, and chapter 3 of this thesis.

contrast, entry is slower for industries where incumbents hold absolute cost advantages over potential entrants, or where capital requirements for entrants are substantial (Orr, 1974a). The evidence with regard to scale economies, excess capacity and restrictive pricing practices (i.e. limit and predatory pricing acting as entry barriers) is both limited and inconclusive (Baldwin and Gorecki, 1987; Geroski, 1991).

In banking, the evidence on the determinants of entry is also rather limited. Orr (1974b) using Canadian data covering the period 1963-1967, estimates a model to explain the entry process in manufacturing, and then applies the estimated coefficients to predict the likely rate of entry into banking. Entry is determined by profit levels, market growth, market size, capital requirements, advertising and the concentration levels. He finds that high capital requirements, advertising expenditures and industry concentration significantly deter entry, while a large market size encourages entry. Orr's model predicts an entry rate of 2.27 banks per year over the period 1963-1967, but the actual entry rate was only 0.5 banks per year. Orr therefore concludes that other factors must explain the entry process in banking markets.

Hannan (1983) examines the relationship between market characteristics and entry decisions using US banking data for Pennsylvania for 1968-1970. Using a conditional logit model, entry is explained by a vector of market structure variables. Hannan finds in general that entry is deterred in markets when incumbents charge low prices and invest in expanding branch networks. This suggests that limit pricing and increasing capacity are important price and non-price entry deterring strategies.[7]

In the simulation model estimated in this section the average rate of entry is denoted by the parameter λ, which is defined as the average number of new banks entering the industry per period. The probabilities that X = 0, 1, 2... banks enter in each time period are defined by the Poisson distribution.

[7] Chapter 3 provides a discussion of these issues in the context of industrial organisation theory, while chapter 4 discusses applications to the banking industry.

$$p(X = x) = \frac{e^{-\lambda}\lambda^{x}}{x!}$$

The average rate of entry is therefore the same for any two time intervals of equal length, and the rate in any period is independent of the rate in any other period. It is assumed that all entrants begin with $s_{it} = 0$, $(S_{it} = 1)$ when entry takes place at time t. An implication is that (except in Industry 2) entrants become smaller relative to $\overline{S}_t$ as time proceeds.

The overall effect on market concentration is dependent on two factors: the rate of entry and the average size of entrants. Evidence from manufacturing suggests that on average entrants are typically smaller than established firms, and that the probability of entry is small (Geroski, 1991). In banking, entry is more heavily regulated than in most manufacturing industries, and so in general may be an even rarer event. However, since the advent of the European Single Market Programme for financial services, the rate of entry has increased particularly in countries which were previously heavily regulated. This is a consequence of the EU's legislation introducing a single banking licence which makes it easier for EU banks to establish cross border presence (EU, 1997a). This has also led to increases in the numbers of foreign banks operating in EU countries (Table 2.8, chapter 2).

Table 8.6 repeats the simulations for the seven Industry types introduced in Table 8.1, allowing for entry on either a small (λ = 0.5), medium (λ =1) and high scale (λ = 2).[8] The rows for λ=0 reproduce the results for Industries 1 to 7 in Table 8.1.

In all Industries, positive rates of entry lead to lower mean size, standard deviation in bank sizes and levels of concentration than is the case where entry is zero. The numbers equivalent measure of industry concentration indicates that larger numbers of equal sized banks could be

[8] Data on entry flows into European banking markets were not available from official statistics. However, some rough estimates of entry to the Italian banking market were available from Central Bank Reports. These suggest that on average over the period 1990-1994, entry was approximately three per cent per annum. Given that over this period the Italian market was among the most regulated in Europe, three per cent is thought to be a 'low' rate of entry. As a consequence the assumptions for 'medium' and 'high' entry are made relative to this benchmark case.

Table 8.6: Effect of Entry on the Evolution of Market Structure

Industry 1: $\beta_2 = 1$, $\beta_3 = 0$, $\sigma_{it} = 0.1$

Entry: $\Pr(X=x) = \dfrac{e^{-\lambda}\lambda^x}{x!}$ Low = $\lambda = 0.5$ Medium = $\lambda = 1$ High = $\lambda = 2$

(x = no. of entrants)

λ	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.03	0.33	8.7	16.1	35.4	18.2	
0.5	25	1.02	0.30	7.2	13.3	29.5	22.2	
1	30	1.02	0.29	5.8	10.9	24.3	27.8	
2	40	1.02	0.28	4.7	8.7	19.4	35.7	
	(ii) t=20							
0	20	1.10	0.49	10.5	19.1	40.0	16.7	
0.5	30	1.07	0.44	7.1	13.4	28.5	25.6	
1	40	1.06	0.40	5.6	9.8	21.4	35.7	
2	60	1.05	0.38	4.0	7.4	15.5	52.6	
	(iii)t=50							
0	20	1.26	0.91	15.1	25.7	49.0	13.2	26.7
0.5	45	1.18	0.76	8.1	13.7	26.7	31.3	25.1
1	70	1.15	0.69	5.4	9.4	18.8	50	24.4
2	120	1.16	0.67	3.3	6.1	12.2	90.9	21.4

Industry 2: $\beta_2 = 0.95$, $\beta_3 = 0$, $\sigma_{it} = 0.1$

Entry: $\Pr(X=x) = \dfrac{e^{-\lambda}\lambda^x}{x!}$ Low = $\lambda = 0.5$ Medium = $\lambda = 1$ High = $\lambda = 2$

(x = no. of entrants)

λ	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.05	0.27	8.2	15.1	33.4	18.9	
0.5	25	1.04	0.25	6.7	12.3	27.2	23.3	
1	30	1.04	0.24	5.5	10.3	23.0	28.6	
2	40	1.03	0.22	3.9	7.4	16.6	40.0	
	(ii) t=20							
0	20	1.09	0.34	8.6	16.0	35.3	18.2	
0.5	30	1.07	0.31	5.9	10.8	24.5	27.8	
1	40	1.06	0.29	4.6	8.4	18.8	37.0	
2	60	1.05	0.27	3.0	5.8	13.1	55.6	
	(iii) t=50							
0	20	1.05	0.33	8.8	16.2	35.4	18.2	18.4
0.5	45	1.05	0.31	4.3	8.0	17.6	41.7	17.8
1	70	1.04	0.30	2.9	5.4	11.8	66.7	14.9
2	120	1.04	0.29	1.6	3.1	7.1	111.1	15

Industry 3: $\beta_2 = 1.02$, $\beta_3 = 0$, $\sigma_{it} = 0.1$

Entry: $\Pr(X=x) = \frac{e^{-\lambda}\lambda^x}{x!}$ Low = $\lambda = 0.5$ Medium = $\lambda = 1$ High = $\lambda = 2$

(x = no. of entrants)

λ	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.08	0.37	9.0	16.8	36.4	17.9	
0.5	25	1.06	0.33	7.1	13.1	28.6	23.3	
1	30	1.06	0.33	6.2	11.6	25.4	27.0	
2	40	1.05	0.30	4.5	8.4	18.5	38.5	
	(ii) t=20							
0	20	1.19	0.64	11.6	21.1	43.0	15.6	
0.5	30	1.13	0.54	7.8	14.0	29.1	25.6	
1	40	1.12	0.51	5.9	11.2	24.0	32.3	
2	60	1.10	0.48	4.2	8.1	17.1	50	
	(iii) t=50							
0	20	2.10	2.83	27.2	40.0	64.8	7.3	30.2
0.5	45	1.56	2.04	16.1	23.6	39.7	16.9	28.1
1	70	1.51	1.83	11.3	17.8	31.2	27.8	27.9
2	120	1.40	1.64	7.7	12.2	21.4	50	24.5

Industry 4: $\beta_2 = 1$, $\beta_3 = 0$, $\sigma_{it} = 0.1+0.02\,S_{it-1}$

Entry: $\Pr(X=x) = \frac{e^{-\lambda}\lambda^x}{x!}$ Low = $\lambda = 0.5$ Medium = $\lambda = 1$ High = $\lambda = 2$

(x = no. of entrants)

λ	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.07	0.35	9.0	16.5	34.2	18.2	
0.5	25	1.06	0.32	7.2	13.1	28.1	22.7	
1	30	1.05	0.31	6.3	11.6	24.5	27.0	
2	40	1.05	0.30	4.7	8.9	18.3	37.0	
	(ii) t=20							
0	20	1.15	0.59	11.7	20.8	42.0	15.9	
0.5	30	1.13	0.52	8.0	14.4	29.2	25.0	
1	40	1.10	0.48	6.1	11.7	23.6	32.3	
2	60	1.09	0.44	4.6	8.1	16.4	50.0	
	(iii) t=50							
0	20	1.38	1.20	18.2	29.1	51.7	11.5	25.2
0.5	45	1.24	0.96	9.9	15.9	28.5	27.8	25.1
1	70	1.21	0.98	7.9	12.1	22.4	43.5	25.2
2	120	1.17	0.83	4.7	7.6	14.4	76.9	23.3

Industry 5: $\beta_2 = 1$, $\beta_3 = 0$, $\sigma_{it} = 0.1\text{-}0.02\, S_{it-1}$

Entry: $\Pr(X=x) = \dfrac{e^{-\lambda}\lambda^x}{x!}$ Low = $\lambda = 0.5$ Medium = $\lambda = 1$ High = $\lambda = 2$

(x = no. of entrants)

λ	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.05	0.34	8.6	16.0	35.6	18.2	
0.5	25	1.04	0.32	7.1	13.3	29.3	22.2	
1	30	1.03	0.30	5.9	11.2	24.4	27.8	
2	40	1.02	0.28	4.4	8.5	19.5	35.7	
	(ii) t=20							
0	20	1.09	0.48	10.1	18.8	39.3	16.7	
0.5	30	1.08	0.43	6.8	13.3	28.2	25	
1	40	1.06	0.40	5.4	9.9	22	34.5	
2	60	1.04	0.36	3.5	6.7	15.3	52.6	
	(iii) t=50							
0	20	1.28	0.86	13.2	23.2	47.5	13.9	26.5
0.5	45	1.16	0.66	6.7	11.9	24.2	33.3	23.6
1	70	1.13	0.61	4.1	8.1	16.9	52.6	23.9
2	120	1.10	0.54	2.7	4.9	10.4	100	22.4

Industry 6: $\beta_2 = 1$, $\beta_3 = 0.1$, $\sigma_{it} = 0.1$

Entry: $\Pr(X=x) = \dfrac{e^{-\lambda}\lambda^x}{x!}$ Low = $\lambda = 0.5$ Medium = $\lambda = 1$ High = $\lambda = 2$

(x = no. of entrants)

λ	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.07	0.39	9.5	17.3	36.9	17.9	
0.5	25	1.06	0.36	7.8	14.2	30.6	21.3	
1	30	1.06	0.34	6.8	12.5	26.9	25.6	
2	40	1.03	0.31	5.1	9.2	19.6	37.0	
	(ii) t=20							
0	20	1.12	0.56	11.3	20.0	41.6	16.1	
0.5	30	1.12	0.51	7.8	14.6	30.8	23.3	
1	40	1.10	0.47	6.2	11.2	23.4	32.3	
2	60	1.08	0.43	4.3	7.7	16.2	52.6	
	(iii) t=50							
0	20	1.30	1.03	16.3	27.0	50.8	12.5	26.3
0.5	45	1.25	0.94	9.1	15.3	29.3	27.8	23.2
1	70	1.22	0.83	6.0	10.5	20.5	47.6	23.9
2	120	1.17	0.75	3.6	6.6	13.4	83.3	24.6

Industry 7: $\beta_2 = 1$, $\beta_3 = -0.1$, $\sigma_{it} = 0.1$

Entry: $\Pr(X=x) = \dfrac{e^{-\lambda}\lambda^x}{x!}$ Low = $\lambda = 0.5$ Medium = $\lambda = 1$ High = $\lambda = 2$

(x = no. of entrants)

λ	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.04	0.31	8.4	15.7	34.8	18.5	
0.5	25	1.03	0.27	6.9	12.9	28.5	22.7	
1	30	1.02	0.23	5.3	10.0	22.1	29.4	
2	40	1.02	0.21	4.3	8.0	17.5	38.5	
	(ii) t=20							
0	20	1.08	0.45	10.1	18.3	39.1	16.9	
0.5	30	1.05	0.35	6.8	12.2	25.9	27.0	
1	40	1.03	0.30	5.1	9.2	19.4	37.0	
2	60	1.02	0.25	3.6	6.4	13.5	55.6	
	(iii) t=50							
0	20	1.23	0.83	14.2	24.8	47.6	13.7	23.6
0.5	45	1.10	0.55	7.2	12.4	23.8	34.5	24.6
1	70	1.06	0.43	4.6	7.9	15.1	58.8	24.8
2	120	1.03	0.32	2.7	4.7	8.9	111.1	26.4

Notes:
In each panel, the results are generated from 20 replications of the development over 10, 20 and 50 time periods of a market comprising of 20 banks, each of which starts from an initial size of 1 unit, and whose subsequent evolution is driven by the model: $\Delta s_{it} = \beta_2 s_{it-1} + \beta_3 \Delta s_{it-1} + u_{it}$. $u_{it} \sim N(0, \sigma_{it}^2)$ $\sigma_{it} = 0.1$

Mean and st.dev denote the mean and standard deviation of actual bank size.
CR.1, CR.2 AND CR.5 are concentration ratios measuring the market share of the top 1, 2, and 5 banks respectively.
Num.equiv is the numbers equivalent version of the Herfindahl - Hirschman index.
Top denotes the number of periods in which one bank retains the largest market share through time.
λ is the average number of new banks entering the industry per period.

supported than is initially the case when entry is zero.[9] Entry, even at the lowest rate, moderates quite substantially the effect of the LPE on trends in concentration in Industry 1. The concentration ratios (CR's) are quite stable when $\lambda = 0.5$, while for $\lambda = 1$ or $\lambda = 2$ there is a tendency towards de-concentration over time. Therefore, for an industry of 20 banks, an entry rate of 0.5 banks per period (2.5% of initial industry numbers) is roughly what is needed to neutralise the effect which the LPE would otherwise have on concentration. In Industry 2, in which there is no tendency towards increased concentration in the long-run with zero entry, any positive rate of entry gives rise to de-concentration because more banks of equal size (on average) are joining the industry. The pattern for Industries 4, 5, 6 and 7 is that entry reduces the mean and standard deviation of bank sizes, leading to a fall in the levels of concentration. In Industry 3, the explosive growth in the variance in s_{it} means that even when entry is at high levels, concentration increases rapidly (albeit less so than when entry is zero). This is because the average entrant is extremely small compared to $\overline{S}_t$ after only a short period of time.

Exit[10]

In a theoretical sense, exit should be easy if incumbent banks have no sunk costs. In reality this is often not the case. In Europe, regulators consider many banks to be 'too big to fail' (Gardener and Molyneux, 1997). Evidence for manufacturing suggests that exit is higher from industries in which profits are low, and in which sunk costs are insignificant (Dunne, Roberts and Samualson, 1988).[11] In banking there is some evidence to suggest that the probability of exit is inversely related to size. Using US data for the period 1946-1975, Rose and Scott (1978) find that the probability of exit through failure is inversely related to bank size, market size and profitability.

It is also possible that there is an association between the entry and exit rates in any time period, if the entrants are displacing incumbent banks by capturing market share. Using US manufacturing data over the period 1963-1982, Dunne, Roberts and Samualson (1988) find a

[9] This assumes that the overall industry size is increased as new banks are not displacing existing ones.
[10] For the purposes of the simulations, exit refers to banks leaving an industry through bankruptcy as their size declines. Merger is considered separately below.
[11] Porter (1980) and the review of contestable markets in chapter 3 of this thesis provide an extended discussion of these issues.

negative correlation between annual entry and exit rates. Entry and exit rates are unlikely to be strongly correlated in banking markets, given that regulators are generally unwilling to allow banks to fail given the negative spillover effects across the rest of the banking industry (Rose, 1987).

In the simulation model, the pattern of exit is controlled by the parameters γ_1 and γ_2. The probability that a bank exits in period t is governed by two factors, namely: the size an individual bank has attained at the end of period t-1, and the overall propensity to exit. The probability is expressed as follows:

$$p\text{ (bank i exits during period t)} = \gamma_2 e^{-\gamma_1 s_{it-1}}$$

where: γ_1 measures the strength of the relationship between s_{it-1} and the probability of exit, and γ_2 controls the overall magnitude of the probability of exit. If $\gamma_1 = 0$, there is no relationship between bank size and probability of exit. $\gamma_1 > 0$, implies that large banks are less likely to exit than smaller banks, while $\gamma_1 < 0$ implies the opposite. Insofar as recent growth affects size, $\gamma_1 > 0$ ensures that the probability of exit is higher if the bank experienced significant negative growth during the previous year, which is in accordance with the formulation of Mansfield (1962).

For the purposes of the simulation model three exit scenarios are discussed. For simplicity γ_1 is held constant at 1, while γ_2 can take values of 0.005, 0.01 and 0.02 to allow variation in the overall rate of exit. These results are shown in Table 8.7(a). The lines for $\gamma_2 = 0$ reproduce the results for Industries 1 to 7 in Table 8.1.

In Industry 1, exit in accordance with the pattern described above, by depleting the population of smaller banks faster than the population of large banks, tends to accelerate the tendency (which is evident anyway as a result of the LPE) towards increased concentration. The same is true for the other Industries. Even in the case of Industry 2, for which there is no tendency towards increased concentration when exit is zero, concentration does not increase progressively when

Table 8.7a: Effect of Exit on the Evolution of Market Structure

Industry 1: $\beta_2 = 1$, $\beta_3 = 0$, $\sigma_{it} = 0.1$

p (exit) = $\gamma_2 e^{-\gamma_1 s_{it-1}}$ Low = γ_2 = 0.005 Medium = γ_2 = 0.01 High = γ_2 = 0.02

γ_2	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.03	0.33	8.7	16.1	35.4	18.2	
0.005	19.2	1.03	0.33	9.0	16.7	36.6	17.5	
0.01	17.8	1.04	0.33	9.8	18.1	39.3	16.1	
0.02	16.1	1.05	0.33	10.6	19.6	42.8	14.5	
	(ii) t=20							
0	20	1.10	0.49	10.5	19.1	40.0	16.7	
0.005	18	1.11	0.49	11.4	20.7	42.9	15.2	
0.01	16.1	1.11	0.50	12.8	23.0	47.3	13.3	
0.02	12.9	1.17	0.51	15.0	27.3	56.0	10.6	
	(iii) t=50							
0	20	1.26	0.91	15.1	25.7	49.0	13.2	26.7
0.005	15.5	1.34	0.92	17.9	30.3	56.7	10.4	26.8
0.01	11.8	1.37	1.02	23.6	39.5	68.7	7.4	28.6
0.02	6.7	1.56	0.98	32.5	53.0	88.8	4.6	27.5

Industry 2: $\beta_2 = 0.95$, $\beta_3 = 0$, $\sigma_{it} = 0.1$

p (exit) = $\gamma_2 e^{-\gamma_1 s_{it-1}}$ Low = γ_2 = 0.005 Medium = γ_2 = 0.01 High = γ_2 = 0.02

γ_2	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.05	0.27	8.2	15.1	33.4	18.9	
0.005	19.2	1.05	0.27	8.5	15.6	34.6	17.9	
0.01	18.3	1.05	0.27	8.8	16.3	35.9	17.2	
0.02	16.1	1.04	0.27	9.9	18.3	40.3	14.9	
	(ii) t=20							
0	20	1.09	0.34	8.6	16.0	35.3	18.2	
0.005	18.4	1.10	0.34	9.2	17.2	37.9	16.7	
0.01	16.5	1.10	0.35	10.3	19.0	41.7	14.7	
0.02	13.1	1.08	0.34	12.6	23.6	50.9	11.8	
	(iii) t=50							
0	20	1.05	0.33	8.8	16.2	35.4	18.2	18.4
0.005	16.2	1.06	0.32	10.3	19.2	42.0	14.7	18.4
0.01	11.8	1.09	0.34	14.0	25.7	55.0	10.5	18.8
0.02	7.9	1.06	0.32	19.8	36.6	75.6	6.9	19.1

Industry 3: $\beta_2 = 1.02$, $\beta_3 = 0$, $\sigma_{it} = 0.1$

p (exit) = $\gamma_2 e^{-\gamma_1 s_{it-1}}$ Low = $\gamma_2 = 0.005$ Medium = $\gamma_2 = 0.01$ High = $\gamma_2 = 0.02$

γ_2	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.08	0.37	9.0	16.8	36.4	17.9	
0.005	18.8	1.08	0.37	9.4	17.7	38.3	16.7	
0.01	18.5	1.07	0.36	9.5	17.7	38.6	16.7	
0.02	15.7	1.10	0.37	11.1	20.5	44.2	13.9	
	(ii) t=20							
0	20	1.19	0.64	11.6	21.1	43.0	15.6	
0.005	18.1	1.20	0.64	12.6	22.9	46.6	14.1	
0.01	16.1	1.22	0.64	14.2	24.8	50	12.5	
0.02	13.0	1.28	0.64	15.4	28.6	57.6	10.4	
	(iii) t=50							
0	20	2.10	2.83	27.2	40.0	64.8	7.3	30.2
0.005	14.8	2.42	3.10	31.5	45.7	72.5	5.9	30.5
0.01	11.4	2.57	2.96	34.8	50.0	78.3	4.9	32.0
0.02	7.3	3.00	2.87	39.0	59.4	90.7	3.8	30.3

Industry 4: $\beta_2 = 1$, $\beta_3 = 0$, $\sigma_{it} = 0.1+0.02\, s_{it-1}$

p (exit) = $\gamma_2 e^{-\gamma_1 s_{it-1}}$ Low = $\gamma_2 = 0.005$ Medium = $\gamma_2 = 0.01$ High = $\gamma_2 = 0.02$

γ_2	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.07	0.35	9.0	16.5	34.2	18.2	
0.005	19.3	1.07	0.35	9.3	17.2	34.8	17.2	
0.01	18.2	1.07	0.35	9.9	18.0	37.1	16.4	
0.02	15.5	1.07	0.33	10.9	20.0	43.6	14.1	
	(ii) t=20							
0	20	1.15	0.59	11.7	20.8	42.0	15.8	
0.005	18.1	1.16	0.60	12.8	22.7	45.5	14.3	
0.01	16.5	1.16	0.59	13.4	23.9	48.5	12.9	
0.02	12.7	1.19	0.60	17.1	30.0	58.5	9.8	
	(iii) t=50							
0	20	1.38	1.20	18.2	29.1	51.7	11.5	25.2
0.005	14.8	1.50	1.27	22.3	35.5	61.1	8.6	25.2
0.01	12.3	1.51	1.22	24.0	37.4	67.9	7.5	24.9
0.02	7.0	1.78	1.44	36.6	57.7	89.1	4.2	24.2

Industry 5: $\beta_2 = 1$, $\beta_3 = 0$, $\sigma_{it} = 0.1\text{-}0.02\, s_{it-1}$

p (exit) = $\gamma_2 e^{-\gamma_1 s_{it-1}}$ Low = γ_2 = 0.005 Medium = γ_2 = 0.01 High = γ_2 = 0.02

γ_2	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.05	0.34	8.6	16.0	35.6	18.2	
0.005	19.2	1.06	0.34	9.0	16.6	36.9	17.5	
0.01	18.1	1.06	0.34	9.4	17.4	38.6	16.4	
0.02	16.4	1.06	0.35	10.4	19.4	42.5	14.7	
	(ii) t=20							
0	20	1.09	0.48	10.1	18.8	39.3	16.7	
0.005	18.1	1.10	0.49	11.1	20.7	43.1	14.9	
0.01	15.9	1.11	0.49	12.3	22.5	47.5	13.2	
0.02	12.4	1.14	0.49	15.1	27.2	57.5	10.2	
	(iii) t=50							
0	20	1.28	0.86	13.2	23.2	47.5	13.9	26.5
0.005	14.9	1.40	0.87	16.6	28.5	56.6	10.4	27.4
0.01	11.2	1.47	0.87	20.1	35.0	69.0	7.9	26.9
0.02	5.8	1.55	0.81	32.3	54.4	92.3	4.2	27.3

Industry 6: $\beta_2 = 1$, $\beta_3 = 0.1$, $\sigma_{it} = 0.1$

p (exit) = $\gamma_2 e^{-\gamma_1 s_{it-1}}$ Low = γ_2 = 0.005 Medium = γ_2 = 0.01 High = γ_2 = 0.02

γ_2	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.07	0.39	9.5	17.3	36.9	17.9	
0.005	19.2	1.07	0.38	9.7	17.7	38.0	16.9	
0.01	18.2	1.08	0.38	10.1	18.4	39.5	16.1	
0.02	16.1	1.08	0.38	11.2	20.6	44.1	14.3	
	(ii) t=20							
0	20	1.12	0.56	11.3	20.0	41.6	16.1	
0.005	18.3	1.14	0.56	12.0	21.3	44.3	14.7	
0.01	16.5	1.16	0.57	13.3	23.4	48.1	13.2	
0.02	13.3	1.19	0.58	15.7	28.1	57.1	10.4	
	(iii) t=50							
0	20	1.30	1.03	16.3	27.0	50.8	12.5	26.3
0.005	15.4	1.37	1.07	19.9	32.6	60.0	9.6	26.2
0.01	11.9	1.44	1.07	22.7	37.3	68.9	7.8	26.7
0.02	7.4	1.61	0.98	28.1	48.3	85.3	5.3	23

Industry 7: $\beta_2 = 1$, $\beta_3 = -0.1$, $\sigma_{it} = 0.1$

p (exit) = $\gamma_2 e^{-\gamma_1 s_{it-1}}$ Low = γ_2 = 0.005 Medium = γ_2 = 0.01 High = γ_2 = 0.02

γ_2	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.04	0.31	8.4	15.7	34.8	18.5	
0.005	19.2	1.04	0.31	8.8	16.4	36.2	17.5	
0.01	18.1	1.04	0.31	9.1	17.1	37.7	16.7	
0.02	16.6	1.05	0.31	9.8	18.3	40.5	15.2	
	(ii) t=20							
0	20	1.08	0.45	10.1	18.3	39.1	17.0	
0.005	18.1	1.09	0.46	11.1	20.1	42.3	15.4	
0.01	16.3	1.10	0.45	11.9	21.7	45.7	13.9	
0.02	13.0	1.12	0.45	14.2	25.8	54.1	11.0	
	(iii) t=50							
0	20	1.08	0.83	14.2	24.8	47.6	13.7	23.6
0.005	14.6	1.36	0.86	17.3	30.7	58.4	10.1	24.2
0.01	11.5	1.37	0.87	21.8	36.0	66.3	7.9	24.8
0.02	6.7	1.53	0.87	30.8	51.4	88.1	4.8	24.9

Notes:

In each panel, the results are generated from 20 replications of the development over 10, 20 and 50 time periods of a market comprising of 20 banks, each of which starts from an initial size of 1 unit, and whose subsequent evolution is driven by the model: $\Delta s_{it} = \beta_2 s_{it-1} + \beta_3 \Delta s_{it-1} + u_{it}$. $u_{it} \sim N(0, \sigma_{it}^2)$ $\sigma_{it} = 0.1$

Mean and st.dev denote the mean and standard deviation of actual bank size.

CR.1, CR.2 AND CR.5 are concentration ratios measuring the market share of the top 1, 2, and 5 banks respectively.

Num.equiv is the numbers equivalent version of the Herfindahl - Hirschman index.

Top denotes the number of periods in which one bank retains the largest market share through time.

γ_1 measures the strength of the relationship between S_{it-1} and the probability of exit.

γ_2 controls the overall magnitude of the probability of exit.

exit is included in the simulations. However, in this case there is little change in average bank size in comparison with the case when exit is zero, whereas in the other six Industries, the effect of exit is to increase the average size of the surviving banks after any number of years.

In all of the seven Industries, exit leads to higher mean size and concentration levels. Even low exit rates in most Industries tend to accelerate the tendency towards higher levels of concentration than under Industry 1. The dispersion of bank sizes tends to increase in Industries where the LPE holds, where large banks enjoy systematic growth advantages or have more stable growth rates through time (i.e. Industries 1, 3 and 4). The dispersion of bank sizes falls in Industries where the growth process favours smaller banks, making exiting banks similar to those banks left in the Industry causing the dispersion of bank sizes to remain relatively narrow.

Table 8.7b shows the effects of varying the parameter γ_1 over the range of values 0, 2 and 4, with higher values of γ_1 imply a stronger inverse relationship between size and the probability of exit. For simplicity γ_2 is held constant at 0.01. Higher values of γ_1 imply that overall, the rate of exit is reduced in all cases, and larger values are observed for mean bank size.

Merger

There are three main types of merger: horizontal, vertical and conglomerate. For the purposes of the present model, the primary interest is in simulating the effects of horizontal mergers (where two banks join together). Such merger activity can increase efficiency through lower costs and increased revenues or bring enhanced market power to the new merged entity. Akhavein, Berger and Humphrey (1997) suggest that horizontal mergers lead to substantial increases in profitability in banking. In recent years there has been a marked increase in merger activity within banking (chapter 2). In Europe, merger and acquisition activity has been particularly strong in the run up to EMU (EU, 1997a).

In the simulations, the probability that a merger takes place in period t is controlled by the parameter ϕ as follows:

Table 8.7b: Effect of Exit on the Evolution of Market Structure (continued)

Industry 1: $\beta_2 = 1$, $\beta_3 = 0$, $\sigma_{it} = 0.1$

p (exit) = $\gamma_2 e^{-\gamma_1 s_{it-1}}$ γ_2=0.01

γ_1	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	18.7	1.02	0.32	9.2	17.1	37.4	16.9	
2	17.7	1.04	0.33	9.8	18.0	39.4	15.9	
4	17.4	1.06	0.32	9.7	18	39.6	15.9	
	(ii) t=20							
0	16.7	1.07	0.47	12.4	22	45.6	13.9	
2	15.7	1.14	0.51	12.9	23.5	48.2	12.9	
4	14.3	1.23	0.48	13.1	23.8	49.7	12.3	
	(iii) t=50							
0	12.5	1.20	0.80	20.4	35.0	65.3	8.4	26.8
2	10.3	1.60	1.02	23.3	39.1	70.7	7.2	26.7
4	9.5	1.71	0.97	23.4	39.3	73.0	6.9	27.2

Industry 2: $\beta_2 = 0.95$, $\beta_3 = 0$, $\sigma_{it} = 0.1$

p (exit) = $\gamma_2 e^{-\gamma_1 s_{it-1}}$ γ_2=0.01

γ_1	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	17.9	1.05	0.27	9.1	16.9	36.9	16.7	
2	17.8	1.06	0.27	9.1	16.8	36.9	16.7	
4	17.6	1.06	0.27	9.1	16.8	37.2	16.4	
	(ii) t=20							
0	15.6	1.10	0.33	10.6	19.9	43.7	14.1	
2	15.9	1.11	0.35	10.7	19.7	42.9	14.3	
4	14.9	1.14	0.34	11.0	20.5	44.7	13.5	
	(iii) t=50							
0	12.1	1.08	0.35	14.0	25.4	54.8	10.5	18.8
2	11.3	1.09	0.33	14.7	26.9	57.9	9.7	19.3
4	8.9	1.11	0.30	17.3	32.1	68.9	7.8	19.6

Industry 3: $\beta_2 = 1.02$, $\beta_3 = 0$, $\sigma_{it} = 0.1$

p (exit) = $\gamma_2 \; e^{-\gamma_1 s_{it-1}}$ $\gamma_2 = 0.01$

γ_1	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	18	1.07	0.37	9.9	18.5	39.9	16.1	
2	17.8	1.10	0.37	10	18.6	40.1	15.9	
4	18.1	1.10	0.37	9.8	18.3	39.3	16.1	
	(ii) t=20							
0	16.3	1.18	0.63	14.0	24.8	50.3	12.5	
2	15.6	1.26	0.65	14.1	25.2	51.2	12.3	
4	14.7	1.32	0.63	14.2	26.0	52.1	11.6	
	(iii) t=50							
0	12.2	2.05	2.75	36.1	52.3	81.2	4.5	28.8
2	10.6	3.11	3.34	33.8	49.8	78.4	5	31.7
4	10	3.34	3.35	34.5	50.8	79.2	5	32.3

Industry 4: $\beta_2 = 1$, $\beta_3 = 0$, $\sigma_{it} = 0.1 + 0.02\,S_{it-1}$

p (exit) = $\gamma_2 \; e^{-\gamma_1 s_{it-1}}$ $\gamma_2 = 0.01$

γ_1	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	18	1.06	0.34	9.9	18.0	36.9	16.4	
2	17.9	1.09	0.35	10.0	18.3	37.7	16.1	
4	17	1.10	0.35	10.3	18.3	39.8	15.4	
	(ii) t=20							
0	16.2	1.13	0.60	14.5	25.3	48.6	12.3	
2	15.9	1.20	0.61	14.1	24.9	49.5	12.7	
4	13.9	1.28	0.57	14.2	26.1	52.4	11.4	
	(iii) t=50							
0	11.4	1.36	1.09	25.2	40.5	70.7	6.8	27.7
2	11.7	1.66	1.28	24.6	39.3	67.3	7.4	26.1
4	9.0	2.02	1.43	28.6	44.4	76.4	5.9	23.9

Industry 5: $\beta_2 = 1$, $\beta_3 = 0$, $\sigma_{it} = 0.1\text{-}0.02\, S_{it-1}$

p (exit) = $\gamma_2\, e^{-\gamma_1 s_{it-1}}$ $\gamma_2 = 0.01$

γ_1	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	17.6	1.06	0.34	9.7	17.5	40	15.9	
2	18.3	1.06	0.34	9.4	17.3	38.2	16.7	
4	17.4	1.09	0.34	9.7	18.0	39.9	15.9	
	(ii) t=20							
0	15.6	1.09	0.48	12.7	23.4	48.3	13	
2	15.8	1.14	0.47	12.1	22.4	47.2	13.3	
4	13.9	1.22	0.46	13.0	24.1	50.0	11.9	
	(iii) t=50							
0	11.7	1.30	0.88	20.7	36.2	68.4	7.9	26.7
2	10.3	1.56	0.84	19.5	36.6	69.9	7.7	27.8
4	8.4	1.80	0.86	22.8	38.9	75.6	6.6	27.1

Industry 6: $\beta_2 = 1$, $\beta_3 = 0.1$, $\sigma_{it} = 0.1$

p (exit) = $\gamma_2\, e^{-\gamma_1 s_{it-1}}$ $\gamma_2 = 0.01$

γ_1	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	17.8	1.06	0.39	10.7	19.2	40.6	15.6	
2	18.3	1.07	0.39	10.4	18.7	39.8	16.1	
4	16.9	1.11	0.38	10.8	19.6	41.8	14.9	
	(ii) t=20							
0	16.4	1.11	0.54	13.2	23.4	48.4	13.2	
2	16.0	1.18	0.56	13.1	23.4	48.3	13.2	
4	14.2	1.25	0.57	14.7	25.9	52.5	11.5	
	(iii) t=50							
0	12.4	1.30	1.03	23.7	38.1	67.8	7.5	25.7
2	10.3	1.67	1.14	24.6	40.1	71.8	6.9	27.1
4	9.0	1.81	1.10	26.1	42.7	76.9	6.1	27.5

Industry 7: $\beta_2 = 1$, $\beta_3 = -0.1$, $\sigma_{it} = 0.1$

p (exit) = $\gamma_2 e^{-\gamma_1 s_{it-1}}$ $\gamma_2 = 0.01$

γ_1	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	18.6	1.04	0.31	8.9	16.7	36.9	16.9	
2	17.8	1.05	0.31	9.3	17.4	38.2	16.4	
4	16.8	1.07	0.31	9.7	18.3	40.2	15.4	
	(ii) t=20							
0	17	1.09	0.46	11.6	21.0	44.7	14.3	
2	15.9	1.10	0.43	11.8	21.5	46.0	13.7	
4	13.6	1.19	0.44	13.5	24.2	51.3	11.8	
	(iii) t=50							
0	12.2	1.22	0.80	20.8	35.1	64.5	8.3	24.5
2	11.2	1.40	0.78	19.8	34.1	65.8	8.4	23.1
4	8.5	1.66	0.84	24.1	41.4	76.3	6.3	24.2

Notes:
In each panel, the results are generated from 20 replications of the development over 10, 20 and 50 time periods of a market comprising of 20 banks, each of which starts from an initial size of 1 unit, and whose subsequent evolution is driven by the model: $\Delta s_{it} = \beta_2 s_{it-1} + \beta_3 \Delta s_{it-1} + u_{it}$. $u_{it} \sim N(0, \sigma_{it}^2)$ $\sigma_{it} = 0.1$

Mean and st.dev denote the mean and standard deviation of actual bank size.
CR.1, CR.2 AND CR.5 are concentration ratios measuring the market share of the top 1, 2, and 5 banks respectively.
Num.equiv is the numbers equivalent version of the Herfindahl - Hirschman index.
Top denotes the number of periods in which one bank retains the largest market share through time.
γ_1 measures the strength of the relationship between S_{it-1} and the probability of exit.
γ_2 controls the overall magnitude of the probability of exit.

$$p(\text{merger}) = \phi(n_t - 1)/n_0$$

where n_t = the population of banks in period t; n_0 = the initial population of banks.

In other words, the probability that a merger happens is directly proportional to the number of surviving banks in the industry. If a merger takes place, the partners are chosen randomly from the existing population of banks, with the probability of being a partner the same for all banks regardless of size or previous growth. The size of the merged bank in subsequent periods is the summation of the sizes that would have been achieved if the two banks had remained separate.

The implications for the size distribution of banks of low, medium and high rates of merger are reported in Table 8.8. Low, medium and high rates of merger are generated by setting ϕ = 0.1, 0.2 and 0.4 respectively. The lines for ϕ = 0 reproduce the results for Industries 1 to 7 in Table 8.1.

From Table 8.8, as ϕ increases, the mean and standard deviation of bank size become higher for all Industries. Overall, there is a positive relationship between ϕ and concentration, as one would expect. The dominance of the top bank tends to lessen, as for the purposes of calibrating this measure, partner banks are assumed to acquire a new identity after the merger has taken place. With high rates of merger, the identity of the largest bank is therefore more susceptible to change than when merger activity is low.

8.5 The Evolution Of The EU Banking Industry

As seen previously (in chapter 2), there have been significant changes in European banking markets in recent years. In many countries the number of banks has fallen and the size of branch networks has also contracted. There has also been an increase in merger and acquisition activity. This has led to increases in average bank size and industry concentration.

Table 8.8 The Effect of Various Merger Scenarios on Bank Size Distributions

Industry 1: $\beta_2 = 1$, $\beta_3 = 0$, $\sigma_{it} = 0.1$

Merger: $\phi(n_t - 1)/n_0$ Low = $\phi = 0.1$ Medium = $\phi = 0.2$ High = $\phi = 0.4$

ϕ	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.03	0.33	8.7	16.1	35.4	18.2	
0.1	19.1	1.39	1.18	18	29.5	54.9	11.2	
0.2	18.3	1.51	1.29	18.1	30.1	57.4	10.8	
0.4	16.5	1.79	1.78	22.6	37.4	63.9	8.3	
	(ii) t=20							
0	20	1.10	0.49	10.5	19.1	40.0	16.7	
0.1	18.1	2.09	2.49	24.3	38.5	65.3	7.9	
0.2	16.4	2.45	2.75	25.1	40.1	68.0	7.4	
0.4	13.6	3.19	3.56	27.8	45.9	75.2	6.3	
	(iii) t=50							
0	20	1.26	0.91	15.1	25.7	49.0	13.2	26.7
0.1	14.8	5.78	9.76	39.9	57.5	83.1	4.1	23.2
0.2	12.7	7.09	11.06	39.7	59.6	85.2	4	23.1
0.4	7.2	13.55	17.81	49.3	72.8	95.5	2.8	20.1

Industry 2: $\beta_2 = 0.95$, $\beta_3 = 0$, $\sigma_{it} = 0.1$

Merger: $\phi(n_t - 1)/n_0$ Low = $\phi = 0.1$ Medium = $\phi = 0.2$ High = $\phi = 0.4$

ϕ	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.05	0.27	8.2	15.1	33.4	18.9	
0.1	18.9	1.40	1.08	16.8	29.3	52.4	12.0	
0.2	17.9	1.54	1.20	17.4	30.1	54.8	11.1	
0.4	16.3	1.83	1.48	18.6	32.9	61.1	9.8	
	(ii) t=20							
0	20	1.09	0.34	8.6	16.0	35.3	18.2	
0.1	18.3	1.74	1.62	19.5	32.5	57.7	9.8	
0.2	16.3	2.09	1.88	21	34.8	61.9	8.9	
0.4	13.1	2.88	2.84	26.4	40.9	70.6	6.7	
	(iii) t=50							
0	20	1.05	0.33	8.8	16.2	35.4	18.2	18.4
0.1	15.5	2.12	1.86	20.1	35.6	63.6	8.7	22.3
0.2	11.7	3.16	3.04	27.5	45.9	77.6	5.9	19.6
0.4	7.4	5.98	5.62	38.4	62.2	92.0	3.8	18

Industry 3: $\beta_2 = 1.02$, $\beta_3 = 0$, $\sigma_{it} = 0.1$

Merger: $\phi(n_t - 1)/n_0$ Low = $\phi = 0.1$ Medium = $\phi = 0.2$ High = $\phi = 0.4$

ϕ	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.08	0.37	9.0	16.8	36.4	17.9	
0.1	19	1.62	1.54	19.3	33.0	58.9	9.9	
0.2	18	1.79	1.77	21.1	34.6	60.9	8.7	
0.4	15.9	2.15	2.13	22.7	37.0	66.0	8.1	
	(ii) t=20							
0	20	1.19	0.64	11.6	21.1	43.0	15.6	
0.1	18.2	2.83	3.87	27.2	43.6	71.3	6.5	
0.2	16.9	3.09	4.48	31.8	47.3	73.1	5.4	
0.4	13.1	4.37	5.05	29.7	48.2	78.7	5.7	
	(iii) t=50							
0	20	2.10	2.83	27.2	40.0	64.8	7.3	30.2
0.1	15.6	72.47	228.50	63.2	77.3	94	2	28.4
0.2	12.5	82.84	241.80	64.8	80.8	95.8	1.9	28.6
0.4	7	171.49	346.68	67.8	87.4	98.8	1.8	20.6

Industry 4: $\beta_2 = 1$, $\beta_3 = 0$, $\sigma_{it} = 0.1 + 0.02\, S_{it-1}$

Merger: $\phi(n_t - 1)/n_0$ Low = $\phi = 0.1$ Medium = $\phi = 0.2$ High = $\phi = 0.4$

	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.07	0.35	9.0	16.5	34.2	18.2	
0.1	18.9	1.60	1.56	20.9	33.0	55.4	9.9	
0.2	17.8	1.75	1.70	21.1	33.9	58.3	9.3	
0.4	16.3	2.04	1.92	21.7	36.1	63.7	8.7	
	(ii) t=20							
0	20	1.15	0.59	11.7	20.8	42.0	15.9	
0.1	18.3	2.60	3.96	29.1	45.3	71.7	5.9	
0.2	16.1	3.12	4.47	30.4	48.2	75.7	5.6	
0.4	12.9	4.09	4.93	29.6	47.0	78.3	5.5	
	(iii) t=50							
0	20	1.38	1.20	18.2	29.1	51.7	11.5	25.2
0.1	15.7	10.38	26.00	49.40	65.60	85.8	2.8	23.5
0.2	11.4	14.23	30.63	53.60	71.50	91.7	2.6	25.4
0.4	7.4	23.0	39.00	52.40	71.30	94.9	2.5	19.9

Industry 5: $\beta_2 = 1$, $\beta_3 = 0$, $\sigma_{it} = 0.1\text{-}0.02\, S_{it\text{-}1}$

Merger: $\phi(n_t - 1)/n_0$ Low = $\phi = 0.1$ Medium = $\phi = 0.2$ High = $\phi = 0.4$

ϕ	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.05	0.34	8.6	16.0	35.6	18.2	
0.1	19.1	1.53	1.34	17.2	30.1	56.4	10.9	
0.2	18.3	1.63	1.38	17	30.2	57.8	10.8	
0.4	16.7	1.90	1.75	19.8	33.5	61.9	9.3	
	(ii) t=20							
0	20	1.09	0.48	10.1	18.8	39.3	16.7	
0.1	18.2	2.06	2.24	22.4	37.2	64.7	8.3	
0.2	16.3	2.40	2.72	24.8	41.4	69.4	7.2	
0.4	13.3	3.28	3.51	27.4	45.3	76.7	6.3	
	(iii) t=50							
0	20	1.28	0.86	13.2	23.2	47.5	13.9	26.5
0.1	16.3	4.83	7.01	32.5	49.6	78.5	5.2	28.0
0.2	12.1	6.82	9.42	37.8	56.9	86.3	4.3	22.6
0.4	7.1	13.60	12.87	41.9	67.9	96.7	3.3	20.9

Industry 6: $\beta_2 = 1$, $\beta_3 = 0.1$, $\sigma_{it} = 0.1$

Merger: $\phi(n_t - 1)/n_0$ Low = $\phi = 0.1$ Medium = $\phi = 0.2$ High = $\phi = 0.4$

ϕ	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.07	0.39	9.5	17.3	36.9	17.9	
0.1	18.9	1.64	1.70	21.1	34.0	59.1	9.3	
0.2	18.3	1.75	1.84	21.3	36.0	62.0	8.9	
0.4	15.8	2.21	2.30	22.8	38.4	68.2	7.8	
	(ii) t=20							
0	20	1.12	0.56	11.3	20.0	41.6	16.1	
0.1	17.2	2.76	3.69	27.6	41.8	68.7	6.8	
0.2	16.5	2.83	3.77	27.7	43.5	72.1	6.5	
0.4	13.1	3.86	4.83	31.6	49.2	78.6	5.5	
	(iii) t=50							
0	20	1.30	1.03	16.3	27.0	50.8	12.5	26.3
0.1	13.7	8.46	16.05	42.2	59.9	85.6	3.61	25.4
0.2	12.5	9.04	16.79	43.8	63.2	88.3	3.45	24.0
0.4	6.7	18.53	30.82	58.9	81.3	98.4	2.14	18.0

Industry 7: $\beta_2 = 1$, $\beta_3 = -0.1$, $\sigma_{it} = 0.1$

Merger: $\phi(n_t - 1)/n_0$ Low = $\phi = 0.1$ Medium = $\phi = 0.2$ High = $\phi = 0.4$

ϕ	Bank No.	Mean	St.dev	CR.1	CR.2	CR.5	Num Equiv.	Top
	(i) t=10							
0	20	1.04	0.31	8.4	15.7	34.8	18.5	
0.1	18.5	1.50	1.21	16.9	29.0	54.2	11.4	
0.2	18.4	1.51	1.22	17.3	29.4	54.8	11.2	
0.4	16.2	1.88	1.65	20.3	34.1	62.3	9.2	
	(ii) t=20							
0	20	1.08	0.45	10.1	18.3	39.1	17.0	
0.1	17.8	2.01	2.24	23.6	37.3	64.9	8.1	
0.2	16.6	2.22	2.38	24.2	38.2	65.4	7.9	
0.4	13.1	3.12	3.32	26.2	43.9	74.9	6.3	
	(iii) t=50							
0	20	1.23	0.83	14.2	24.8	47.6	13.7	23.6
0.1	15.3	5.08	8.20	35.4	54.1	81.3	4.5	22.3
0.2	12.3	6.53	9.12	37.8	56.6	83.4	4.3	19.7
0.4	7.0	12.55	14.92	47.5	71.9	95.7	2.9	19.6

Notes:

In each panel, the results are generated from 20 replications of the development over 10, 20 and 50 time periods of a market comprising of 20 banks, each of which starts from an initial size of 1 unit, and whose subsequent evolution is driven by the model: $\Delta s_{it} = \beta_2 s_{it-1} + \beta_3 \Delta s_{it-1} + u_{it}$. $u_{it} \sim N(0, \sigma_{it}^2)$ $\sigma_{it} = 0.1$

Mean and st.dev denote the mean and standard deviation of actual bank size.

CR.1, CR.2 AND CR.5 are concentration ratios measuring the market share of the top 1, 2, and 5 banks respectively.

Num.equiv is the numbers equivalent version of the Herfindahl - Hirschman index.

Top denotes the number of periods in which one bank retains the largest market share through time.

ϕ controls the probability that a merger takes place in period t.

n_t is the population of banks in period t.

n_0 is the initial population of banks.

' The underlying reasons for these developments are well known: banks have been facing an increasing competitive environment in the wake of wide ranging deregulation and a quickening pace of financial innovation. The lifting of constraints on balance sheets, interest rates and commissions, the reduction in geographical and functional barriers and technological advantages have unleashed unprecedented forces working towards a major restructuring and consolidation in the banking industry.... The implication of these powerful trends in de-regulation and technology is that the restructuring and consolidation under way in the banking industry will extend well into the future.... Less clear are the speed and limits of these trends.'[12]

Using the simulations methodology described in sections 8.2 to 8.4, this section presents some hypothetical projections for the possible future evolution of the five major EU banking markets of France, Germany, Italy, Spain and UK. The assumptions for the simulations are based on official statistics concerning trends in average bank size and growth, entry, exit and merger activity, as well as other, sometimes anecdotal evidence. The aim is to generate projections which give an indication as to how the structure of each country's banking industry might evolve in the future if the patterns of growth, entry, exit and merger which are implicit in the assumptions were to be realised.

8.5.1 Entry, Exit and Merger in EU Banking

Entry

Since 1992, entry has increased in most European banking markets. Berger, Demsetz and Strahan (1999) argue that '... *there may be an increase in the degree of contestability of financial services markets because of the removal of geographic restrictions on banking organizations allow existing institutions to enter or threaten to enter more local markets.*' [13]

In many countries, the majority of entrants have been foreign banks. The number and market shares of foreign banks increased in most EU banking markets between 1980 and 1994, (chapter 2, Tables 2.8 and 2.9). This was especially so in France, and to a lesser extent in Italy, Germany,

[12] Bank of International Settlements (1996), p.83-85.

[13] Berger, Demsetz and Strahan (1999), p.15.

Spain and the UK (EU, 1997a). Foreign banks account for a substantial share of banking industry assets particularly in the UK (57.4%). In France, Germany, Italy and Spain foreign bank influence has also increased, but at a slower rate. The assets shares of foreign banks in these four countries are 14.1%, 4.5%, 3.5% and 10% respectively (chapter 2, Table 2.9).

Exit

Exit by bankruptcy or other cause of failure is generally low in banking markets.

'... the banking industry is arguably characterised by an exit problem. Firms are less subject than in other sectors to the market mechanisms designed to discipline behaviour.'[14]

However, some exit can be observed indirectly by changes in bank numbers and the size of branch networks, which are caused by the expansion or contraction of multinational banks' operations in selected countries. Over the period 1980 to 1995, the largest reductions in bank numbers were in the UK, France and Germany (where numbers fell by 24.1%, 17.6% and 18.1% respectively) followed by Spain and Italy (where numbers fell by 13.2% and 8.9% respectively).[15]

The numbers of branches also fell in France and the UK, but increased in Germany, Italy and Spain (Chapter 2, Table 2.7). However, these figures must be treated with caution, given that re-organisation and consolidation of branch networks is often a consequence of a merger between existing banks, rather than outright closure.

Mergers

Mergers and acquisition activity has increased substantially in recent years as banks have sought to increase size to realise potential economies of scale and other efficiency savings, or to extend market power.[16] Over the period 1985 to 1995 the highest level of merger and acquisition activity among EU banking markets was in the UK (where 380 mergers or acquisitions in banking,

[14] Bank of International Settlements (1996), p.89. See also Tirole (1994b), and Gardener and Molyneux(1997) who discuss this exit problem for European and US banks.
[15] These figures are calculated from Table 2.6 in chapter 2.
[16] Recent examples include the merger of Union Bank of Switzerland with Swiss Bank Corporation and Credit Lyonnaiss with Paribas.

insurance and other types of financial services took place), followed by France, Spain, Italy and Germany with 77, 26, 22 and 22 deals respectively. In 1995 the value of merger and acquisition deals was worth $21.7 billion in the UK, followed by $3.2 billion in France, $3billion in Italy, $2.1 billion in Spain and $0.7 billion in Germany (Bank of International Settlements, 1996).

The net effect of entry, exit and merger and acquisition activity is reflected in changes in the overall level of industry concentration. Table 8.9 shows CR5 and CR10 in 1980 and 1995 for France, Germany, Italy, Spain and the UK. Overall, concentration has fallen in France and the UK, remained stable in Germany, and risen in Italy and Spain.

Table 8.9: Effects of Entry, Exit and Merger on Concentration

Country	Five-Bank Concentration Ratio (CR5)		Ten-Bank Concentration Ratio (CR10)		Change in Concentration	
	1980	1995	1980	1995	% change in CR5	% Change in CR10
France	57	47	69	63	-10	-6
Germany	18	17	28	28	-1	-
Italy	26	29	42	45	+3	+3
Spain	38	49	58	62	+11	+4
UK	63	57	80	78	-6	-2

Adapted from Bank of International Settlements (1996), Table v.8, p.86.

Tentative conclusions can be drawn for each banking market. In France, there appears to have been relatively high levels of entry and merger activity, and low exit. The banking market is relatively concentrated. Consolidation has progressed rapidly in recent years with decreases in branch numbers and a relatively high degree of merger and acquisition activity. In recent years the numbers employed have fallen by less than in the UK, as a consequence of strict labour laws (Morgan Stanley, 1996).

The German banking system is the least concentrated of the five countries considered. Entry into the German market has been relatively low, exit has also been low, while the rate of merger and acquisition activity was, until recently, the lowest in Europe. Although, some consolidation has taken place in commercial banking, the savings and co-operative banking sectors are still highly fragmented (Morgan Stanley Dean Witter, 1998a).

In Italy, entry, exit and merger activity have been low historically (Williams, 1996). The market has historically been tightly regulated, and is among the most fragmented in Europe. The level of concentration is low relative to France, Spain and the UK. Recent research suggests that the Italian banking system could benefit greatly from efficiency gains if substantial consolidation takes place (Morgan Stanley Dean Witter, 1997b). During 1998, the Italian banking market experienced a wave of large bank mergers (Williams, 1998).

In Spain, the rate of entry has been moderate, while exit has been low. Merger and acquisition activity has been low historically. However, in recent years some degree of consolidation through merger and acquisition has taken place, leading to increased levels of concentration (de la Fuente, 1998). Some research argues that since the Spanish banking market is one of the most profitable, at present there may be little real pressure for further consolidation (Morgan Stanley Dean Witter, 1997c). However, this feature appears to be changing as EMU creates enhanced competitive pressure through the further integration of European banking markets.[17]

The UK banking market has traditionally been one of the most open banking markets, characterised by a rapidly increasing foreign bank presence, and by the widespread conversion of building societies into banks. As a consequence the market has experienced relatively high levels of entry, exit and merger activity. Concentration levels in the UK retail sector are relatively high. In recent years there has been a high level of merger and acquisition activity both within banking, and across banking and insurance (Morgan Stanley Dean Witter, 1998b). Consequently, at present there appears to be a tendency for the Office of Fair Trading (OFT) to adopt a more interventionist regulatory stance.

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[17] In February 1999, Spain's two largest banks, Banco Santander and BCH merged.

8.5.2 Market Structure Projections

The assumptions used to calibrate the market structure projections are based on information concerning: a) recent bank size distributions for each of the five countries (discussed below); b) the relationship between a bank's current size and growth rate based on the empirical results presented in chapter 7; c) the relationship between a bank's lagged and current growth rates, also based on the empirical results presented in chapter 7 and d) entry, exit and merger rates based on the evidence discussed above. For each market, entry, exit and merger are categorised as 'high', 'medium' or 'low' and parameter values that control entry, exit and merger in the simulations are assigned in accordance with the discussion in sections 8.4 and 8.5.1.

To calibrate the simulations, an initial size distribution of banks for each country is defined. Data on total assets of all banks (ECU billion) and total bank numbers was collected from Central Bank Reports for each country in 1995. Data was also collected on the asset size of the five largest banks in each country. This enabled a five bank concentration ratio (CR5) to be calculated. The data are shown in Table 8.10.

Table 8.10 Market Size and Concentration For France, Germany, Italy, Spain and the UK

Country	Total Assets of all banks (ECU Billion)	Assets of Top Five Banks (ECU Billion)	CR5 (%)	Total Number of Banks
France	3102.3	1352.2	43.6	593
Germany	4307.9	1357.9	31.5	3487
Italy	1327.4	510.9	38.5	941
Spain	1027.5	430.5	41.9	318
UK	2265.8	1035.6	45.7	560

Notes:
Asset size data and bank numbers from Central Bank Reports of each respective country in 1995. Assets of top five banks in 1995, calculated from *The Banker, September 1996.* CR5 denotes the % of total assets held by the five largest banks in 1995.

The concentration data in Table 8.10 is similar, but not identical to the Bank of International Settlements (BIS) data quoted in Table 8.9. It is unclear how the size of the market was measured in the BIS data and whether consolidated or unconsolidated accounts data is used to calculate concentration. Consequently, for the purposes of model calibration it was necessary to collect assets data for all banks from Central bank reports, and the consolidated asset sizes of the five largest banks in each market from *The Banker.*

From the information on bank numbers, market sizes and concentration, it was possible to choose the parameters of the lognormal distribution to match the average size of banks, and the market share of the top five banks with the data obtained from various central bank reports. The assumptions used to calibrate the simulation model for each banking market are reproduced schematically in Table 8.11.

It is assumed that the initial logarithmic sizes, s_{i0}, are distributed $s_{i0} \sim (\bar{s}_0, v_0^2)$.The mean and standard deviation, $\bar{s}_0$ and v_0 are chosen by trial and error to satisfy the following criteria:

(i) $E(S_{io})$ = total assets / total number of banks, where $S_{io} = e^{s_{io}}$.

(ii) $F_s(x)$=1– (5 / total number of banks), and

$F_S(x)$ = CR5 / 100

where $X = e^x$ and $F_s(\ )$ and $F_S(\ )$ are the distribution functions of s_{i0} and S_{io} respectively.

Table 8.11 shows the values of $\bar{s}_0$ and v_0 which meet these conditions for each of the five countries, together with the assumed values of the parameters β_2 and β_3, and the entry, exit and merger assumptions in each case.[18] Figure 8.2 illustrates the calculation of $\bar{s}_0$ and v_0 using the data in Table 8.10 for France.

[18] A 'time period' in the simulation represents two years because of the way the data is organised in the empirical analysis.

Table 8.11: Assumptions for Simulations for France, Germany, Italy, Spain and the UK

Country	$\bar{s}_0$	v_0	β_2	β_3	σ_{it}	λ	γ_2	ϕ
France	5.81	2.4	0.99	0.125	0.34	1	0.005	0.6
Germany	2.61	3.1	1	0.125	0.19	0.6	0.005	0.4
Italy	4.51	2.4	0.98	0.125	0.48	0.8	0.005	0.6
Spain	6.11	2	0.99	0.125	0.28	0.8	0.005	0.6
UK	5.51	2.4	1	0.125	0.29	1	0.005	0.8

Notes:

The data generating process for bank size and growth is:

$\Delta s_{it} = (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + u_{it}$ where: $E(u_{it}) = 0$ and $var(u_{it}) = \sigma_{it}^2$

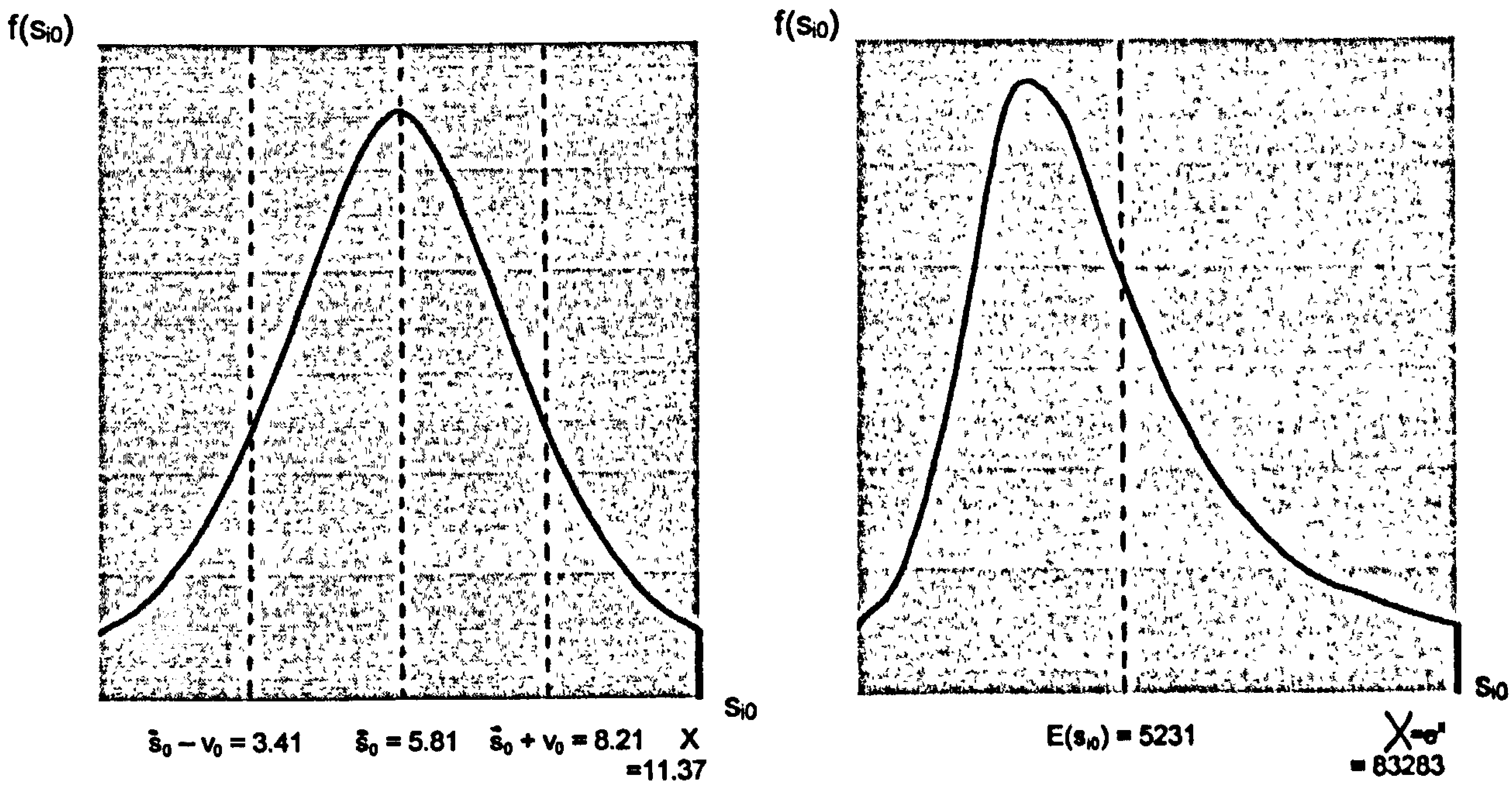
$\bar{s}_0$ and v_0 are the mean and standard deviation of the normal distribution from which the initial logarithmic sizes of banks are drawn randomly.

Entry: $p(X = x) = \frac{e^{-\lambda}\lambda^x}{x!}$, where λ denotes the average rate of entry.

Exit: $p(\text{exit}) = \gamma_2 e^{-\gamma_1 (s_{it-1} - \bar{s}_t)}$, where γ_1 measures the strength of the relationship between $(s_{it-1} - \bar{s}_t)$ and the probability of exit, and γ_2 controls the overall magnitude of the probability of exit.

Merger: ϕ controls the probability that a merger takes place. $p(\text{merger}) = \phi(n_t - 1)/n_0$; where n_t = the population of banks in period t; n_0 = the initial population of banks.

Figure 8.2: Calculation of $\bar{s}_0$ and v_0 for France



Notes: $\bar{s}_0$ and v_0 are the mean and standard deviation of the normal distribution from which the initial logarithmic size of banks are drawn randomly (see Table 8.10).

The top five banks represent 0.8% of the total population of banks defined in Table 8.10.

$E(S_{io})$ is the total assets of the all banks in France / the total number of banks.

$X = e^x$ denotes the cut off point between the top five banks in the lognormal distribution and the remainder of the population of banks. To the right of the cut off point, the top five banks (which make up for 0.8% of the total number of banks), account for 43.6% of all bank assets. To the left of the cut off point (the remaining 99.2% of banks) account for 57% of total assets

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For each country 500 runs of a simulation which traces the evolution of 20 representative banks over 10 periods are carried out. In each run, the initial sizes of the 20 representative banks are drawn randomly from a lognormal distribution, whose parameters are shown in Table 8.11. Table 8.12 shows the projections for each country.

Table 8.12: Market Structure Projections for France, Germany, Italy, Spain and the UK

France: $\beta_1 = \bar{s}_0(1-\beta_2)$, $\beta_2 = 0.99$, $\beta_3 = 0.125$, $\sigma_{it} = 0.34$, $\lambda = 1$, $\gamma_1 = 1$, $\gamma_2 = 0.005$, $\phi = 0.6$

t	n	Mean	St.dev	U_t	M_t	L_t	MS1	MS2	MS5	Num. Equiv	Top
0	20.0	6096	19754	3616	340	32	50.4	68.5	88.4	2.8	
1	20.3	6826	22398	3849	361	34	50.2	68.2	88.6	2.8	
2	19.7	7342	23612	4260	463	50	50.2	68.1	88.6	2.9	
3	19.6	7459	23410	4595	525	60	49.6	67.6	88.3	2.9	
4	19.5	7972	25157	4954	582	68	49.8	67.6	88.2	2.9	
5	19.6	8130	25320	5250	626	75	49.1	67.1	87.8	2.9	
6	19.6	8626	26954	5627	669	80	49.3	66.7	87.6	2.9	
7	19.6	9026	28424	5957	715	86	48.6	66.4	87.3	2.9	
8	19.7	9595	30502	6236	755	91	48.4	66.3	87.3	2.9	
9	19.8	9575	29900	6531	791	96	48.6	66.2	87.1	2.9	
10	19.8	9993	31286	6838	831	101	48.4	66.1	87.1	2.9	7.7

Germany: $\beta_1 = 0$, $\beta_2 = 1$, $\beta_3 = 0.125$, $\sigma_{it} = 0.19$, $\lambda = 0.6$, $\gamma_1 = 1$, $\gamma_2 = 0.005$, $\phi = 0.4$

t	n	Mean	St.dev	U_t	M_t	L_t	MS1	MS2	MS5	Num. Equiv	Top
0	20.0	1351	5175	279	13	0.6	59.9	77.1	93.6	2.2	
1	20.1	1402	5344	293	13	0.6	59.5	76.9	93.5	2.2	
2	18.6	1588	5790	346	23	1.6	59.6	77.1	93.4	2.2	
3	18.1	1692	6022	380	28	2.0	59.5	77.2	93.4	2.2	
4	17.9	1917	6940	414	31	2.0	59.4	77.1	93.4	2.2	
5	17.8	1961	6967	450	35	3.0	58.9	76.8	93.3	2.2	
6	17.6	2020	7050	487	38	3.0	58.9	76.9	93.4	2.2	
7	17.5	2066	7100	525	42	3.0	58.6	76.8	93.3	2.2	
8	17.5	2203	7635	559	44	4.0	58.5	76.5	93.3	2.2	
9	17.5	2987	10567	599	47	4.0	58.4	76.4	93.3	2.2	
10	17.4	3074	10771	639	51	4.0	58.3	76.2	93.2	2.2	9.0

Italy: $\beta_1 = \bar{s}_0(1-\beta_2)$, $\beta_2 = 0.98$, $\beta_3 = 0.125$, $\sigma_{it} = 0.48$, $\lambda = 0.8$, $\gamma_1 = 1$, $\gamma_2 = 0.005$, $\phi = 0.6$

t	n	Mean	St.dev	U_t	M_t	L_t	MS1	MS2	MS5	Num. Equiv	Top
0	20.0	1650	5193	978	89	8	50.7	69.5	89.3	2.8	
1	20.1	1659	5052	1034	93	8	49.5	68.5	88.9	2.9	
2	19.3	1798	5371	1124	119	13	49.9	68.5	88.8	2.9	
3	18.9	1862	5428	1236	138	15	49.4	68.2	88.6	2.9	
4	18.7	2063	5801	1348	152	17	48.5	67.6	88.6	2.9	
5	18.6	2186	6403	1470	170	20	47.9	67.0	88.3	2.9	
6	18.5	2274	6668	1573	182	21	48.0	67.1	88.2	3.0	
7	18.3	2369	6754	1680	196	23	48.8	67.5	88.2	2.9	
8	18.2	2438	6820	1801	212	25	48.9	67.6	88.2	2.9	
9	18.1	2531	7061	1895	223	26	48.5	67.3	88.2	2.9	
10	18.2	2729	7717	2024	236	27	48.3	67.3	88.1	2.9	7.3

Spain: $\beta_1 = \bar{s}_0\,(1-\beta_2)$, $\beta_2 = 0.99$, $\beta_3 = 0.125$, $\sigma_{it} = 0.28$, $\lambda = 0.8$, $\gamma_1 = 1$, $\gamma_2 = 0.005$, $\phi = 0.6$

t	n	Mean	St.dev	U_t	M_t	L_t	MS1	MS2	MS5	Num. Equiv	Top
0	20.0	3166	8289	3160	443	62	44.9	62.6	84.3	3.3	
1	20.1	3214	8302	3253	458	65	44.4	62.1	84.0	3.4	
2	19.7	3368	8466	3492	530	80	44.2	61.6	83.8	3.4	
3	19.5	3566	8843	3720	585	92	43.7	61.4	83.7	3.4	
4	19.4	3756	9127	3987	634	101	43.3	61.3	83.7	3.4	
5	19.3	3930	9431	4228	677	108	43.2	61.3	83.7	3.6	
6	19.2	4075	9705	4442	714	115	42.9	61.0	83.5	3.6	
7	19.1	4196	9882	4696	762	124	42.7	60.7	83.2	3.6	
8	19.1	4326	10076	4910	800	130	41.9	60.2	83.1	3.7	
9	18.9	4582	10640	5166	849	140	41.5	60.0	83.1	3.7	
10	18.9	4742	10977	5417	894	147	41.9	60.2	82.9	3.7	7.8

UK: $\beta_1 = 0$, $\beta_2 = 1$, $\beta_3 = 0.125$, $\sigma_{it} = 0.29$, $\lambda = 1$, $\gamma_1 = 1$, $\gamma_2 = 0.005$, $\phi = 0.8$

t	n	Mean	St.dev	U_t	M_t	L_t	MS1	MS2	MS5	Num. Equiv	Top
0	20.0	4012	12566	2598	248	24	49.8	68.3	88.4	2.9	
1	20.0	4367	13783	2811	264	25	49.6	68.1	88.4	2.9	
2	19.4	4893	14848	3210	341	36	49.3	67.9	88.4	2.9	
3	19.0	5642	17350	3600	400	44	49.4	67.8	88.4	2.9	
4	18.9	6288	19239	4057	452	50	49.5	67.5	88.5	2.9	
5	18.7	7179	22133	4421	497	56	49.2	67.6	88.5	2.9	
6	18.5	7617	23281	4876	543	60	50.1	68.0	88.8	2.9	
7	18.5	8440	26042	5373	587	64	50.2	67.9	88.8	2.9	
8	18.5	9763	31076	5845	625	67	50.7	68.3	88.9	2.8	
9	18.4	10425	33088	6286	674	72	50.9	68.7	89.2	2.8	
10	18.3	11137	35526	6776	724	77	50.5	68.6	89.1	2.8	7.8

Notes:
In each panel, the results are generated from 500 replications of the development over 10 time periods of a market comprising of 20 banks, which start from an initial size distribution as defined in Table 8.11, and whose subsequent evolution is driven by the model. $\Delta s_{it} = (\beta_2 - 1)s_{it-1} + \beta_3 \Delta s_{it-1} + u_{it}$; $u_{it} \sim N(0, \sigma_{it}^2)$ σ_{it} as shown.
Mean and st.dev denote the average and standard deviation of actual bank size.
M_t denotes the actual size of a bank whose logarithmic size is the mean for the population of banks.
U_t denotes the actual size of banks whose logarithmic size is one standard deviation above the mean logarithmic size.
L_t denotes the actual size of banks whose logarithmic size is one standard deviation below the mean logarithmic size.
MS1, MS2 and MS5 denote the market share of the top 1, 2, and 5 banks respectively.
Num.equiv is the numbers equivalent version of the Herfindahl - Hirschman Index.
Top denotes the number of periods in which one bank retains the largest market share through time.

Entry: $p(X = x) = \dfrac{e^{-\lambda}\lambda^x}{x!}$, where λ denotes the average rate of entry. λ = 0.6, 0.8 and 1 respectively.

Exit: p (exit) = $\gamma_2 e^{-\gamma_1 (s_{it-1} - \bar{s}_t)}$, where γ_1 measures the strength of the relationship between $s_{it-1} - \bar{s}_t$ and the probability of exit, and γ_2 controls the overall magnitude of the probability of exit. $\gamma_1 = 1$, while $\gamma_2 = 0.005$.

Merger: p(merger) = $\phi(n_t - 1)/n_0$; where n_t = the population of banks in period t; n_0 = the initial population of banks. ϕ denotes the likelihood of a merger taking place. ϕ = 0.4, 0.6 and 0.8 respectively.

In France, the projections suggest a small decrease in the total number of banks over the ten periods. The cohort of 20 representative banks declines in number to an average (over the 500 simulations) of 19.8 in Table 8.12. Mean bank size increases from ECU 6096m to ECU 9993m mainly as a consequence of merger activity. The standard deviation of bank sizes also increases. Around two-thirds of the population of banks are typically located within the range of sizes between U_t and L_t (which denote the actual size of banks whose logarithmic size is one standard deviation above and below the mean logarithmic size respectively). M_t (which denotes the actual size of a bank whose logarithmic size is the mean for the population of banks) increases from ECU 340m to ECU 831m. The market share of the top bank (denoted by MS1 measures the market share of the top 5% of banks at the beginning of the ten periods) is projected to decrease, as a consequence of the assumed growth advantages of smaller banks, and the entry of new banks; MS1 falls from 50.4% to 48.4% over the ten periods. [19]

A faster rate of decline in the total number of banks is projected for Germany. The cohort of 20 representative banks is depleted to an average (over 500 simulations) of 17.4 by the end of ten periods. Mean bank size is projected to increase quite rapidly from ECU 1351m to ECU 3074m over the ten periods. M_t increases from ECU 13m to ECU 51m. This is mainly as a consequence of the operation of the LPE, which was found to hold in the case of Germany in chapter 7. With a relatively low rate of entry being assumed, the trend towards increased market dominance of the top banks is not offset to any great extent by the appearance of new firms. MS1 declines slightly from 59.9% to 58.3% over the ten periods.

In Italy, the projections suggest a decrease in the total number of banks over the ten periods. The cohort of 20 representative banks declines to an average of 18.2 in Table 8.12. The mean of bank size is projected to increase from ECU 1650m to ECU 2729m mainly as a consequence of merger activity. The standard deviation of bank size increases, as do U_t, M_t and L_t. The

[19] MS1, MS2 and MS5 are the market shares of the top one, two and five banks as a proportion of a population of 20 banks. In other words, MS1, MS2 and MS5 are the % of assets held by the top 5%, 10% and 25% of banks at the beginning of the simulation. In contrast, CR5 in Table 8.10 is the market share of the top five banks as a proportion of all banks in each country respectively.

combination of the systematic growth advantages held by small banks (evidenced by a rejection of the LPE in chapter 7), entry, exit and merger leads to a decline in MS1 from 50.7% to 48.3%.

In Spain, the cohort of 20 representative banks is depleted to an average (over 500 simulations) of 18.9. Although small banks grow proportionately faster than larger banks, their advantages are not sufficient to prevent increases in the mean and standard deviation of bank sizes. Mean bank size increases from ECU 3166m to ECU 4742m. This is in part a consequence of merger activity. MS1 declines from 44.9% to 41.9% over the ten periods.

Finally, in the UK, the cohort of 20 representative banks is depleted to an average (over 500 simulations) of 18.3. Mean bank size more than doubles from ECU4012m to ECU 11137m, partly as a consequence of the operation of the LPE (which was found to hold for UK banks in chapter 7), and partly as a consequence of the relatively high level of merger activity which is assumed to in the case of the UK. The operation of the LPE, together with the assumed patterns of entry and merger activity also leads to a large increase in the standard deviation of bank size. MS1 increases over the ten periods, as the increased size of the largest banks is augmented by the high rate of merger.

Overall, the projections suggest that if the assumptions on which they are based are correct, then bank numbers are likely to decline in all of the countries considered. The mean and standard deviation of bank sizes increases in all cases. These increases are particularly pronounced in Germany and the UK, where the LPE was previously found to hold. The asset share (measured by MS1) of the top banks is expected to decline in all cases, with the exception of the UK. The rate of decline is greatest in cases where small banks are assumed to grow proportionately faster than larger banks, and / or where entry is assumed to be high. This is particularly evident in the case of Italy and Spain.

8.6 Conclusions

Using stochastic simulation techniques, this chapter has examined the implications for market structure of various departures from the LPE in its strictest form. The simulations illustrated the effects of firm growth, entry, exit and merger activity on the evolution of bank sizes and market concentration, for seven simulated industry types. Using a simulated industry in which the LPE holds as the benchmark, the implications of various alternative assumptions regarding bank growth were examined. In simulated industries in which large banks tend to grow faster than small banks, concentration naturally increases faster than under the LPE. If small banks grow faster than large banks, there is no long-term tendency for concentration to increase. The tendencies toward increasing concentration develop more quickly when large firms experience more variable growth rates than their smaller counterparts, and where there is positive persistence of growth. The same tendencies develop more slowly when small firms have more variable growth rates than their larger counterparts, and where there is negative persistence of growth.

Superimposition of entry, according to the assumptions used in the simulations tends to lead to a lower mean bank size and less dispersion of bank sizes, and results in lower levels of concentration in all simulated industries. Entry, even at the lowest rate, moderates quite substantially the effect of LPE on concentration in the benchmark case, and there is a tendency towards de-concentration over time in the cases of 'medium' and 'high' rates of entry. However, in simulated industries where large banks tend to grow faster than their smaller counterparts, concentration continues to increase, even with 'high' rates of entry.

If small banks are more likely to exit than large banks, then exit naturally leads to higher mean bank size and increased concentration among the survivors. As a result of exit, the dispersion of bank sizes increases in simulated industries where large banks grow faster than smaller banks, or where there is less inter-firm variation in the growth of large banks. The opposite is found in simulated industries where the growth process favours smaller banks. Finally, mergers lead to increases in mean bank size and in the dispersion of bank sizes in all simulated industries.

Using the simulations methodology, projections were carried out which show how the structures of the French, German, Italian, Spanish and UK banking markets might evolve in the future under assumptions governing growth, entry, exit and merger. The simulations were calibrated using official statistics on bank sizes, our own estimated parameters which measure the size-growth relationship from earlier chapters, and recent anecdotal evidence on entry, exit and merger activity,

In France, increased entry, reductions in bank and branch numbers and medium rates of merger and acquisition activity have led to a fall in concentration in recent years. In chapter 7, it was also found that smaller French banks grew faster than their larger counterparts in the early 1990s. This may be explained by the adjustments made by larger banks in the light of the sluggish performance of the national economy in the early 1990s, which may have inhibited the growth of the banks concerned. This study also finds that banks which enjoyed above average levels of growth in the period 1990-1992 enjoyed above average growth again in 1992-1994. Using our own estimated parameters, summary statistics on bank sizes, and stylised facts on entry, exit, and merger, projections of the possible future evolution of the French banking market suggest a small reduction in the number of banks over ten periods. Mean size is projected to increase, mainly as a consequence of merger activity. The market share of top banks is projected to fall in response to the systematic growth advantages held by small banks, and the entry of new banks.

Historically, entry has been low in the German banking market. In recent years there has been a fall in bank numbers, but an increase in the number of branches. The rate of acquisition and merger has been one of the lowest in Europe, but has increased in recent years. In chapter 7 it was found that the LPE holds for German banks, and that there is positive persistence in growth rates through time. Using our estimated parameters along with other evidence on entry, exit and merger, and summary statistics on bank sizes, projections of the possible future structure of the German banking market show a significant decline in the number of banks of more than 10% over ten periods. A large increase in the mean and standard deviation of bank size is projected, and entry has little effect on the high market shares of the top banks.

Entry has taken place at a slower rate in the Italian banking market than in more de-regulated markets like the UK. There has been a reduction in the number of banks in Italy, but an increase in the number of branches. Tight regulation has meant that entry, exit and merger activity has been historically low, although recently rates of entry and merger have increased. In chapter 7 it was found that small Italian banks grew faster than larger banks in the early 1990s. This may be a reflection of the substantial restructuring which took place in Italy in the response to the EU's Single Market programme. Large Italian banks had to adjust their operations more significantly than their smaller counterparts, because of the threat of potential competition from foreign banks. These adjustments acted as a drag on the growth of large banks relative to their smaller counterparts. Using these empirical findings and evidence on entry, exit and merger rates, the market structure projections suggest a moderate decrease in the number of banks, and increases in the mean and median bank size. However, the rate of entry and the systematic growth advantages held by smaller banks, result in the market share of the top banks declining slightly.

There has been an increasing tendency for foreign banks to enter the Spanish banking market in recent years. There has also been a small reduction in the total number of banks, but an increase in the number of branches. Merger activity has also increased. In chapter 7, it was found that smaller Spanish banks grew faster than their larger counterparts. As in the case of Italy, this may be a reflection of restructuring which took place in response to the EU's Single Market programme. Using this empirical finding, together with other information on entry, exit and merger, the Spanish market structure projections show a moderate decrease in bank numbers. There is an increase in mean and median bank size and a slight decrease in the market shares of the top banks.

The UK banking market has experienced high rates of entry, exit and merger activity in recent years. There has been substantial foreign bank entry and large reductions in the number of banks and the number of bank branches. In chapter 7, it was found that the LPE holds for the UK banking market. Here the projections suggest a decrease in bank numbers over ten periods. The mean, median and standard deviation of bank size also increases, through the workings of the LPE. The market share of the top banks increases as a result of the workings of the LPE, and the moderately high rates of merger which are assumed in the simulations.

Overall, the simulation results presented in this chapter provide useful insights into the role of stochastic and systematic factors in determining the evolution of market structure. Nevertheless, the results are only as good as the assumptions on which they are based, although care has been taken to ensure that the assumptions are based on factual empirical evidence. The projections suggest that the EU banking industry is likely to be characterised by a market structure with smaller numbers of banks arising from the merger of existing banks. Mean and median bank size is likely to increase in response to the increasingly competitive conditions. This may result in an increased number of mergers as banks attempt to gain a competitive advantage through the realisation of scale and scope economies. However, this does not mean that concentration will necessarily increase. Increased competition may lead to a decline in the market dominance of the top banks.

CHAPTER 9

SUMMARY, LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The aim of this thesis is to test the extent to which the Law of Proportionate Effect holds for European banks and manufacturing firms. Based on the findings of this empirical investigation, possible implications for the future structure of European banking markets have been investigated. In this chapter, the major empirical findings of the thesis are summarised. In doing so the relevance of the results from a theoretical and empirical perspective are highlighted. The limitations of the data set and the empirical model(s) estimated are also discussed. Finally, some possible directions for future research are forwarded.

This thesis has tested whether or not an empirical relationship exists between firm size and growth in European banking and manufacturing. The approach adopted has more in common with the studies of the LPE (reviewed in chapter 5), than with the traditional industrial organisation literature and its application to banking (reviewed in chapters 2, 3 and 4). However, a review of the traditional industrial organisation literature on the determinants of concentration provides an essential background to this study.

In chapter 2 the effects of globalisation, de-regulation, dis-intermediation, technological change and EMU on the structure and performance of European banking are examined. These changes have led to consolidation at the bank and branch level as banks have placed a greater strategic focus on cost and profit efficiency, and the maximisation of shareholder value. There has also been an increased emphasis on the pursuit of non-interest income. Overall, European banking has been transformed from an industry characterised by protection and limited competition, toward a contestable market where banks are strategically focused on improving efficiency, strengthening customer relationships and maximising shareholder value.

In chapter 3 the role of market structure in determining the ways in which manufacturing firms and industries behave and perform is examined. The finding that emerges is that firms in highly concentrated manufacturing industries tend to outperform those in industries which are less concentrated. Empirical evidence as to whether this is due to collusion between incumbent firms or differential efficiencies is inconclusive. An examination of the determinants of market structure shows that economies of scale, high levels of product differentiation and advertising, slow industry growth, small firm numbers and the operation of random factors lead to increased industry concentration, while high entry rates and industry growth lead to falling levels of concentration.

Chapter 4 examines the role of market structure in determining the performance of banks, and the forces which may determine banking market structure. Evidence supports the view that market concentration and barriers to entry influence performance. Among the determinants of market structure, the evidence on economies of scale is mixed. In contrast to manufacturing, there is some evidence that high growth leads to increasing concentration in banking markets. There is also evidence that technological advances and changes in customer attributes lead to increased concentration, as banks grow to meet new competitive challenges. Some evidence suggests that stochastic forces play a part in shaping banking market structure.

Chapter 5 discusses previous literature which has tested the Law of Proportionate Effect (LPE) by examining the relationship between firm size and growth for manufacturing industries. The results suggest that the LPE plays a substantial part in the evolution of firm sizes, and may outweigh systematic explanations of market concentration discussed in chapters 3 and 4.

In chapters 6 and 7, the thesis investigates whether the LPE holds or not in the European banking and manufacturing industries during the period 1990-94, using a data set on size and growth for approximately 600 banks and 750 manufacturing firms. For the sample of banks and manufacturing firms, a cross-sectional logarithmic growth model is estimated, with the coefficient on initial size interpreted as giving an indication of whether or not the LPE held in each of the industries investigated. The coefficient on lagged growth shows the extent to which growth rates were correlated through time, while a regression of the squared residuals of the growth equation on size, illustrates whether variability in growth across banks or firms is dependent on which point of the size distribution a bank or firm is located. The model(s) allow for differences in the size-growth relationship between different types of bank, manufacturing firms in different industrial sectors, and firms with different countries of origin.

Across the banking sample, differences in the size-growth relationship were found for various countries, so the tests of LPE allow for country specific effects. In the main the LPE was found to hold in five of the eight banking markets considered, namely Belgium, Denmark, Germany, Netherlands and the United Kingdom. This implies that a tendency for concentration to increase naturally over time may be at work in each of these countries, even in the absence of factors influencing growth, which are related to size. However, the LPE was rejected in France, Italy and Spain, where smaller banks grew faster than their larger counterparts, suggesting a tendency for mean reversion in the size distribution of banks over the long term. For France, this is thought to reflect the adjustments made by large banks in response to the economy wide difficulties experienced in the early 1990s. In Italy and Spain, changes in regulation brought about by the Single Market Programme may have impinged on the growth prospects of large banks in these countries. For the EU as a whole, some evidence was found that bank growth rates persisted over time. For total assets, banks which achieved growth above (or below) the norm in the period 1990-92 were likely to do so again in 1992-94. For off balance sheet business, the opposite was case, although no relationship between growth in successive periods is found for the equity measure.

The general conclusion of this thesis is that the LPE holds in the majority of European banking markets. This suggests that if the same patterns continue in the future, European banking markets may tend to grow more highly concentrated over time, even in the absence of factors such as economies of scale, which give large banks cost advantages over their smaller counterparts, or strategies on the part of large banks which seek to exploit their market power to the detriment of smaller competitors and potential entrants. From a policy perspective these results could suggest a need over the long term for regulatory measures such as market share ceilings or the forced divestiture of large market shares, to limit the level of concentration.

This thesis recognises that the LPE is a long run explanation of market structure. Stochastic simulations are used to investigate the possible long run evolution of market structure in European banking. In chapter 8, a more general model of bank growth, which encompasses assumptions about entry, exit and merger are presented. The implications for the evolution of market structure of various departures from the LPE are assessed. The tendency for the LPE to create increases in industry concentration are accelerated when large firms grow proportionately faster or experience more variable growth rates than their smaller counterparts, and where there is positive persistence of growth. In contrast, the tendency for the LPE to produce increases in industry concentration is offset when smaller firms grow proportionately faster or have more variable growth rates than their larger counterparts, and where there is negative persistence of growth. Entry tends to have an offsetting effect on the tendency for the LPE to produce increases in industry concentration, while exit and merger accelerate the tendency of the LPE to produce increases in concentration.

Based on the empirical results of the estimated relationship between size and growth and other evidence drawn from official sources, simulations of the possible future bank industry structure for France, Germany, Italy, Spain and the United Kingdom are reported in chapter 8. Overall, the simulations provide useful insights into the role of stochastic and systematic factors in determining the evolution of market structure. The projections presented suggest that the European banking industry may in future be characterised by a market structure with smaller numbers of banks. Mean and median bank size may increase as banks merge in response to the increasingly competitive conditions in the banking industry. The increased competition may also lead to a decline in concentration levels.

This thesis also tests the extent to which the LPE holds for European manufacturing firms. The results reported for the manufacturing sample are generally similar to those reported in much of the recent literature on the LPE in manufacturing (Dunne and Hughes, 1994 and Hart and Oulton, 1996). Differences in the size-growth relationship were found between different industry groupings and countries of origin. The LPE was rejected in eight out of the eleven manufacturing groupings sampled (alcohol, building materials, chemicals, electricals, engineering, food, paper and textiles) and in three countries (Germany, Spain and the UK). Generally, the results suggest that the tendency for small firms to grow faster than large firms implies that concentration is not expected to increase in most European manufacturing industries. Small firms are found to have more variable growth rates than their larger counterparts in manufacturing, suggesting that large firms may enjoy advantages associated with diversified operations, which make them less susceptible to periods of extremely high or low growth.

Overall, the differences observed in the results between manufacturing and banking may arise from the competitive conditions and regulatory environment prevailing in each case. Small and large banks use similar inputs (deposits, labour and capital), to produce similar outputs (loans, assets and off balance sheet business), which are priced in accordance with prevailing market conditions, leading to banks growing at similar rates, which ultimately leads to an acceptance of the LPE. This is not the case for the more heterogeneous and less regulated manufacturing industries, in which small firms can often create niche markets and sell differentiated products, enabling them to capture market share from their larger counterparts.

The present study, in common with previous work of this nature, is subject to a number of limitations, which arise from the type of model used and the data employed. The approach used to test the LPE in the present and previous studies extrapolate from a cross-sectional regression to examine the consequences of the cross-sectional relationship between size and growth for the evolution of industry concentration in the long run. However, the results presented in chapter 7 do not constitute direct evidence that the relationships between bank size and growth hold over any time period other than 1990-94. As a consequence, it is difficult to tell whether acceptance or rejection of the null hypothesis supporting the LPE is simply an artefact of the sample used, or whether it accurately reflects patterns which will dictate the long run evolution of market structure. It is therefore slightly anomalous, although understandable in view of the lack of suitable firm level data over time that cross-sectional rather than time series methods pre-dominate in the empirical literature. In the past, neither the data nor the empirical techniques have been available to address these issues. However, continual improvements in data sets such as BANKSCOPE, and recent advances in methods for testing for unit roots and co-integration using panel data, may pave the way for hypotheses such as the LPE to be tested within a more dynamic framework in the foreseeable future.

Further research could utilise the recent advances in econometric techniques to test the LPE using pooled or panel estimation methods. The standard approach to testing the LPE uses cross-sectional regression in which the logarithm of firm growth is regressed against initial size and previous growth. Under this approach there is an implicit assumption that the equilibrium mean size to which banks revert is the same for all banks. However, it is possible that this is not the case.

A number of papers have developed strategies for testing for unit roots using multi-variate or panel data sets (Levin and Lin, 1993; Quah, 1994; Wu and Zhang, 1996; Im, Pesaren and Shin, 1997). The data sets used in these studies use few cross-sectional observations and large numbers of time series observations. In contrast, the present study (along with others which have been used to test the LPE) use large numbers of cross-sectional observations, and low numbers of time series observations. Future research could exploit the time series dimension of the data set by developing pooled or panel methods of estimation.

The sample used in the current investigation is comprised predominately of large banks and manufacturing firms. Although it contains a heterogeneous collection of banks and firms in terms of their size characteristics, the present study provides little or no evidence concerning the LPE for banks and manufacturing firms at the very smallest end of the size distribution. Furthermore, the sample does not include banks or firms which entered or exited the markets during the period 1990 to 1994. The exclusion of new banks or firms may introduce one form of selection bias, as does excluding banks or firms that have exited the market over the period of observation. If the size-growth relationship differs between existing, and entering and exiting banks or firms, tests of the LPE across a sample which consists solely of banks or firms that have survived over the entire period of investigation may give a misleading picture of the effects of firm size on growth. The current data set does not allow the exploration of this bias further in chapter 7. However, the effects of superimposing assumptions about entry, exit and merger onto the empirical results on the relationship between size and growth for surviving firms have been considered in the simulation model(s) described in chapter 8.

The future evolution of market structure in European banking is undoubtedly a complex phenomenon. There are currently many forces generating change in the industry, including technology, deregulation, globalisation, securitisation and EMU. Further research of market structure should be aimed at examining the effects of each of the aforementioned forces on the evolution of bank sizes and concentration.

Appendix 1: Results of Selected Studies Testing for the Determinants of Changes and the Level of Concentration

Author	Sample	Findings
Weiss (1963)	87 US manufacturing industries for 1947-1954.	Positive relationship between economies of scale and changes in concentration.
Kamerschen (1968)	212 US manufacturing industries for 1947-63.	The level of industry concentration is inversely related to firm numbers and industry growth.
Orstein, Weston, Intriligator and Shrieves (1973)	All US manufacturing industries for 1963	Advertising and firm size are positively related to concentration. Industry growth has a negative relationship with concentration.
Dalton and Rhoades (1974)	All US manufacturing industries for 1947-67.	Industry growth leads to declines in concentration, while product differentiation leads to increasing levels of concentration.
Mueller and Hamm (1974)	166 US manufacturing industries for 1947-60.	Strong association between product differentiation and concentration. Industry growth, industry size, and entry are inversely related to concentration.
Mueller and Rodgers (1980)	166 US manufacturing industries for 1947-72.	Positive relationship between changes in advertising expenditures and changes in concentration.
Caves and Porter (1980)	166 US manufacturing industries for 1954-72.	Positive relationship between economies of scale and concentration. A negative relationship is found between industry growth, entry and concentration.
Hart and Clarke (1980)	76 UK industries 1958-68	Positive relationship between economies of scale and concentration. A negative relationship is found between market size and concentration.

Appendix 2: Results of selected studies testing for scale economies in European banking

Author	Sample	Findings
Levy-Garboua and Renard (1977)	94 French banks for 1974.	Evidence of increasing returns to scale.
Fanjul and Maravall (1985)	83 Spanish commercial and 54 Spanish savings banks for 1979.	Find significant economies of scale associated with the number of products and services offered
Dietsch (1988)	243 French banks for 1986.	Finds little evidence of economies of scale at the firm level, but some evidence at the plant level.
Hardwick (1989)	97 UK building societies for 1985	Finds significant evidence of economies of scale for building societies less than £280 million in size
Baldini and Landi (1990)	294 Italian banks for 1987	Find significant evidence of economies of scale at branch level, which is positively related to bank size. They further find that bank level economies tend to become significant at large output ranges.
Drake (1992)	76 UK building societies for 1988	Finds some evidence of economies of scale for building societies of asset size between £120 million to £500 million.
Rodriquez, Alvarez and Gomez (1993)	64 Spanish banks for 1990	Finds significant evidence of economies of scale for medium sized banks, and diseconomies of scale for large banks.
Dietsch (1993)	343 French banks for 1987.	Finds significant evidence of economies of scale at all output levels.
Vennet (1993b)	2600 EU credit institutions for 1991	Finds evidence of economies of scale in the $3-$10 billion asset size range.
McKillop and Glass (1994)	89 UK building societies which are grouped into national, regional and local categories for 1991.	Economies of scale are found for national and local building societies, and constant returns for regional building societies.
Lang and Welzel (1994)	700 German Co-operative banks	Finds little evidence for economies of scale at any of the output levels.

Appendix 3: Summary of Selected Studies of LPE for Manufacturing Firms

Study	Sample Characteristics	Results	Additional Information
Hart and Prais (1956)	UK data covering the period 1885 to 1950. Firm size measured as the stock exchange valuation.	Split sample into five sub-periods, and find that LPE holds until 1939. From 1939-1950 negative relation between size and growth. Overall, accepts LPE.	Implies concentration in UK manufacturing is increasing up to 1939, after which the process stabilises.
Hart (1962)	UK data covering the period 1931 to 1954. Sample comprises of brewing, spinning and drinks firms. Size measured as gross profit – depreciation.	LPE tested for various time periods. Finds equal mean growth rates in all periods considered. However, finds large brewing firms have more variable growth rates than small. Overall, accepts LPE.	
Hymer and Pashigian(1962)	US data covering period 1946-55 for 1000 largest manufacturing firms. Size measured as assets.	Average mean growth rates are unrelated to firm sizes. Variation in firm growth rates is inversely related to firm size. Overall, rejects LPE.	
Mansfield (1962)	US data covering period 1916 to 1957 for firms in steel, petroleum and tyre industries covering various sub-periods. Size measure is firm output.	Tests the LPE for all firms, for surviving firms only, and for firms operating above the industry minimum efficient scale. LPE only accepted for firms operating above the minimum efficient scale. Dispersion of growth rates found to be greater for smaller firms. Overall rejects LPE.	First study to explicitly examine the role of attrition. Smaller firms are more likely to die than large firms. Surviving small firms have higher and more variable growth rates than their larger counterparts.
Samuals(1965)	Data covering the period 1951 to 1960 for 322 UK manufacturing firms. Size measured by net assets.	Larger firms grow faster than smaller firms through economies of scale advantages. Overall, rejects the LPE.	Examines role of mergers in boosting growth rates of large firms. Part of the superior growth of large firms can be explained by merger activity. May also be caused by large firms revaluing assets more frequently than small firms.
Utton (1972)	Data on 1527 UK manufacturing firms drawn from 13 industries covering the period 1954 to 1965. Size measured as net assets.	Large firms grow faster than smaller firms in five industries, while smaller firms grow faster in one industry. Overall, rejects LPE.	Explores the contribution of mergers to growth rates of industries where large firms were found to grow faster than small firms. The LPE is accepted for firms not involved in merger activity.
Samuals and Chesher (1972)	UK data for 2000 firms drawn from 21 industry groups. Size measured as net assets.	Large firms grow faster than small firms. Variation in growth rates declines with size. Departures from LPE are greatest in industries characterised by an oligopolistic structure. Growth rates persist through time.	Examine the role of firm births and deaths in the growth-size relationship. Deaths take place across all size classes, while most births take place in the smallest size class of firms.
Aaronovitch and Sawyer (1975)	UK data on 233 quoted manufacturing firms over the period 1959 to 1967. Size measured as net assets.	LPE holds.	Addresses problem of heteroscedasticity in firm growth rates.

Chesher (1979)	Data covering the period 1960 to 1969 for 183 UK manufacturing firms.	No relationship between firm size and growth. Growth rates persist from one period to the next.	Outlines a methodology for testing the LPE when firm growth rates exhibit serial correlation.
Kumar (1985)	UK data covering the period 1960 to 1976. The sample is split into three sub-periods, namely: 1960-65 (1747 firms), 1966-1971(1021 firms), 1972-1976 (824 firms). Net assets, fixed assets, total equity, employees and sales measure firm size.	12% of growth persists from one period to the next. Negative relationship between size and growth for 1960-1965 and 1972 - 1976, but accepts LPE for the period 1966-1971. Growth rates are inversely related to firm size. Overall, rejects LPE.	Similar results for net assets, fixed assets and equity. Differ slightly when using employees and sales. Examines the relationship between firm size and acquisition growth and finds a positive relationship for 1960-1971, but negative relation for 1966-1976.
Evans (1987a)	US data for 42,339 small firms over the period 1976-1980. Size measured by number of employees.	Failure of firms decreases with age, as does growth and variability of growth. Overall rejects LPE.	Examines influence of age on firm growth. Results suggest that older firms have less variability in growth rates caused by learning economies of scale.
Evans (1987b)	US data for 17,339 small manufacturing firms covering the period 1976-1982.	Finds an inverse relationship between firm size, and growth and age.	Results suggest the usefulness of models incorporating firm age to explain differences in growth.
Hall (1987)	US data covering the period 1972 to 1983. Three samples of firms. 1) 1972-1983 (962 firms); 2) 1972-1979 (1349 firms); 3) 1976-1983 (1098 firms). Size is measured as employee numbers.	Negative relationship between size and growth for all samples. Small firms have more variable growth rates than large firms.	Addresses estimation problems of sample attrition and measurement error. Results are robust with respect to these.
Dunne, Roberts and Samualson (1988)	US data for 200,000 US manufacturing plants over the period 1967-1977. Size measured by number of employees.	Growth declines with plant size. Growth declines with age for mulitplant firms. Variability of growth declines with pant size. Overall, younger, smaller plants have faster, more variable growth rates than large firms.	Examine the probability off failure. Small plants grow faster, but tend to fail more frequently.
Contini and Revelli (1989)	Italian data for 467 small manufacturing firms covering the period 1973-1986. Size measured as employees.	Presents results for 1973-1981 and 1981-1986. LPE is accepted for lager firms for 1977-1981. LPE is rejected for small firms in all industries sampled. Overall, small firms grow faster than larger firms.	
Acs and Audretsch (1990)	US data aggregated at the industry level for 408, 4-digit industries. Size measured as employees.	Accepts LPE in 245 of the 408 industries sampled. Overall, LPE is accepted.	Authors contend that when the firm exit is incorporated into an analysis of size and growth, the tendency for smaller firms to grow faster than their larger counterparts is offset by a greater propensity of small firms to exit.
Reid (1992)	UK data for 73 small firms covering the period 1985-1988. Size measured by sales and employees.	Negative relationship between size and growth. Also finds younger firms have higher growth rates. Overall, rejects LPE.	

Wagner (1992)	German data on 7,000 small firms. Sample period covers the 1978-1989. Size is measured by the number of employees.	Finds no relationship between size and growth. However, growth rates of firms are correlated over time leading a rejection of LPE.	Focuses on three year overlapping periods to reduce possible biases arising from firm exit.
Dunne and Hughes (1994)	UK data comprising of 2,149 firms. Further split into 2 time periods 1975-1980 and 1980-1985. Size measured as net assets.	LPE accepted for majority of size classes in 1980-1985, but rejected in all classes 1975-1980.	Address role of bias arising from the exit of slow growing firms, and find that exit cannot account for the observed results.
Hart and Oulton (1996)	UK data on 87,100 small independent firms covering the period 1989-1993. Size measured as net assets, employees and sales.	Negative relation between firm growth and size implying that the smallest firms grow the fastest. This finding is robust with respect to size category of firm examined, and size measure used.	The first large-scale study of small firm size-growth relationships in the UK.

BIBLIOGRAPHY

Aaronovitch, S. and Sawyer, M.C. (1975) Mergers, growth and concentration, *Oxford Economic Papers*, 27, 136-55.

Abraham, J. and Lierman, F. (1991) European banking in the nineties: a supply side approach, *IEF Research Papers*, RP 91/8.

Acs, Z.J. and Audretsch, D.B. (1990) *Innovation and Small Firms*. Cambridge: Cambridge University Press.

Aitchison, J. and Brown, J.A.C. (1966) *The Lognormal Distribution*: Cambridge: Cambridge University Press.

Akehurst, G. (1987) The economics of services: An introduction, *The Service Industries Journal*, 7, 1-11.

Akhavein, J.D., Berger, A.N. and Humphrey, D.B. (1997) The effects of megamergers on efficiency and prices: evidence from a bank profit function, *Review of Industrial Organisation*, 12, 95-139.

Alhadeff, D.A. and Alhadeff, C.P. (1964) Growth of large banks, 1930-1960, *Review of Economics and Statistics*, 46, 356-63.

Alhadeff, D.A. and Alhadeff, C.P. (1976) Growth and survival patterns of new banks, 1948-1970, *Journal of Money Credit and Banking*, 8, 199-208.

Aliber, R.Z. (1975) International banking: growth and regulation, *Columbia Journal of World Business*, 10, 9-15.

Allen, L. and Rai, A. (1996) Operational efficiency in banking: an international comparison, *Journal of Banking and Finance*, 20, 655-72.

Altunbas, Y. and Molyneux, P. (1993) Scale and scope economies in European banking, *Research Papers in Banking and Finance*, RP 93/18, *University College of North Wales.*

Altunbas, Y. and Molyneux, P., Gardener, E.P.M. and Moore, B. (1999) Efficiency in Euorpean banking, *Institute of European Finance, Working Paper.* Forthcoming.

Amel, D. and Froeb, L. (1991) Do firms differ much? *Journal of Industrial Economics*, 39, 323-29.

Andersen, Arthur (1986) *European Banking and Capital Markets - A Strategic Forecast.* London: Economist Intelligence Unit.

Andersen, Arthur (1993) *European Banking and Capital Markets - A Strategic Forecast.* London: Economist Intelligence Unit.

Axelrod, R. (1984) *The Evolution of Cooperation.* New York: Basic Books.

Baer, H. and Mote, R. (1985) The effects on Nationwide banking and concentration, *Federal Bank of Chicago Economic Perspectives*, 9, 3-17.

Bailey, D. and Boyle, S.E. (1971) The optimal measure of concentration, *Journal of the American Statistical Association*, 66, 702-06.

Bain, J.S. (1951) Relation of profit rate to industry concentration: American manufacturing, 1936-1940, *Quarterly Journal of Economics*, 65, 293-324.

Bain, J.S. (1956) *Barriers to New Competition.* Cambridge, Mass.: Harvard University Press.

Bain, J.S. (1959) *Industrial Organisation.* New York: Wiley.

Baldini, D. and Landi, A. (1990) Economie di scala e complementarieta di costo nell'industria bancaria Italiana, *L'Industria*, 1, 25-45.

Baldwin, R. (1991) On the microeconomics of EMU, *European Economy, Special Edition*, 1, 21-35.

Baldwin, J.R. and Gorecki, P.K. (1987) Plant creation versus Plant acquisition: The entry process in Canadian manufacturing, *International Journal of Industrial Organisation*, 5, 27-41.

Ballarin, E. (1986) *Commercial Banks Amid the Financial Revolution: Developing a Competitive Strategy.* Cambridge: Ballinger.

Baltensberger, E. and Dermine, J. (1987) Banking De-regulation, *Economic Policy,* April, 65-109.

Baltensperger, E. and Dermine, J. (1990) European banking: Prudential and regulatory issues in J. Dermine (ed.) *European Banking in the 1990's*, p17-36. London: Blackwell.

Bank of England (1994) Economic and Monetary Union in Europe, *Bank of England Fact Sheet.* May.

Bank of International Settlements (1996) *66th Annual Report.* Basle: Bank of International Settlements.

The Bankers' Almanac (1997). Sussex: Reed Information Services.

Barber, L. (1998) EMU – A leap into the unknown: The great experiment. *Guide to economic and monetary union.* London: Financial Times.

Baumol, W.J. (1982) Contestable markets: an uprising in the theory of industry structure, *American Economic Review,* 72, 1-15.

Baumol, W.J., Panzer, J. and Willig, R.D. (1982) *Contestable Markets and the Theory of Industry Structure,* New York: Harcourt, Brace, Jovanovich.

Benston, G.J. (1965) Branch banking and economies of scale, *Journal of Finance*, 312-31.

Benston, G.J., Hanweck, G.A. and Humphrey, D.B. (1982) Scale economies in banking: a restructuring and reassessment, *Journal of Money Credit and Banking,* 14, 435-56.

Berger, A.N. (1995) The profit-structure relationship in banking - tests of market power and efficient structure hypotheses, *Journal of Money Credit and Banking*, 27, 404-31.

Berger, A.N., Hunter, W.L. and Timme, S.G. (1993) The efficiency of financial institutions: A review and preview of research past, present and future, *Journal of Banking and Finance*, 17, 221-249.

Berger, A.N. and Hannan, T.H. (1989) The price-concentration relationship in banking, *Review of Economics and Statistics,* 71, 291-99.

Berger, A.N. and Mester, L.J. (1997) Inside the black box: what explains differences in the efficiencies of financial institutions, *Journal of Banking and Finance*, 21, 895-947.

Berger, A.N. and Humphrey, D. (1997) Efficiency of financial institutions: international survey and directions for future research. *European Journal of Operational Research*, 98, 175-212.

Berger, A.N. and Hannan, T.H. (1998) The efficiency cost of market power in the banking industry: a test of the quite life and related hypotheses, *Review of Economics and Statistics,* 80, 454-65.

Berger, A., Demsetz, R. and Strahan, P. (1999) The consolidation of the financial services industry: causes, consequences and implications for the future, *Journal of Banking and Finance, Forthcoming.*

Bertero E. (1994) The banking system, financial markets, and capital structure: Some evidence from France: Oxford Review of Economic Policy, 10, 68-78.

Bertrand, J. (1883) Book review of Cournot's work, *Journal des Savants,* 499-508.

Bisigano, J. (1992) Banking in the European Community: Structure, Competition and Public Policy, in Kaufman, G. (ed.), *Banking Structures in Major Countries.* London: Kluwer Academic Publishers.

Bisoni, C. (1990) Growth policies in Italian Credit Institutions: Size and Diversification, *IEF Research Papers*, RP 90/1.

Blanden, M. (1998) Countdown to EMU, *Banker*, June, 18-22.

Bourke, P. (1989) Concentration and other determinants of bank profitability in Europe, North America, and Australia, *Journal of Banking and Finance*, 13, 65-79.

Bresnahan, T.F. and Schmalensee, R.C. (1987) The empirical renaissance in industrial economics: an overview, *Journal of Industrial Economics, 35, 371-78.*

Britton, L.C., Clark, T.A.R. and Ball, D.F. (1992) Modify or extend? The application of the structure conduct performance approach to service industries, *The Service Industries Journal*, 12, 34-43.

Broker, G. (1989) *Competition in Banking.* Paris: OECD.

Bruni, F. (1990) Banking and financial de-regulation towards 1992: The Italian case, in Dermine, J. (ed.), *European Banking in the 1990's*. Oxford: Basil Blackwell.

Burke, T. (1991) *Competition in Theory and Practice*. London: Routledge.

Caminal, R., Gual, J. and Vives, X. (1990) Competition in Spanish Banking, in Dermine, J. (ed.), *European Banking in the 1990's*. Oxford: Basil Blackwell.

Canals, J. (1993) *Competitive Strategies in European Banking*. Oxford: Clarendon Press.

Canals, J. (1997) *Universal Banking: International Comparisons and Theoretical Perspectives*. Oxford: Clarendon Press.

Caves, R.E. and Porter, M.E. (1977) From entry barriers to mobility barriers: Conjectural decisions and contrived deterrence to new competition, *Quarterly Journal of Economics*, 91, 241-261.

Caves, R.E and Porter, M.E. (1980) The dynamics of changing seller concentration, *Journal of Industrial Economics*, 29, 1-15.

Chamberlin, E.H. (1962) *The Theory of Monopolistic Competition*, 8th edition. Cambridge, Mass.: Harvard University Press [originally published 1933].

Chandler, A.D. (1990) *Scale and Scope: The Dynamics of Industrial Capitalism*. Cambridge: Harvard University Press.

Chesher, A. (1979) Testing the law of proportionate effect, *Journal of Industrial Economics*, 27, 403-11.

Clarke, R. (1979) On the lognormality of firm and plant size distribution: some UK evidence, *Applied Economics*, 11, 415-33.

Clark, J.B. (1899) *The Distribution of Wealth*. London: Macmillan.

Colmant, H. (1990) The evolution of institutional structures and regulations, in De Boissieu,C. (ed.), *Banking in France*, London: Routledge.

Conti, V. and Maccarinelli, M. (1993) De-regulation and profitability in different OECD banking systems, *IEF Research Papers*, No.93/18.

Contini, B. and Revelli, R. (1989) The relationship between firm growth and labour demand, *Small Business Economics*, 1, 309-14.

Coscutta, D., di Battista, M.L., Giannini, C. and Urga, G. (1988) Processo produttivo e strttura dei costi nell'industria bancaria Italiana, in *Banca e Mercato a cura di F. Ceserini, M.Grillo, M.Monti, M. Onado (eds.)* Bologna: Mullino.

Cournot, A. A. (1927) *Researches into the Mathematical Principles of the Theory of Wealth.* New York: Macmillan [originally published 1838].

Cubbin, J.S. and Geroski, P.A. (1990) The persistence of profits in the United Kingdom, in Mueller D.C (ed.), *The Dynamics of Company Profits: An International Comparison.* Cambridge: Cambridge University Press.

Curry, B. and George, K. (1983) Industrial Concentration: a survey, *Journal of Industrial Economics*, 31, 203-55.

Curry, T.J. and Rose, J.T. (1984) Diversification and barriers to entry: Some Evidence From Banking, *The Antitrust Bulletin*, 29, 759-773.

Dalton, J.A. and Rhoades, S.A. (1974) Growth and product differentiation as factors influencing changes in concentration, *Journal of Industrial Economics*, 22, 235-40.

Davies, S. (1987) Vertical Integration, in Clarke, R. and McGuiness, T. (eds.), *The Economics of the Firm.* Oxford: Basil Blackwell.

Davies, S.W. and Lyons, B.R. (1982) Seller concentration: The technological explanation and demand uncertainty, *Economic Journal*, 92, 903-19.

Davies, S. W. (1989) Concentration, in *Davies, S and Lyons, B. (eds.) The Economics of Industrial Organisation.* London: Longman.

De Bandt, O. and Davis, E.P. (1998) Competition, contestability and market structure in European banking sectors on the eve of EMU: Evidence from France, Germany, and Italy with a perspective on the United States. *Paper presented at the VII Tor Vegata Financial Conference on " Post Euro competition and strategy among financial systems and bank firm relations", Rome, 26-27 November 1998.*

De Boisseu, C. (1990) The French banking sector in light of European Financial Integration, in Dermine, J. (ed.), *European Banking in the 1990's.* Oxford: Basil Blackwell.

De la Fuente, M. (1998) 'Spain'. *Banking in the New EU and Switzerland and Norway.* London: Financial Times Publishing.

Delors Report (1989) *Committee for the study of European Monetary Union. Report on European Integration and Monetary Union in the EC.* April. Brussels: EC.

Demsetz, H. (1973) Industry structure, market rivalry and public policy, *Journal of Law and Economics*, 16, 1-9.

Demsetz, H. (1982) Barriers to entry, *American Economic Review,* 72, 47-57.

Dermine, J. (1990) *European Banking in the 1990's.* Oxford: Basil Blackwell.

Deutsche Bank Research (1998) The effects of EMU on the structure of European banking, *EMU Watch*, No. 59. October.

Diamond, D. and Dybvig, P. (1986) Banking theory, deposit insurance and banking regulation, *Journal of Business*, 59, 55-68.

Dietsch, M. (1988) *Economies d'echelle et economies d'evergure dans les banques de depots francais, mimeo.* Institut d'Etudes Politiques de Strasbourg.

Dietsch, M. (1993) Economies of scale and scope in French commercial banking industry, *Journal of Productivity Analysis,* 4, 35-40.

Dixit, A. (1982) Recent Developments in oligopoly theory, *American Economic Review, Papers and Proceedings,* 72, 12-17.

Dixit, A. and Nalebuff, B. (1991) *Thinking Strategically.* New York: Norton Books.

Dixon, R. (1991) *Banking in Europe: The Single Market.* London: Routledge.

Drake, L. (1992) Economies of Scale and Scope in UK building societies: an application of the translog multiproduct cost function, *Applied Financial Economics, 2,* 211-219.

Dun and Bradstreet International (1995) *Dun and Bradstreet Europa.* Bucks: Dun and Bradstreet.

Dunne, P. and Hughes, A. (1994) Age, size, growth and survival: UK companies in the 1980's, *Journal of Industrial Economics*, 42, 115-140.

Dunne, T., Roberts, M.J. and Samuelson, L. (1989) The growth and failure of US manufacturing plants, *Quarterly Journal of Economics*, 104, 671-98.

EC (1997) *Panorama of EU Industry: The Key to European Industry.* Vols. 1 and 2. Luxembourg: Office for Official Publications of the European Communities.

Eckard, E.W. (1995) A note on the Profit-Concentration relation, *Applied Economics*, 27, 219-23.

Economist (1998a) The economics of antitrust, *Economist,* May.

Economist (1998b) The single currency: pressure on the plumbers, *Economist*, September.

Edgeworth, F.Y. (1932) *Mathematical Psychics.* London: Kegan Paul [originally published 1881].

Emerson, M., Aujean, M., Catinat, P., Goybet, A. and Jacquemin, A. (1988) *The Economics of 1992: The EC Commission's Assessment of the Economic Effects of Completing the Internal Market.* London: Oxford University Press.

Engwell, L. (1973) *Models of Industrial Structure.* Lexington: Lexington Books.

Euromoney (1998) The Euro, *Euromoney*, June.

European Economy (1988) *An Assessment of the Potential Economic Effects of Completing the Internal Market of the European Community. " The Costs of Non-Europe" project*, March.

European Union (1997a) Credit Institutions and Banking, *The Single Market Review*, Subseries 2, vol.3. London: Kogan Page.

European Union (1997b) Food, Drink and Tobacco Processing Machinery, *The Single Market Review*, Subseries 1, vol. 1. London: Kogan Page.

European Union (1997c) Construction Site Equipment, *The Single Market Review*, Subseries 1, vol. 4. London: Kogan Page.

European Union (1997d) Textiles and Clothing, *The Single Market Review*, Subseries 1, vol. 3. London: Kogan Page.

European Union (1997e) Chemicals, *The Single Market Review*, Subseries 1, vol. 5. London: Kogan Page.

Evanoff, D.D. and Fortier, D.L. (1988) Re-evaluation of the structure-conduct-performance paradigm in banking, *Journal of Financial Services Research*, 1, 277-94.

Evans, D.S. (1987a) Tests of alternative theories of firm growth, *Journal of Political Economy*, 95, 657-74.

Evans, D.S. (1987b) The relationship between firm growth, size and age: estimates for 100 manufacturing industries, *Journal of Industrial Economics*, 35, 567-81.

Fanjul, O. and Maravell, F. (1985) La eficiencia del sistema bancario espanol, *Alianza University, Madrid.*

Fitchew, G. (1990) European Financial Markets: The Commissions Proposals, in Dermine, J. (ed.), *European Banking in the 1990's*. Oxford: Basil Blackwell.

Fraser, P. and Vittas, D. (1984) *The Retail Banking Revolution*. London: Lafferty Publications.

FT (1998) *Guide to economic and monetary union.* London: Financial Times.

Fudenberg, D. and Tirole, J. (1989) Non co-operative game theory for industrial organisation: an introduction and overview, in Schmalensee, R. and Willig, R.D., (eds.), *Handbook of Industrial Organisation*, Amsterdam: North-Holland.

Gardener, E.P.M. (1990) Financial conglomeration: a new challenge for banking, in Gardener, E.P.M. (Ed.) *The Future of Financial Systems and Services.* London: MacMillan.

Gardener, E.P.M. (1997) The Future of Traditional Banking, in Revell, J. (ed.) *The Recent Evolution of Financial Systems.* London: MacMillan.

Gardener, E.P.M. and Teppett (1992) The impact of 1992 on the financial services sectors of EFTA countries, *EFTA Occasional Paper*, No.33 (revised).

Gardener, E.P.M. and Molyneux, P. (1993) *Changes in Western European Banking.* London: Unwin - Hyman.

Gardener, E.P.M. and Molyneux, P. (1997) The too-big-to-fail doctrine revisited, *European Investment Bank Papers*, 2, 15-32.

Geroski, P.A. (1990) Modelling persistent profitability, in Mueller D.C (ed.), *The Dynamics of Company Profits: An International Comparison.* Cambridge: Cambridge University Press.

Geroski, P.A. (1991) *Market Dynamics and Entry.* Oxford: Blackwell.

Gibrat, R. (1931) *Les Inegalities Economiques*, Paris: Sirey.

Gilbert, R. (1984) Bank market structure and competition - a survey, *Journal of Money Credit and Banking*, 16, 617-45.

Gilbert, R.J. and Newberry, D.M.G (1982) Pre-emptive patenting and the persistence of monopoly, *American Economic Review*, 72, 514-26.

Gilligan, T., Smirlock, M. and Marshall, W. (1984) Scale and scope economies in the multi-product banking firm, *Journal of Monetary Economics*, 13, 393-405.

Goddard, J.A. and Wilson, J.O.S. (1996) Persistence of profits for UK manufacturing and service sector firms, *The Service Industries Journal,* 16, 105-17.

Goddard, J.A. and Wilson, J.O.S. (1999) Persistence of profit: a new empirical interpretation. *The International Journal of Industrial Organisation.* Forthcoming.

Gual, J. and Neven, D. (1993) Banking in Social Europe - Market Services and European Integration, *European Economy,* 3, 153-83.

Hall, B. (1987) The relationship between firm size and firm growth in the US manufacturing sector, *Journal of Industrial Economics,* 35, 583-606.

Hannah, L. and Kay, J.A. (1977) *Concentration in Modern Industry.* London: MacMillan.

Hannah, L. and Kay, J.A. (1981) The contribution of mergers to concentration growth: a reply to Professor Hart, *Journal of Industrial Economics,* 29, 305-13.

Hannan, T. (1983) Price, Capacity and the entry decision: A conditional Logit analysis, *Southern Economic Journal,* 50, 539-50.

Hardwick, P. (1989) Economies of scale in building societies, *Applied Economics,* 21, 1291-1304.

Hart, P.E. (1962) The size and growth of firms, *Economica,* 29, 29-39.

Hart, P.E. (1981) The effects of mergers on industrial concentration, *Journal of Industrial Economics,* 29, 315-20.

Hart, P.E. and Prais, S.J. (1956) The analysis of business concentration: A statistical approach. *Journal of the Royal Statistical Society, Series A,* 119, 150-91.

Hart, P.E. and Clarke, R. (1980) *Concentration in British Industry: 1935-1975.* Cambridge: Cambridge University Press.

Hart, P.E. and Oulton, N. (1996) The size and growth of firms, *Economic Journal,* 106, 1242-52.

Heggestad, A.A. (1984) Comment on bank market structure and competition: a survey, *Journal of Money Credit and Banking*, 16, 645-50.

Herfindahl, O.C. (1950) *Concentration in the US Steel industry.* Unpublished Ph.D. thesis.

Hirschman, A.O. (1945) *National Power and the Structure of Foreign Trade*, (University of California Bureau of Business and Economic Research, Berkeley, 1945).

Hunter, W.C. and Timme, S.G. (1986) Technical change, organisational form and the structure of bank production, *Journal of Money Credit and Banking*, 18, 152-66.

Hymer, S. and Pashigan, P. (1962) Firm size and rate of growth, *Journal of Political Economy*, 52, 556-69.

IMF (1995) *World Economic Outlook.* International Monetary Fund.

Ijiri, Y. and Simon, H.A. (1964) Business firm growth and size. *American Economic Review*, 54, 77-89.

Ijiri, Y. and Simon, H.A. (1967) A model of business firm growth, *Econometrica*, 35, 348-55.

Ijiri, Y. and Simon, H.A. (1977) *Skew Distributions and the Size of Business Firms.* Amsterdam: North-Holland Press.

Im, K.S., Pesaran, M.H. and Shin, Y. (1997) Testing for unit roots in heterogeneous panels, *Department of Applied Economics Working Papers Amalgamated Series, No.9526.* University of Cambridge.

Jackson, W.E. (1992) The price-concentration relationship in banking: a comment, *Review of Economics and Statistics*, 74, 373-76.

Jenny, F. and Weber, A.P. (1990) The persistence of profits in France, in Mueller D.C (ed.), *The Dynamics of Company Profits: An International Comparison.* Cambridge: Cambridge University Press.

Jevons, W.S. (1970) *The Theory of Political Economy.* Harmondsworth: Penguin [originally published 1871].

Jovanovic, B. (1982) Selection and evolution of industry, *Econometrica*, 50, 649-70.

Kamerschen, D.R. (1968) Market growth and industry concentration, *Journal of the American Statistical Association*, 63, 228-41.

Kane, E.J. (1987) Competitive Financial Re-regulation: An international perspective, in Portes, R. and Swoboda, A.K. *Threats to International Financial Stability.* Cambridge: Cambridge University Press.

Kaufman, G. (1989) *Are Some Banks too large too fail? Myth and Reality.* Mimeo. Loloya: University of Chicago.

Kay, J.A. (1993) *Foundations of Corporate Success.* Oxford: Oxford University Press.

Khemani, R.S. and Shapiro, D.M. (1990) The persistence of profitability in Canada, in Mueller D.C (ed.), *The Dynamics of Company Profits: An International Comparison.* Cambridge: Cambridge University Press.

Kindleberger, C.P. (1984) *A Financial History of Western Europe.* London: Allen and Unwin.

Kirzner, I. (1973) *Competition and Entrepreneurship.* Chicago: Chicago University Press.

Klemperer, P. (1987) Markets with consumer switching costs, *Quarterly Journal of Economics*, 102, 375-94.

Klepper, S. (1996) Entry, exit, growth, and innovation over the Product Life Cycle, *American Economic Review*, 86, 562-83.

Knight, F.H. (1921) *Risk, Uncertainty and Profit, Part* 2. Boston: Houghton Mifflin Company.

Kolari, J. and Zardkoohi, A. (1987) *Bank Cost Structure and Performance.* Lexington: Lexington Books.

Kalecki, M. (1945) On the Gibrat distribution, *Econometrica*, 13, 161-70.

Koutsoyannis, A. (1979) *Modern Microeconomics*. London: MacMillan.

Kumar, M.S. (1985) Growth, acquisition activity and firm size: evidence from the United Kingdom, *Journal of Industrial Economics,* 33, 327-38.

Kwoka, J.E. (1982) Regularity and diversity in firm size distributions in US industries, *Journal of Economics and Business*, 34, 391-95.

Lafferty Business Research (1990) *Financial Revolution in Europe*. Dublin: Future Print.

Lafferty Business Research (1993) *Financial Revolution in Europe II: The Revaluation Deepens and Widens.* Dublin: Lafferty Publications Limited.

Lang, G. and Welzel, P. (1994) *Efficiency and Technical Progress in Banking, Empirical Results for a Panel of German Co-operative Banks,* Institut fur Volkswirtschaft der Universitat Augsburg, WP.117.

Leach, R. (1997) *Financial Services and the Single Currency*: London: Croner Publications.

Lerner, A.P. (1934) The concept of monopoly and the measurement of monopoly power, *Review of Economic Studies,* 1, 157-75.

Levin, A. and Lin, C.F. (1993) Unit roots in panel data: asymptotic and finite sample properties, *Unpublished Manuscript*, University of California.

Levy - Garboua, L. and Renard, F. (1977) Une etude statistique de la rentabilite des banques en France en 1974, *Cahiers Economiques et Monetaires, 5.*

Lewis, A. and Pescetto, G. (1996) *EU and US Banking in the 1990's*. London: Academic Press.

Llewellyn, D.T. (1992a) Banking and Financial Services, in Swann, D. (ed.), *The Single European Market and Beyond*. London: Routledge.

Llewellyn, D. (1992b) The British Financial System, in Kaufman, G. (ed.) *Banking Structures in Major Countries*. London: Kluwer Academic Publishers.

Llewellyn, D.T. (1995) The future business of banking, *Banking World*, January.

Lohneysen, E., Baptista, A. and Walton, A. (1990) Emerging Roles in European Retail Banking, *McKinsey Quarterly*, 3, 127-135.

Lyons, B. (1987) Strategic behaviour by firms, in Clarke, R. and McGuiness, T. (eds.), *The Economics of the Firm*. Oxford: Basil Blackwell.

Machlup, F. (1952) *The Economics of Seller Competition*. New York: John Hopkins Press.

Macmillan UK Stock Exchange Yearbook (1997) London: Waterlow Press.

Majoni, G., Rebecchini, S. and Santini, C. (1992) Monetary integration versus financial integration, in Steinherr, A. (ed.), *The New European Financial Market Place*. London: Longman.

Mansfield, E. (1962) Entry, Gibrat's Law, innovation, and the growth of firms, *American Economic Review*, 52, 1023-51.

Marris, R. (1964) *The Economic Theory of Managerial Capitalism*. London: MacMillan.

Marshall, A. (1961) *The Principles of Economics*, 9th edition, with annotations by C.W. Guillebaud. London: Macmillan [originally published 1890].

Masera, R.S. (1990) Issues in financial regulation: Efficiency, Stability, Information, in D.E. Fair and C. de Boissieu (eds.), *Financial Institutions in Europe under competitive conditions*. Netherlands: Kluwer Academic Press.

Mason, E.S. (1939) Price and production policies of large scale enterprise, *American Economic Review*, 29, 61-74.

Mason, E.S. (1949) The current state of the monopoly problem in the United States, *Harvard Law Review*, 62, 1265-85.

Maude, D. and Molyneux, P. (1996) Banking in Germany, *Financial Times Management Report*. London: Financial Times.

Mayer, C. (1990) The regulation of financial services: Lessons from the United Kingdom for 1992, in Dermine, J. (ed.), *European Banking in the 1990's.* Oxford: Basil Blackwell.

McCauley, R.N. and White, W.R. (1997) The EURO and European Financial Markets, *Bank of International Settlements, Working Paper,* No. 41, May.

McDonald, F. (1992) The Single European Market, in McDonald, F. and Deardon, S. (eds.) *European Economic Integration, 16-38.* London: Longman.

McCloughan, P. (1995) Simulation of Industrial Concentration, *Journal of Industrial Economics,* 43, 405-33.

McKillop, D. and Ferguson, C. (1993) *Building Societies: Structure, Performance and Change.* London: Graham and Trotman.

McKillop, D.G. and Glass, C.J. (1994) A cost model of building societies as producers of mortgages and other financial products, *Journal of Business Finance and Accounting,* 21, 1031-46.

Metais, J. (1997) The banking industry in the nineties: do emerging trends challenge the theory? in Revell, J. (ed.) *The Recent Evolution of Financial Systems.* London: MacMillan.

Molyneux, P. and Thornton, J. (1992) Determinants of European bank profitability: a note, *Journal of Banking and Finance,* 16, 1173-78.

Molyneux, P. (1993) Market structure and profitability in European banking, *University College of North Wales, Research Papers in Banking and Finance, RP 93/9.*

Molyneux, P., Lloyd-Williams, M. and Thorton, J. (1994) Competitive conditions in European banking, *Journal of Banking and Finance,* 18, 445-59.

Molyneux, P. and Forbes, W. (1995) Market structure and performance in European banking, *Applied Economics,* 27, 155-59.

Molyneux, P., Altunbas, Y. and Gardener, E. (1996) *Efficiency in European Banking.* Chichester: Wiley.

Morgan Stanley (1994) New Fundamentals for the bank to the year 2000, *European Banking Strategy*, March.

Morgan Stanley (1995) French banking long-term under performance may be over, *European and UK Banking Bulletin*, 6th November.

Morgan Stanley (1996) French banks: Light at the end of the tunnel, *European Financial Briefing*, 21st June.

Morgan Stanley Dean Witter (1997a) European banking: The pace of consolidation accelerates, *European Banking Strategy*, 16th December.

Morgan Stanley Dean Witter (1997b) Italian banks: Talking the talk or walking the walk, *UK and Europe Investment Research*, 5th September.

Morgan Stanley Dean Witter (1997c) Spain: The Spanish banking system, *UK and Europe Investment Research*, 4th April.

Morgan Stanley Dean Witter (1998a) German banks: The emergence of value, *UK and Europe Investment Research*, 20th August.

Morgan Stanley Dean Witter (1998b) UK banking commentary: resilient in the downturn, *UK and Europe Investment Research*, 23rd July.

Mueller, D.C. (1972) A life cycle theory of the firm. *Journal of Industrial Economics*, 20, 199-219.

Mueller, D.C. (1990) The persistence of profits in the United States, in Mueller D.C (ed.), *The Dynamics of Company Profits: An International Comparison.* Cambridge: Cambridge University Press.

Mueller, W.F. and Hamm, L.G. (1974) Trends in industrial concentration, *Review of Economics and Statistics*, 56, 511-20.

Mueller, W.F and Rodgers, R.T. (1980) The role of advertising in changing concentration of manufacturing industries, *Review of Economics and Statistics*, 62, 89-96.

Mullineaux, D.J. (1975) Economies of scale of financial institutions, *Journal of Monetary Economics*, 233-40.

Murphy, N.B. (1972) Cost of banking activities: interaction between risk and operating cost: a comment, *Journal of Money Credit and Banking*, 4, 614-15.

Nathan, A. and Neave, E.H. (1989) Competition and contestability in Canada's financial system: empirical results, *Canadian Journal of Economics*, 22, 576-94.

Nelson, R.R. and Winter, S. (1982) *An Evolutionary Theory of Economic Change*. Cambridge: Cambridge University Press.

Neuberger, D. (1998) Industrial organization of banking: a review, *International Journal of the Economics of Business*, 5, 97-118.

Neven, D.J. (1990) Structural adjustment in European retail banking: some views from industrial organisation, in J. Dermine (ed.) *European banking in the 1990's*. Oxford: Blackwell.

Nickell, S. (1981) Biases in dynamic models with fixed effects, *Econometrica*, 49, 1417-26.

Odagiri, H. and Yamawaki, H. (1990) The persistence of profits in Japan, in Mueller D.C (ed.), *The Dynamics of Company Profits: An International Comparison*. Cambridge: Cambridge University Press.

OECD (1992) *Banks Under Stress*. Paris: OECD.

Orr, D. (1974a) The determinants of entry: A study of the Canadian manufacturing industries, *The Review of Economics and Statistics*, 56, 58-65.

Orr, D. (1974b) The economic determinants of entry into Canadian banking: 1963-7, *The Canadian Journal of Economics*, 8, 82-99.

Orstein, S.J., Weston, J.F., Intriligator, M.D. and Shrieves, R.E. (1973) Determinants of market structure, *Southern Economic Journal*, 39, 612-25.

Oxford Analytica / Citibank (1998) Growth strategies for global banks, *Global Banking Brief*, November / December.

Peltzman, S. (1977) The gains and losses from industrial concentration. *Journal of Law and Economics*, 20, 229-64.

Penrose, E.T. (1959) *The Theory of the Growth of the Firm*. Oxford: Basil Blackwell.

Phillips, A. (1976) A critique of empirical studies of relations between market structure and profitability, *Journal of Industrial Economics*, 24, 241-49.

Porter, M.E. (1980) *Competitive Strategy: Techniques for Analysing Industries and Competitors*. New York: The Free Press.

Pratten, C.F. (1971) *Economies of Scale in manufacturing industry*. Cambridge: Cambridge University Press.

Price Waterhouse (1988) The Cost of Non-Europe in Financial Services, in *Research on the cost Europe: Basic Findings, vol. 9.* Brussels: EU.

Quah, D. (1994) Exploiting cross-section variations for unit root inference in dynamic data, *Economics Letters*, 44, 9-19.

Quandt, R.E. (1966) On the size distribution of firms, *American Economic Review*, 56, 416-32.

Reid, G.C. (1992) Small firm growth and its determinants, *Department of Economics discussion paper, no. 9213*, University of St.Andrews.

Revell, J, (1987) Mergers and the Role of Large Banks. *Institute of European Finance Research Monographs in banking and Finance*, no.2. (University of North Wales, I.E.F.)

Revell, J. (1991) Changes in Universal Banks and the Effects of Bank Mergers, *IEF Research Papers, RP 91/15.*

Rhoades, S.A. (1980) Entry and competition in banking, *Journal of Banking Finance*, 4, 143-150.

Rhoades, S.A. (1983) Concentration of world banking and the role of US banks among the 100 largest, 1956-1980, *Journal of Banking and Finance*, 7, 427-37.

Rhoades, S.A. (1985) Market share as a source of market power: implications and some evidence, *Journal of Economics and Business*, 37, 343-363.

Rhoades, S.A. (1997) Research on IO topics in banking: an introduction and overview, *Review of Industrial Organisation*, 12, 1-8.

Rhoades, S.A. (1998) The efficiency effects of bank mergers: an overview of case studies of nine mergers, *Journal of Banking and Finance*, 22, 273-91.

Rhoades, S.A. and Yeats, A.J. (1974) Growth, consolidation and mergers in banking, *Journal of Finance*, 29, 1397-1405.

Robinson, J. (1933) *Economics of Imperfect Competition*. London: MacMillan.

Rodriguez, J.R.O., Alvarez, A.A and Gomez, P.P. (1993) *Scale and scope economies in banking: a study of savings banks in Spain*. Universidad de la Laguna, Tenerife, Spain.

Rose, P.S. (1987) *The Changing Structure of American Banking*. New York: Columbia University Press.

Rose, P.S. and Scott, W.L. (1978) Risk in commercial banking: evidence from post war failures, *Southern Economic Journal*, 45, 90-106.

Ryan, C. (1992) The integration of financial services and economic welfare after 1992, *CEPR Discussion Paper*, No.677, June.

Rybczynski, T.M. (1988) Financial Systems and industrial restructuring, *National Westminster Bank Quarterly Review, November*, 3-13.

Salomon Brothers (1993) Cost management in global banking: the lessons of low cost providers, *International Equity Research, October*. London: Saloman Brothers.

Samuals, J.M. (1965) Size and growth of firms, *Review of Economic Studies*, 32, 105-12.

Samuals, J.M. and Chesher, A.D. (1972) Growth, Survival, and Size of Companies,1960-69, in Cowling, K. (ed.) *Market Structure and Corporate Behaviour.* London: Gray-Mills.

Salop, S.C. and Scheffman, D. (1983) Raising rivals' costs, *American Economic Review*, 73, 263-71.

Schelling, T. (1960) *The Strategy of Conflict.* Cambridge, Mass.: Harvard University Press.

Scherer, F.M. (1980) *Industrial Market Structure and Economic Performance,* 2nd edition. Boston: Houghton Mifflin Company.

Scherer, F.M. and Ross, D. (1990) *Industrial Market Structure and Economic Performance,* 3rd edition. Boston: Houghton Mifflin Company.

Scherer, F.M., Beckenstein, A., Kaufer, E. and Murphy, R.D. (1975) *The Economics of Multi-Plant Operation: An International Comparisons Study.* Cambridge: Cambridge University Press.

Schmalensee, R.C. (1978) Entry deterrence in the ready-to-eat cereal industry, *Bell Journal of Economics,* 9, 305-27.

Schmalensee, R.C. (1985) Do markets differ much, *American Economic Review,* 74, 341-51.

Schumpeter, J.A. (1950) *Capitalism, Socialism and Democracy,* 3rd edition. New York: Harper and Row [originally published 1942].

Schwalbach, J. and Mahmood, T. (1990) The persistence of corporate profits in the Federal Republic of Germany, in Mueller D.C. (ed.), *The Dynamics of Company Profits: An International Comparison.* Cambridge: Cambridge University Press.

Schwed, F. (1965) *Where are the Customers' Yachts?* New York: Simon and Schuster.

Schweitzer, S.A. (1972) Economies of Scale and holding company affiliation in banking, *Southern Economic Journal,* 39, 258-66.

Shaffer, S. (1982) A non-structural test for competition in financial markets, in *Bank structure and Competition, Conference Proceedings, Federal Reserve Bank of Chicago, 225-43.*

Shaffer, S. (1993) Can mergers improve bank efficiency? *Journal of Banking and Finance*, 17, 423-36.

Short, B.K. (1979) The relation between commercial bank profit rate and banking concentration in Canada, Western Europe, and Japan, *Journal of Banking and Finance*, 3, 209-19.

Shepherd, W.G. (1997) *The Economics of Industrial Organization*. New Jersey: Prentice-Hall.

Sherman, R. (1977) Theory comes to industrial organisation, in Jacquemin, A. and De Jong, H.W. (eds.), *Welfare Aspects of Industrial Markets*. Martinus Nijhoof.

Siegfried, J. and Evans, L. (1994) Empirical studies of entry and exit: A survey of the evidence, *Review of Industrial Organisation*, 9, 121-155.

Silber, W. (1983) The process of financial innovation, *American Economic Review*, 73, 89-95.

Silberman, I.H. (1967) On lognormality as a summary measure of concentration, *American Economic Review*, 57, 807-31.

Simon, H.A. and Bonnini, C.P. (1958) The size distribution of business firms, *American Economic Review*, 48, 607-17.

Singh, A. and Whittington, G. (1968) *Growth, Profitability and Valuation*. Cambridge: Cambridge University Press.

Singh, A. and Whittington, G. (1975) The size and growth of firms, *Review of Economic Studies*, 42, 15-26.

Smirlock, M. (1985) Evidence of the (non) relationship between concentration and profitability in banking, *Journal of Money Credit and Banking*, 17, 69-83.

Smirlock, M., Gilligan, T.W. and Marshall, W. (1984) Tobin's q and the structure performance relationship, *American Economic Review*, 74, 1051-60.

Spence, A.M. (1977) Entry, capacity, investment and oligopolistic pricing, *Bell Journal of Economics*, 8, 534-44.

Spence, A.M. (1981) The learning curve and competition, *Bell Journal of Economics*, 12, 49-70.

Spindt, P.A. and Tarhan.V. (1992) *Are There Synergies in Bank Mergers?* Working Paper, Tulane University: New Orleans.

Sraffa, P. (1926) The laws of returns under competitive conditions, *Economic Journal*, 36, 535-50, (Reprinted in Boulding, K.E. and Stigler, G.J. (eds.), *Readings in Price Theory*. London: Allen and Unwin).

Stackleberg von, H. (1934) *The Theory of the Market Economy, (translated by A.T. Peacock)*. London: William Hodge.

Stanbeck, T.M. (1979) *Understanding The Service Economy: Employment, Productivity, Location. (Policy Studies in Employment and Welfare, Number 35)*. London: John Hopkins University Press.

Stigler, G.J. (1951) The division of labor is limited by the extent of the market, *Journal of Political Economy*, 59, 185-93.

Stigler, G.J. (1957) Perfect competition, historically contemplated, *Journal of Political Economy*, 65, 1-17.

Stigler, G.J. (1958) The economies of scale, *The Journal of Law and Economics*, 1, 54-71.

Stigler, G.J. (1968) *The Organisation of Industry*. Illinois: Irwin.

Sutton, J. (1991) *Sunk Costs and Market Structure*. London: MIT Press.

Sylos-Labini, P. (1962) *Oligopoly and Technical Progress*, Cambridge, Mass: Harvard University Press [originally published 1957].

Szego, G. and Szego, V. (1992) The structure of the Italian Banking System, in Kaufman, G. (ed.) *Banking Structures in Major Countries*, London: Kluwer Academic Publishers.

Tew, B. (1992) Onwards to EMU, in Swann, D. (ed.), *The Single European Market and Beyond.* London: Routledge.

Thornton, J. (1991) Concentration in world banking and the role of Japanese banks, *Econmia Aziendale*, 10, 263-72.

Tirole, J. (1994a) On banking and intermediation (Joseph Schumpeter Lecture), *European Economic Review*, 38, 469-87.

Tirole, J. (1994b) Western prudential regulation: assessment, and reflections on its applications to Central and Eastern Europe, *Economics of Transition*, 2, 129-50.

Tschoegl, A.E. (1982) Concentration among international banks: a note, *Journal of Banking and Finance*, 6, 567-78.

Tschoegl, A.E. (1983) Size, growth and transnationality among the world's largest banks, *Journal of Business*, 56, 187-201.

Utton, M. (1972) Mergers and the growth of large firms, *Bulletin of Oxford University Institute of Economics and Statistics*, 34, 189-97.

Vennet, R.V. (1995) The effects of mergers and acquisitions on the efficiency and profitability of EC credit institutions, *University of Ghent Research Papers*, no.95/07.

Vennet, R.V. (1998) Cost and profit dynamics in financial conglomerates and universal banks in Europe, *Paper presented for the SUERF/CFS colloqium,* Frankfurt. October 1998.

Vesala, J. (1993) *Retail Banking in European Financial Integration*, No.77. Helsinski: Bank of Finland.

Vives, X. (1991a) Regulatory reform in European banking, *European Economic Review*, 35, 505-15.

Vives, X. (1991b) Banking, competition and European integration, in Giovanni, A. and Mayer, C. (eds.) *European Financial Integration*. Cambridge: Cambridge University Press.

Wagner, J. (1992) Firm size, firm growth and the persistence of chance, *Small Business Economics*, 4, 125-31.

Walters, I. (1988) *Global Competition in Financial Services.* Cambridge: Ballinger.

Weiss, L.W. (1963) Factors in changing concentration, *Review of Economics and Statistics*, 45, 70-77.

Weiss, L.W. (1965) An evaluation of mergers in six industries, *Review of Economics and Statistics*, 47, 172-81.

Weiss, L.W. (1974) The concentration-profits relationship and antitrust, in H. Goldschmid, H.M. Mann and J.F. Weston (eds.), *Industrial Concentration: The New Learning*, 183-233. Boston: Little Brown.

White, H. (1980) A heteroscedasticity-consistent covariance matrix estimator and a direct test for heteroscedasticity, *Econometrica*, 48, 817-38.

White, L.J. (1994) On the international harmonisation of bank regulation, *Oxford Review of Economic Policy*, 10, 94-105.

White, W.R. (1998) The coming transformation of continental European banking?, *Bank of International Settlements Working Papers*, No.54, June.

Williams, J.M. (1996) 'Italy', *Banking in the EU and Switzerland.* London: Financial Times Publishing.

Williams, J.M. (1998) 'Italy', *Banking in the New EU and Switzerland and Norway.* London: Financial Times Publishing.

Williamson, O. (1975) *Markets and Hierarchies.* New York: Free Press.

Wu, Y. and Zhang, H. (1996) Mean reversion in interest rates: New evidence from a panel of OECD countries, *Journal of Money Credit and Banking*, 28, 604-21.

Yeats, A.J., Irons, E.D. and Rhoades, S.A. (1975) An analysis of new bank growth, *Journal of Business*, 48, 199-203.