Post-Deregulation Developments in Financial Services.
The Case of the Banking Industry in Argentina

By

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Declaration

From Chapter 2, I derived a paper titled "Consolidation and competition. The case of the Argentine banking industry", which has been presented at the European Network of Industrial Policy (EUNIP) Conference (Vienna, November 2001); Royal Economic Society (RES) Annual Conference (University of Warwick, March 2002) and in the Industrial Organisation workshop at Warwick.

From Chapter 2, I also derived a paper titled "Consolidation, market power and cost economies in the banking industry. Empirical evidence from Argentina" circulated as Warwick Economic Research Paper No. 633. The paper has also been presented at the 7 th Spring Meeting of Young Economists (Paris, April 2002), and 29th European Association for Research in Industrial Economics (EARIE) Annual Conference (Madrid, September 2002) and in various seminars at Universidad Torcuato Di Tella and IAE – Universidad Austral (Argentina).

Post-Deregulation Developments in Financial Services. The Case of the Banking Industry in Argentina.

Summary

This thesis studies post-deregulation developments in financial services by examining the banking industry in Argentina during the 1990s. The main interests of this study lie in the analysis of the effects of consolidation in the banking industry on market power, cost economies and economic welfare, the relationship between ownership structure and economic efficiency and the consequences of consolidation and banks' geographic diversification on multimarket contact and market entry dynamics. Chapter 1 introduces the main issues discussed in the thesis and Chapter 2 describes the contextual industry framework and the post-deregulation developments that form the basis for the empirical analysis undertaken in the remaining chapters.

Chapter 3 explores the effects of consolidation on market power, cost economies and economic welfare using bank-level data for Argentine retail stock banks over the period 1993-2000 to estimate a cost-function based model incorporating deposits- and loans-market pricing behaviour. The results provide evidence of market power exploitation in the market for loans but not in the market for deposits and also the presence of significant cost economies. The findings further show an increase in consumers' surplus and banks' profits over the period possibly associated with the exploitation of scale economies and technical change, which may have counteracted the effect of market power.

Chapter 4 uses different approaches to measure cost and profit efficiency as well as scale economies and technical change for different ownership types in the banking industry over the 1993-2000 period. The results indicate that within the domestic-owned banking sector, stock banks seem to be more cost efficient than mutual and public-owned banks, that all banks operate under increasing returns to scale but that only stock banks benefited from technical progress. The findings also reveal that domestic-owned stock banks appear to be as efficient as foreign-owned banks in terms of both costs and profits. The results also indicate an increase in efficiency for all ownership types over the sample period, however, the most significant improvement appear to be that of mutual and public-owned banks.

Chapter 5 examines the impact of multimarket contact on entry into new markets in the banking industry over the 1994-2000 period using survival analysis techniques. The results suggest that banks with large asset bases and greater experience are more likely to expand into new markets when the level of demographic variables such as population density, demand or market growth are favourable. The findings tentatively imply that multimarket contact reduces the likelihood of entry into new markets and that other factors such as market dominance and market concentration also have a negative impact on entry. Finally, the results reveal that strategic similarity among multimarket competitors possibly amplifies the negative effect of multimarket contact on the hazard of entry. Chapter 6 summarises the findings of the thesis and discusses avenues for future research.

Chapter 1

Introduction

1.1 Introduction

The banking industry has experienced extraordinary changes over the last decades. Banking markets have been deregulated and opened up to foreign competition in a number of countries around the world with the aim of achieving more efficiency. As banking markets were seen as partly characterised by collusive behaviour, liberalisation policies have been targeted at fostering innovation and efficiency, by making markets more competitive and reducing oligopoly rents. An additional objective was to put an end to the financial repression, where the level of interest rates to depositors were maintained artificially low by governments. As a result, post-deregulation developments such as mergers and consolidation, privatisation of public-owned banks and entry of foreign banks have led to deep changes in the structure of domestic banking markets.

Deregulation and liberalisation policies in the Argentine banking system were motivated by similar reasons. The new government that took office in 1989 found the economy submerged in hyperinflation, a persisting recession and a dramatic fiscal deficit. The new administration therefore embarked on a reform process aimed at the resizing of the State, the deregulation of the economy and the integration of the country into the international community. Financial deregulation and liberalisation were adopted with the aim of facilitating greater competition in the financial sector. These policies were also accompanied by several reforms oriented towards strengthening safety and soundness in the banking sector. As a result of these reforms, the structure of the banking industry changed to a substantial degree. The number of banks declined, banking concentration increased sharply, banks became larger and more geographically diversified and public-owned banks lost participation to private banks, with an increasing presence of foreign-owned entities.

This thesis studies post-deregulation developments in financial services by examining the retail banking industry in Argentina after its deregulation in the early 1990s. The retail banking industry is of special interest for competition analysis and antitrust policy as it serves households and small- and medium-sized firms. This is because retail banking is more likely than wholesale banking to be subject to market imperfections such as market power due to information asymmetries between sellers and buyers, switching costs, and the prevalence of local rather than international markets. Post-deregulation developments in the retail banking industry include mergers, consolidation and geographic expansion, privatisation of public-owned banks and entry of foreign financial institutions. These events raise many interesting research and policy issues.

Previous research has analysed the effects of consolidation on market power or cost economies in retail banking markets. None of these studies, however, have focused on the market power and cost economies consequences of consolidation on consumers' welfare. Existing empirical evidence has also examined the relative efficiency of private and public-owned firms, mainly in non-financial industries. Due to data limitations, few works have analysed efficiency differences across several ownership types in the retail banking industry. Past research on the effects of multimarket contact on banks' competitive behaviour has mainly focused on outcomes of rivalry rather than on the rivalry process itself. This thesis contributes to the banking literature by providing new empirical evidence on the effects of consolidation on market power, cost economies and economic welfare, on the relative efficiency of different ownership types and on the influence of banks' geographic expansion on multimarket contact and local market competition.

This thesis is of particular interest to both policy makers and academics. Based on a unique data set – as will be discussed next – the thesis extends existing research by casting new light on the following three main questions. First, what are the effects of changes in market power and cost economies, as a result of consolidation, on consumers' surplus and banks' profits. Second, what are the efficiency differences between: (i) public-owned and private banks, (ii) mutual and stock banks, and (iii) domestic- and foreign-owned banks. Third, what is the effect of multimarket contact on banks' rates of entry into new geographic markets.

These issues are addressed using post-deregulation data over the 1993-2000 period. Such a period covers a decade of institutional order and economic stability. These conditions were however interrupted in December 2001 with the resignation of the Nation's President, the devaluation of the currency, the freezing of bank deposits and an asymmetric 'pesification' of banks' loans and deposits. While loans denominated in dollars were converted into pesos according to the exchange rate established by the Convertibility Law (one peso per U.S. dollar), deposits denominated in foreign currency were converted at a different rate (1.4 pesos per U.S. dollar), which ultimately led to imbalances in banks' balance sheets. The findings of this thesis are not, however, affected by such events. The implications drawn from the empirical results could in fact assist policy makers in the development of future policies.

1.2 Data

Many studies in the empirical banking literature use aggregate industry data to analyse market power or the effects of multimarket contact on competition due to data limitations. Additionally, while few studies analyse the Argentine banking industry, none of these works considers the period 1993-2000 due to data availability. Information at the bank level became available in 1997, when the Central Bank started publishing accounting and other type of data at the bank level. Before then detailed aggregate data for the industry were publicly available, but information on individual banks was far from detailed. The data for the period 1993-1997 was obtained as a result of special requests to the Central Bank. For this reason, the data set used in this study is unique.

The distinguishing features of the data set used in the thesis are twofold. Firstly, drawn on accounting and additional information from the retail banking industry, the data set records detailed cost and output data for different types of banks, which allows analysis of the cost structure of the industry as well as consideration of cost and profit efficiency differences between different ownership types. Secondly, the data set provides detailed information of banks' branches localisation, which permits detailed analysis of banks' decisions in terms of geographic expansion. This information is rarely available for a developing country. This fact also makes the data set used in this study unique.

1.3 Structure and Aims

The rest of the thesis is structured as follows. Chapter 2 provides the contextual industry framework that leads to the research questions addressed in the rest of the thesis. The first part of the chapter describes the characteristics of the consolidation process in the Argentine banking industry, its effects on the structure of the sector and on the geographic range of banks' operations. The second part of the chapter examines the privatisation of public-owned banks, the entry of foreign financial institutions and discusses the changes in the ownership structure of the industry as a result of these developments. This chapter is not intended, however, to be a full appraisal of the effects of financial deregulation and regulatory reforms.

The three chapters that follow present empirical results. Each chapter makes use of different data. Chapter 3 uses balance sheet data of stock banks only, Chapter 4 makes use of the same balance sheet data but for all retail banks in the industry and Chapter 5 utilises branch location information, bank-level accounting data as well as market-level information for all retail banks. As mentioned above, the quantity and richness of the data collected and used in this study represents a significant advance over other works carried out for the industry. A detailed report of the data sources and the construction of the variables is included in each chapter.

Chapter 3 examines the market and cost structure of the banking industry in order to provide some useful insights on the effects of consolidation on market power, cost economies and economic welfare. To that aim it estimates a cost-function based model incorporating deposits- and loans-market pricing behaviour. This study differs from previous works in two ways. Firstly, it examines market power in both the markets for loans (output) and deposits (input) using bank-level data and allowing for a flexible cost structure. Secondly, it is the first study that analyses the effects of consolidation on market power, cost economies and consumers' welfare. The results provide evidence of market power exploitation in the market for loans but not in the market for deposits.

The findings also suggest the presence of significant cost economies. The results further show an increase in consumers' surplus and banks' profits over the period possibly associated with the exploitation of scale economies and technical change, which may have counteracted the effect of market power.

Chapter 4 explores efficiency differences between stock, mutual, public- and foreign-owned banks. To that aim it uses different approaches to measure cost and profit efficiency as well as scale economies and technical change for the different ownership types in the retail banking sector. This study makes two contributions to the empirical banking literature. Firstly, this is the first study to consider efficiency differences across four ownership types: stock, mutual, public- and foreign-owned banks. Secondly, it analyses the relationship between ownership and efficiency in a developing economy. The results indicate that within the domestic-owned banking sector, stock banks seem to be more cost efficient than mutual and public-owned banks, that all banks operate under increasing returns to scale but that only stock banks benefited from technical progress. The findings also reveal that domestic-owned stock banks appear to be as efficient as foreign-owned banks in terms of both costs and profits. The results also indicate an increase in efficiency for all ownership types over the post-deregulation period, however, the most significant improvement appear to be that of mutual and public-owned banks.

Chapter 5 examines the impact of multimarket contact on banks' rates of entry into new geographic markets. To that aim it uses bank-market level data, includes controls for bank- and market-level characteristics and uses survival analysis techniques. The main contribution of this study to the multimarket contact literature lies in the analysis of the moderating effects of several variables, which have not been considered, at least simultaneously, in previous works. The results suggest that banks with large asset bases and greater experience are more likely to expand into new markets when the level of demographic variables such as population density, demand intensity or market growth are favourable. The findings tentatively imply that multimarket contact reduces the likelihood of entry into new markets and that other factors such as market dominance and market concentration also have a negative impact on entry. Finally, the results seem to reveal that strategic similarity among multimarket competitors amplifies the negative effect of multimarket contact on the hazard of entry.

Chapter 6 concludes. This chapter draws the thesis together by reviewing the main findings of the preceding chapters. It also brings together the main policy implications provided by the empirical results. This chapter concludes offering further avenues for future research based on the analysis developed throughout the thesis.

Chapter 2

Post-Deregulation Developments in the Argentine Banking Industry

2.1 Introduction

At the beginning of the last century, Argentina possessed a well-developed financial system with significant financial savings in an economy of low inflation and persistent growth.[1] The banking sector played an important role allocating savings to investment and financing the country's development. Capital was very mobile and domestic interest rates as well as prices were close to international levels. However, the Great Depression and the radical change of the economic system towards an *import substitution* model in the early 1940s led to a long period of financial repression, increasing macroeconomic instability and chronically high inflation rates. Minimum reserve requirements were set at 100% and bank deposits were administered on behalf of the Central Bank until the late 1950s. Real interest rates were considered an instrument of economic policy and remained negative until the late 1970s. As a result, credit was rationed and privileged to sectors producing import substitutes, the government and housing.[2]

At the end of the 1980s the Argentine economy was characterised by high inflation as a result of increasing fiscal imbalances and foreign debt expansion. During 1989 consumer prices increased by 4,924%, the real exchange rate reached the highest

[1] The M3 to GDP ratio (a measure of financial depth) was at 50-60%, the average annual inflation rate was 1.8% while GDP growth averaged 3.9% annually (Vénganzonès and Winograd, 1997).
[2] For a detailed analysis of Argentina's monetary and financial evolution see Escudé (1991) and Vénganzonès and Winograd (1997).

historic level, GDP dropped by 6.2% and the unemployment rate rose to 7.6%. In this context, the government set out an ambitious economic programme oriented towards deregulation of the economy, liberalisation of financial markets, renegotiation of public debt, reorganisation of the public sector - mainly through the privatisation of public utilities - and opening of trade. At the beginning of 1991 the Convertibility Law fixed the peso at par with the U.S. dollar. Since then the performance of the Argentine economy changed to a substantial degree and the macroeconomic instability notably reduced: the annual inflation rate fell to one digit, GDP increased at an annual rate of 5.5% throughout the first half of the decade, although growth rates have been volatile since 1996, the fiscal deficit was virtually eliminated but unemployment increased, the trade balance surplus became a deficit and the foreign debt increased.

The effects of both economic recovery and financial deregulation had a significant impact on the functioning of domestic financial and credit markets, basically characterised by an increase in the degree of monetisation and an improvement in the credit volume.[3] A new Central Bank Charter further contributed to the recovery, modernisation and development of the banking sector. In particular, the new Charter limited rediscounting and public sector loans to emergencies and forbade the use of money supply to finance public deficit. In addition, the Central Bank improved the regulation of capital and reserve requirements and the inspection of financial entities through the Superintendence of Financial Institutions. More severe norms concerning capital adequacy, diversification of credit risks, provisions for non-performing loans and minimum auditing standards were adopted. Additionally, foreign entry restrictions were loosened and a process towards the privatisation of public-owned banks started.

These reforms were basically aimed at ensuring the safety and soundness of the financial system and at the same time at making the banking sector efficient and competitive. As a result of these reforms, the banking industry experienced important changes, which accelerated after the Mexican crisis of 1994. Firstly, several mergers and acquisitions among domestic banks took place. This process led to a significant reduction in the number of banks operating in the system and a notable increase in the degree of concentration. Secondly, as a result of the privatisation process and the elimination of entry restrictions, the ownership structure changed to a substantial degree towards an industry increasingly dominated by private and foreign-owned banks. Finally, the size and geographic diversification of banks increased notably.

This chapter examines post-deregulation developments in the Argentine banking industry to provide the background for the empirical analysis. The rest of the chapter is organised as follows. Section 2.2 analyses the characteristics of the consolidation process in the retail banking industry and its consequences in terms of market concentration, activity level and geographic expansion of retail banks. Section 2.3 discusses the ownership changes that resulted from the privatisation process and the entry of foreign banks. Section 2.4 summarises and presents the conclusions.

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[3] The M3 to GDP ratio raised from 5.2% in 1990 to 18.4% in 1994 and 32.6% in 1999 (Asociación de Bancos Argentinos, 1999).

2.2 Consolidation and Geographic Expansion

The reforms implemented throughout the 1990s led to mergers and acquisitions among domestic banks (M&As), to failures of smaller financial institutions and also to the entry of large foreign banks, which prompted a constant process of consolidation that accelerated during the Mexican crisis of 1994. Table 2.1 shows the number of M&As, failures, conversions, privatisations and authorisation of new entities that took place over the 1993-2000 period. Figures in Table 2.1 show that these events led to a decline in the number of banks from 134 in 1993 to 65 in 2000. The 20 failures and 55 M&As, almost all of them among private banks, explain the reduction in the number of institutions. In addition, the privatisation of more than half of the 28 public provincial banks operating in 1993 accounts for the decline in the number of public banks.

Table 2.1

M&A, failures, conversions and privatisation

Argentine retail banking industry, 1993-2000.

Type of bank	December 1993	M&A[a]	F	C	P	A	December 2000
Public	29	-2	0	0	-16	0	11
- National	1	0	0	0	0	0	1
- Provincial [b]	28	-2	0	0	-16	0	10
Private	105	-53	-20	0	16	6	54
- Domestic	95	-61	-20	0	16	4	34
Stock	56	-34	-15	6	16	4	33
Mutual	39	-27	-5	-6	0	0	1
- Foreign [c]	10	8	0	0	0	2	20
Total	134	-55	-20	0	0	6	65

Source: Own calculations based on Información de Entidades Financieras, Banco Central de la República Argentina.

Notes: [a] M&A: mergers and acquisitions; F: failures; C: conversions; P: privatisations; A: authorisation of new entities. [b] Includes municipal banks. [c] Includes local banks under foreign control (50% or more of shares foreign-owned) and local offices of foreign banks.

The structure of the industry notably changed as a result of the consolidation process. Table 2.2 presents market structure and activity level indicators over the 1993-2000 period. The information suggests that, despite the noteworthy reduction in the number of institutions, financial intermediation significantly increased between 1993 and 2000 as deposits rose from $39.7 to $83.3 and loans increased from $40.7 to $73.5 billion, with an impressive jump in the number of accounts. But market concentration, as measured by either deposits or loans, also increased sharply. Despite remaining low in absolute terms, the Herfindahl-Hirschman Index (HHI) for loans increased from 503 to 792 over the period.[4] This tendency towards increasing concentration could be explained by the M&As, which not only reduced the number of firms but also increased the inequality in the size distribution of banks as the dispersion in market shares escalated from 1.8 to 3.2%. This is further confirmed by the market shares of banks classified by size: large banks increased their market share of loans from 85.8% in 1993 to 92.2% in 2000, while medium and small-sized institutions lost 4.5% and 1.9% of the loans market, respectively.[5]

The consolidation process led not only to substantial changes in the size of banks and the distribution of market shares but also in the geographic range of banks' operations. Table 2.3 shows the proportion of banks operating in different provinces and the network size and geographic diversification of the average bank. The data reveal that 83% of banks had branches in one to four provinces in 1993, while the proportion of

[4] The HHI of concentration is defined as the sum of the squared market shares of all banks in the market. The formula is $HHI=\sum S_j^2=(v^2+1)/N$, where S_j is the market share of bank j, N the number of banks in the market and v the coefficient of variation of banks' market shares. The HHI thus synthesises information on both the number of banks in the market and the distribution of market shares. The HHI has an upper value of 10,000, in the case of a monopolist firm with 100% of the market, and tends to zero in the case of a large number of firms with small market shares.

[5] Banks are classified into three groups (large, medium and small) according to their volume of loans in each year.

banks operating in less than five provinces fell to 58% by 2000. In addition, the proportion of banks operating in more than 20 provinces increased from 3 to 10%. The figures in Table 2.3 also show that in 1993 the average bank had 30 branches - located in 4 provinces - while in 2000 the average bank operated a network of 72 branches - located in 7 provinces.

Table 2.2

Market structure and activity level

Argentine retail banking industry, 1993-2000.

Measure	1993	1994	1995	1996	1997	1998	1999	2000
Number of banks	134	135	108	95	89	75	71	65
Volume (billion $) [a]								
Loans	40.7	50.9	48.2	52.8	60.8	72.2	75.5	73.5
Deposits	39.7	46.0	39.9	49.3	62.5	75.7	80.9	83.3
Number of accounts (million)								
Loans	4.9	5.0	4.5	5.5	7.5	9.6	9.8	10.2
Deposits	7.8	9.1	9.1	10.1	12.7	16.8	18.3	19.1
Concentration [b]								
HHI	503.4	476.6	550.4	588.2	572.5	704.0	724.0	791.6
Market Shares St.Dev. (%)	1.82	1.77	2.21	2.30	2.32	2.79	2.90	3.18
Market share (%) [b]								
Large	85.8	85.1	80.7	80.5	80.5	85.6	91.5	92.2
Medium	10.1	11.2	15.7	15.3	9.0	11.8	6.2	5.5
Small	4.1	3.7	3.6	4.2	10.5	2.6	2.3	2.2

Source: Own calculations based on Financial Statements and Información de Entidades Financieras, Banco Central de la República Argentina.
Notes: [a] Constant pesos December 2000. [b] Loans.

The consolidation process also led to changes in interest rates, banks' efficiency and profitability. Table 2.4 presents financial indicators for the retail banking industry over the 1993-200 period. The level of interest rates shows that the intermediation spread declined from 14% to 12%, though it remained high.[6] The level of interest rates rose during the Mexican crisis of 1995, but at the end of the period the interest rate on deposits is one third while that on loans one fifth lower than their initial values. The efficiency ratios suggest a clear improvement over the entire period. On the one hand, they show a sustained decrease in operating expenses as a proportion of total assets (from 11.6 to 8.0). The reduction of the number of employees as well as of wages seems to be the main reason explaining this tendency. On the other hand, deposits per employee more than doubled during the period, which suggests an increase in the degree of 'bancarisation' and in labour productivity. Profitability, measured by returns on equity or returns on assets, shows a significant improvement over the second half of the period.

Table 2.3

Geographic diversification

Argentine retail banking industry, 1993-2000.

Year	Proportion of banks with operations in (%):				Average bank	
	Less than 5 Provinces	6 to 10 provinces	11 to 20 provinces	More than 20 Provinces	Number of branches	Number of provinces
1993	83.2	8.4	5.3	3.1	30	4
1994	80.9	10.7	5.3	3.1	30	4
1995	71.4	14.3	9.9	4.4	42	5
1996	70.1	12.6	12.6	4.6	45	5
1997	69.1	12.3	13.6	4.9	49	6
1998	62.5	16.7	12.5	8.3	61	7
1999	60.3	15.9	14.3	9.5	70	7
2000	58.1	16.1	16.1	9.7	72	7

Source: Own calculations based on information provided by the Banco Central de la República Argentina.

[6] The intermediation spread is simply measured as the difference between the interest rate on loans and that on deposits.

Table 2.4

Evolution of financial indicators

Argentine retail banking industry, 1993-2000.

Indicator (%) [a]	1993	1994	1995	1996	1997	1998	1999	2000
Interest rates								
Deposits	9.7	9.1	15.7	7.3	7.0	7.2	7.1	6.9
Loans	23.7	21.9	24.5	17.0	15.4	15.9	18.0	18.9
Economic efficiency								
Operating expenses / Assets	11.6	10.6	11.1	8.7	7.7	7.0	8.0	8.0
Labour expenses / Assets	6.5	5.9	6.2	4.8	4.0	3.5	3.9	3.8
Deposits/Employee (thousand $)	275.9	323.8	182.1	404.3	476.0	556.6	578.0	581.6
Profitability								
Profit / Equity (ROE)	10.3	6.8	-11.9	-9.0	8.5	14.8	12.4	12.7
Profit / Asset (ROA)	1.5	0.5	-3.0	-1.3	0.8	1.9	2.2	2.0

Source: Own calculations based on Financial Statements.
Notes: [a] Annual indicators.

2.3 Ownership Structure

The Argentine banking industry is characterised by a diversity of bank ownership types. Argentine banks can be classified as public- and private-owned banks. The former can be national- or provincial-owned, whereas the latter can have a mutual or stock ownership structure. Mutual banks are formally owned by their depositors and possibly their borrowers while stock banks are owned by their shareholders.[7] Stock banks can be further classified as domestic- or foreign-owned. The ownership structure of the industry changed during the 1990s as a result of the privatisation of public provincial banks, the consolidation of mutual banks and the entry of foreign financial institutions through the acquisition of domestic banks. Table 2.5 shows the evolution of the ownership structure in the Argentine banking industry over the 1993-2000 period.

[7] These two types of banks also differ in that the stock bank can increase its capital by issuing new stock while the mutual increases capital via retained earnings.

The privatisation of banks started in 1991, but the funds provided by the Fondo Fiduciario - set up during 1995 with funds from multilateral institutions - and the deposit insurance agency (SEDESA) contributed to accelerate the process (Calomiris and Powell, 2001). As a consequence, 12 banks were privatised during the period 1994-1996, followed by an additional 4 during the period 1997-2000 (see Table A1 in the Appendix). The privatised institutions were primarily acquired by other existing domestic banks or domestic groups of investors. Two of the ten largest banks in Argentina, the Banco de la Nacion Argentina and the Banco de la Provincia de Buenos Aires, still remain under the control of the national government and the provincial government of Buenos Aires, respectively.

Table 2.5

Ownership structure

Argentine retail banking industry, 1993-2000.

Year	Total	Public		Private		
		Provincial[a]	National	Mutual	Stock	Foreign[b]
1993	134	28	1	39	56	10
1994	135	28	1	38	58	10
1995	106	25	1	16	53	11
1996	95	18	1	8	55	13
1997	89	14	1	7	46	21
1998	75	10	1	4	40	20
1999	71	10	1	2	36	22
2000	65	10	1	1	33	20

Source: Own calculations based on Información de Entidades Financieras, Banco Central de la República Argentina.
Notes: [a] Includes municipal banks. [b] Includes local banks under foreign control (50% or more of shares foreign-owned) and local offices of foreign banks.

Table 2.5 shows that privatisation reduced the number of public provincial banks from 28 in 1993 to 10 in 2000.[8] In addition, the number of private institutions decreased

[8] Two provincial banks were absorbed i.e. the Banco Social de Córdoba was absorbed by the Banco de la Provincia de Córdoba and the Banco Municipal de Paraná was absorbed by Banco de Entre Ríos S.A.

from 105 to 54. The number of private banks halved as a result of mergers, acquisitions and failures, especially after the Mexican crisis of 1994. Table 2.6 presents the market share of public- and private-owned banks over 1993-2000. The figures reveal that public banks lost almost 15% of the market for loans, nearly 10% of the market for deposits and about 20% of total assets. In contrast, the two largest public banks - Banco Nacion and Banco de la Provincia de Buenos Aires - slightly increased their market share of loans (deposits) from 20.6% (23.7%) in 1993 to 24.6% (25.6%) in 2000. Finally, private banks gained more than 15% of the market for loans, nearly 8% of the market for deposits and almost 10% of total assets.[9]

Table 2.6

Market share of public- and private-owned banks

Argentine retail banking industry, 1993-2000.

Year	Loans			Deposits			Assets		
	Public	Largest public[a]	Private	Public	Largest public[a]	Private	Public	Largest public[a]	Private
1993	24.2	20.6	55.2	17.3	23.7	59.0	17.8	17.9	64.3
1994	19.8	20.2	60.0	14.9	21.0	64.1	15.3	17.0	67.7
1995	18.0	23.2	58.8	13.4	24.4	62.2	13.2	18.1	68.7
1996	14.1	22.2	63.7	10.5	25.0	64.5	9.4	15.2	75.4
1997	11.4	22.1	66.5	7.9	25.8	66.3	6.7	14.0	79.3
1998	10.6	22.7	66.7	8.3	26.9	64.8	7.1	14.1	78.8
1999	5.9	23.2	70.9	7.6	25.6	66.8	4.1	14.2	81.7
2000	4.6	24.6	70.8	7.5	25.6	66.9	3.9	12.9	83.2

Source: Own calculations based on Financial Statements.

Notes: [a] The two largest public banks are Banco Nacion and Banco de la Provincia de Buenos Aries.

Another distinguishing feature of the Argentine banking industry during the 1990s was the consolidation of mutual banks. Between 1994 and 1995, the number of mutual banks decreased from 38 to 16, mainly as a consequence of mergers and acquisitions

[9] During the Tequila crisis, the financial system lost deposits, however larger private and public banks gained deposits from other mutual and public provincial banks i.e. flight to 'quality' (Calomiris and

(see Table A2 in the Appendix). These banks basically merged due to the loss of deposits experienced during the Mexican crisis. For example, five banks merged into a new mutual bank - Banco Argencoop - while another eight originated a new stock bank - Banco BISEL. During the second half of the decade the number of mutual banks further declined as a consequence of failures and also the conversion of several mutual banks to stock financial institutions. As a result, the share of mutual banks in total loans (deposits) fell from 5.5% (6.6%) to 1.2% (1.4%) between 1993 and 2000.

Probably the most notorious change in the Argentine banking industry during the last decade was the entry of foreign banks. The removal of restrictions on foreign direct investment and the repatriation of profits facilitated by the Convertibility Law allowed more foreign institutions to enter the domestic market. After the Mexican crisis, British, Canadian, French and Spanish (to name a few) financial institutions entered the domestic market primarily through acquisitions of domestic banks that were in a good financial condition and have an extended network of branches, rather than through the acquisition of privatised provincial banks. This process began slowly in 1995-1996, but accelerated significantly during 1997-1999. As a result, the number of foreign banks increased from 10 in 1993 to 20 in 2000 the majority of which are European followed by American (see Table A3 in the Appendix). Table 2.7 presents the evolution of market shares of foreign- and domestic-owned banks in Argentina over 1993-2000. The data shows that foreign-owned banks significantly increased their market share of loans (deposits) from 14.5% (14.0%) in 1993 to 49.6% (48.4%) in 2000. In contrast, domestic banks lost almost 35% of the market for loans and deposits.

Powell, 2001).

Table 2.7

Market share of foreign- and domestic-owned banks

Argentine retail banking industry, 1993-2000.

Year	Loans		Deposits		Assets	
	Foreign [a]	Domestic	Foreign [a]	Domestic	Foreign [a]	Domestic
1993	14.5	85.5	14.0	86.0	14.2	85.8
1994	15.1	84.9	15.3	84.7	13.6	86.4
1995	17.6	82.4	18.8	81.2	18.9	81.1
1996	41.1	58.9	38.2	61.8	40.5	59.5
1997	44.4	55.6	41.4	58.6	46.1	53.9
1998	45.6	54.4	42.6	57.4	47.6	52.4
1999	47.9	52.1	46.8	53.2	50.4	49.6
2000	49.6	50.4	48.4	51.6	53.5	46.5

Source: Own calculations based on Financial Statements.
Notes: [a] Includes local banks under foreign control (50% or more of shares foreign-owned) and local offices of foreign banks.

Table 2.8 presents efficiency and profitability indicators by ownership type. Efficiency ratios at the beginning of the period show that mutual and public-owned banks appear to be the least efficient in terms of operating expenses to total assets, labour expenses to total assets and deposits per employee. These efficiency indicators also reveal an improvement for all ownership types over the decade. During the second half of the period, the differences between stock, mutual and public-owned banks in terms of operating expenses to total assets, labour expenses to total assets and deposits per employee are smaller than over the first half of the period.

Profitability measures at the beginning of the period show that within the domestic banking sector stock banks appear to be more profitable, in terms of both returns on equity and returns on assets, than mutual and public-owned banks. But the differences in profitability between stock domestic- and foreign-owned banks seem to be small. When analysed over time, profitability shows an improvement for all ownership types, but especially for mutual institutions. In fact, at the end of the period mutual banks exhibit the highest rate of return on assets (and rate of return on equity) when compared with the other ownership types. This result may be explained by the significant decline in the number of mutual banks leading to the presence of just one mutual institution at the end of the decade.

Table 2.8

Financial indicators

Stock, mutual, public- and foreign-owned retail banks, 1993-2000.

Indicator (%) [a]	1993-1996				1997-2000			
	Public	Mutual	Stock	Foreign	Public	Mutual	Stock	Foreign
Interest rates								
Deposits	9.9	12.6	10.6	5.8	6.3	6.7	7.1	6.2
Loans	18.3	25.9	22.4	13.3	15.1	19.6	18.9	14.6
Economic efficiency								
Operating exp / Assets	10.4	13.7	9.7	7.5	8.5	8.8	8.3	6.3
Labour exp / Assets	6.1	7.3	5.2	4.2	4.2	4.0	4.1	3.0
Deposits/Employee (thousand $)	269.4	213.5	280.6	515.6	468.9	482.8	449.8	775.9
Profitability								
Profit / Equity (ROE)	-20.5	-0.8	7.4	4.2	7.2	16.4	16.6	14.9
Profit / Asset (ROA)	-5.4	0.0	0.9	0.5	1.0	2.7	2.5	2.1

Source: Own calculations based on Financial Statements.
Notes: [a] Annual indicators.

2.4 Conclusions

At the beginning of the 1990s, the banking industry in Argentina was deregulated and opened up to foreign competition with the aim of making the sector efficient and competitive. As a result of these reforms, the banking industry experienced important changes, which accelerated after the Mexican crisis of 1994. Firstly, several mergers and acquisitions among domestic banks took place. This process led to a significant reduction in the number of banks operating in the system and a notable increase in the degree of concentration. Secondly, as a result of the privatisation process and the elimination of entry restrictions, the ownership structure changed to a substantial degree towards an industry increasingly dominated by private and foreign-owned banks. Finally, the size and geographic diversification of banks increased notably.

These changes raise important policy concerns. First, the increasing levels of concentration could allow banks to take advantage of market power by setting prices less favourable to consumers and reducing output levels. But at the same time, the increasing size of banks could allow them to exploit cost economies. Second, the high level of inefficiency that characterises public-owned banks suggests that privatisation policies should lead to efficiency improvements. Additionally, the increasing presence of foreign-owned banks could place domestic banks under peer pressure to improve efficiency. Third, the increasing geographic presence of large banks and their higher degree of multimarket contact could facilitate tacit agreements, with the consequent negative effects on consumers.

These observations suggest that two opposing effects could be operating in the banking industry as a result of post-deregulation developments. On the one hand, the larger scale of banks' operations resulting from consolidation, the increasing presence of private banks derived from privatisation and increased competition from foreign institutions could lead to efficiency gains, which could be transferred to consumers in the form of more favourable prices and higher output levels. On the other hand, the increasing degree of concentration among larger banks and the higher degree of contact among these larger institutions could facilitate the exploitation of market power, with the consequent negative effects on consumers. If the first effect is more important, consumers will be better off as a result of deregulation. In contrast, if the second effect dominates, the consequences of the structural changes on consumers' welfare will be negative. These issues are analysed in the following chapters.

Appendix

Table A1

Privatisation of public banks

Argentine retail banking industry, 1993-2000.

Bank	Privatisation started[a]	Private ownership started[b]
Provincial		
De la Provincia de La Rioja	NA	July 1994
Del Chaco S.E.M.	November 1993	November 1994
De Entre Ríos S.A.	August 1993	January 1995
De la Provincia de Formosa	December 1995	December 1995
De la Provincia de Misiones	August 1993	January 1996
De la Provincia de Rio Negro	July 1992	March 1996
Provincial de Salta	July 1994	March 1996
De la Provincia de Tucumán	January 1996	July 1996
De la Provincia de San Luis	January 1995	August 1996
De la Provincia de Santiago del Estero	January 1995	September 1996
De la Provincia de San Juan	July 1995	November 1996
De Previsión Social (Mendoza)	March 1995	November 1996
De la Provincia de Jujuy	June 1995	January 1998
De la Provincia de Santa Fe	July 1996	July 1998
De la Provincia de Santa Cruz	October 1995	October 1998
Municipal		
Municipal de Tucumán	July 1996	July 1998

Source: Informe al Congreso de la Nación (various years), Banco Central de la República Argentina.
Notes: [a] Date of law or decree authorising privatisation. [b] Date of creation of private institution.

Table A2

M&A, failures and conversions

Argentine mutual banking sector, 1993-2000.

Year	No of banks January	M&A	Failures	Conversions	No of banks December
1994	39	-1	0	0	38
1995	38	-19	-1	-2	16
1996	16	-6	0	-2	8
1997	8	0	-1	0	7
1998	7	0	-3	0	4
1999	4	-1	0	-1	2
2000	2	0	0	-1	1
Total		-27	-5	-6	

Source: Own calculations based on Información de Entidades Financieras, Banco Central de la República Argentina.

Table A3

Foreign bank entry

Argentine banking industry, 1993-2000.

Acquired bank	Date	Acquired share (%)	Acquiring Institution
Banco Tornquist S. A.	September 1996	100	O'Higgins-Central Hispano S.A. (Chile)
Banco Frances del Río de La Plata S.A.	December 1996	30	Banco Bilbao Viscaya (Spain)
Banco Liniers Sudamericano S.A.	April 1997	51	BT LA Holdings LLC. (U.S.)
Banco Río de La Plata S.A.	July 1997	50	Banco Santander S.A. (Spain)
Banco Crédito de Cuyo S.A.	July 1997	67	Abinsa S.A. (Chile)
Banco Transandino S. A.	July 1997	51	Abinsa S.A. (Chile)
Banco Roberts S.A.	August 1997	100	HSBC Latin America BV (U.K)
Banco de Crédito Argentino S.A.	August 1997	28	Banco Frances S.A. (under the control of Banco Bilbao Viscaya)
Banco Los Tilos S.A.	November 1997	40	Caja de Ahorros Provincial San Fernando de Sevilla y Jerez (Spain)
Banco Quilmes S.A.	December 1997	70	Bank of Nova Scotia (Canada)
Banco del Buen Ayre S.A.	November 1998	100	Banco Itaú S.A. (Brazil)
Banco Bisel S.A.	January 1999	36	Caisse Nationale de Credit Agricole (France)
Banco de Entre Ríos S.A.	March 1999	82	Banco Bisel (under the control of Caisse Nationale de Credit Agricole)
Banco de la Edificadora de Olavarria S.A.	October 1999	39	Giuseppe Zilio (Italy)
Banco Caja de Ahorro S.A.	March 2000	Indirect control	Banco Sudameris S.A. (group Banca Intensa SPA – Italy)
Banco Suquía S.A.	May 2000	60	Banco Bisel (under the control of Caisse Nationale de Credit Agricole)
Mercobank S.A.	May 2000	50	Abinsa S.A. (Chile)

Source: Informe al Congreso de la Nación, Banco Central de la República Argentina.

Chapter 3

Consolidation, Market Power and Cost Economies

3.1 Introduction

Post-deregulation developments in the Argentine banking sector led to deep changes in the structure of the industry. The reforms implemented throughout the 1990s led to mergers and acquisitions among domestic banks, to failures of smaller financial institutions and also to the entry of large foreign banks, through the acquisition of domestic institutions, which prompted a constant process of consolidation. As a result of this process, the number of banks operating in the system almost halved and concentration of deposits and loans among the largest institutions increased sharply during the decade.

These significant changes raise important policy concerns. On the one hand, it can be argued that a high level of concentration could allow banks to take advantage of oligopoly and oligopsony power by raising the interest rate on loans and reducing the rate on deposits. On the other hand, the increasing size of banks could be indicative of the potential for scale and other types of economies, which could allow larger firms to increase their cost efficiency. These efficiency gains can be transferred to borrowers and depositors in the form of higher deposit and lower loan interest rates if competition limits the exploitation of market power. Measuring the effects of banking industry consolidation on consumers' welfare thus requires detailed consideration of the oligopoly and oligopsony nature of the market as well as the cost structure of the industry. Such a model facilitates the evaluation of whether any benefits from efficiency gains have been translated to customers or if exploitation of market power and cost economies has instead resulted in excess profits.

Previous studies present several limitations. First, most studies have focused on the measurement of market power without consideration of the cost structure or have estimated cost economies ignoring the market influences on the behaviour of banks and ultimately the impact of both on economic welfare. Second, studies have basically relied on aggregate data, which are limiting for at least two reasons. On the one hand, results based on the assumption that firms have identical cost functions may be misleading if firms are heterogeneous. On the other hand, difficulties emerge if the industry is represented in terms of an oligopoly and oligopsony rather than monopoly and monopsony framework, as this requires modelling individual decision-making units. Third, deposits have frequently been considered as inputs, but the potential for oligopsony power in this market has been ignored.

This chapter investigates the market and cost structure of the Argentine banking industry using a panel data set for the period 1993-2000. The focus of the analysis is on the measurement of market power (in both the markets for loans and deposits), scale economies and technological change and their impact on economic welfare. Towards this aim it uses a cost function-based model to characterise the cost structure of retail banks along with profit maximisation conditions over loans and deposits. It analyses the changes in economic welfare associated with the consolidation of the banking sector using a partial equilibrium framework by adding up the variations in consumers' surplus and banks' profit. The results provide evidence of market power exploitation in the market for loans (but not deposits) and also the presence of significant cost economies. The findings further show an increase in consumers' surplus and banks' profits over the sample period possibly associated to the exploitation of cost economies and technical change which may have counteracted the effect of market power.

The rest of the chapter is organised as follows. Section 3.2 reviews related studies regarding the measurement of market power and cost economies in general and in the banking industry in particular. Section 3.3 introduces the model and the measures of market power and cost economies and discusses the empirical implementation. Section 3.4 presents the data sources and definition of variables and provides a brief overview of the dataset while section 3.5 discusses the results. Finally, the last section summarises and presents the conclusions.

3.2 Literature Review

The *traditional approach* to the analysis of market power is based on the structure-conduct-performance hypothesis (SCP). The conceptual basis of this paradigm, due to Mason (1939) and Bain (1951), basically states that high levels of concentration (structure) facilitate the adoption of collusive behaviour and thus the setting of higher prices and reduced output levels (conduct) ultimately leading to higher profitability (performance). Several authors demonstrate that there are some market conditions under which the hypothesis is valid. Cowling and Waterson (1976) and Dansby and Willig (1979) show that if firms set a target output level rather than price per se and choose their output levels assuming that rivals will not vary their output levels in response, firms' profitability will depend on the sum of squared market shares of all firms in the market. Similarly, Saving (1970) demonstrates that a k-firm dominant cartel plus a competitive fringe of smaller firms, generate a fixed relationship between the combined market share of the k largest firms in the market and firms' performance.

Several economic theories challenge the realism of these specialised conditions under which high levels of concentration lead to higher profitability and show that the structure-performance linkage is not valid under alternative assumptions. On the one hand, the theory of contestable markets suggests that competitive outcomes can be attained even in concentrated markets. Baumol et. al. (1982) shows that if an entrant into a market offers the same services at lower prices and can recover any cost of entry while abandoning the industry, competitive prices could be attained regardless of the number of firms in the market.[10] On the other hand, the theory of trigger price strategies suggests one set of conditions that allow collusive behaviour to be sustained among arbitrarily many firms. Friedman (1971) shows that if firms realise that the temporary profits one firm could gain by underpricing its rivals could be more than offset by the expected losses from rivals' retaliation in subsequent periods, even a large number of firms may tacitly collude.

Empirical studies based upon the SCP hypothesis usually explore different relationships between structural concentration measures and profit margins or price levels as proxies for performance. In general, these studies seem to provide support for the structure-performance linkage. However, these works are subject to several conceptual, methodological and data flaws.[11] Gilbert (1984) and Weiss (1989) provide good summaries of profit- and price-concentration studies in banking while Demsetz (1973),

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[10] Competitive prices are those that cover the costs of production plus a rate of return on capital.

Smirlock (1985) and Kimmel (1991) present some methodological criticisms. More recent studies such as Kurts and Rhoades (1991) and Berger (1991, 1995) try to fix these flaws but provide limited support for the structure-performance relationship in banking. It therefore becomes evident that a lack of strong theoretical foundations and mixed empirical results motivated the search for alternative methodologies to analyse market power.

Several *alternative approaches* have been proposed to analyse market power. These techniques directly explore the behaviour of output or prices instead of relying on an observation of market structure as the traditional approach proposes. These techniques can be classified according to whether *reduced form* or *structural* equations are estimated. These methods basically differ in their data requirements and the type of assumptions maintained. Within the reduced-form methods, the test proposed by Panzar and Rosse (1987) has received particular attention in the banking literature.[12] However, structural models have become widely used in recent studies of market power in the banking industry.

The *Panzar-Rosse approach* (PR) relies on the fact that an individual firm will price differently in response to a change in its costs, depending on whether it operates in a competitive or monopolistic market. This test uses information on shifts in revenue in response to shifts in factor prices to test for market power. The empirical implementation requires the estimation of a reduced-form revenue function from which

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[11] These studies are unable to adequately capture heterogeneity across industries and firms. Additionally, there are econometric issues of endogeneity of some of the explanatory variables as well as serious data problems with these works.

[12] Another reduced form approach that has been widely used to test for market power is Hall's (1988) method. This technique is based on the Solow residual θ, which is an index of Hicks-neutral technical progress. However, this test has not been used in the banking literature.

the PR statistic can be computed: sum of the elasticities of revenue with respect to each of the factor prices. This statistic equals unity under perfect competition, cannot be positive under monopoly and is positive but less than unity under monopolistic competition. A major advantage of this technique is that it requires specification of only one equation (Shaffer, 1994). However, this test is subject to some practical problems. On the one hand, for most demand and cost functions, the correct reduced-form revenue function is extremely complicated and the use of a misspecified equation can bias the results (Hyde and Perloff, 1995). On the other, the test is powerless for some specifications, such as the Cobb-Douglas.

Notwithstanding these drawbacks, several studies have applied this technique to banks. Nathan and Neave (1989) analyse a sample of Canadian banks over 1982-1984, finding evidence of monopolistic competition. Hannan and Liang (1993) apply the test to a sample of U.S. banks over 1983-1989 not rejecting the monopoly power hypothesis. Molyneux et al. (1994) analyses banking markets in five European countries during 1986-1989, finding evidence of monopolistic competition in Germany, U.K., France and Spain and perfect collusion in Italy. Shaffer and DiSalvo (1994) estimate the PR statistic using data for an U.S. county with two banks. They find competitive outcomes over the subperiod 1976-1986 but perfect collusion over the full period 1970-1986. Carbo et al. (2001) apply the test to Spanish savings banks over the post-deregulation period 1986-1998, finding evidence of monopolistic competition.

Among the alternative approaches, structural models have been widely used to analyse market power in the banking industry. The *structural approach* to the analysis of market power basically assumes that firms set prices or quantities in order to maximise profits and that such a decision is based on cost considerations and on the degree of competition in the market, which depends on demand conditions and also on the characteristics of interaction among firms (see Iwata, 1974; Appelbaum, 1979, 1982; Gollop and Roberts, 1979). If the inverse market demand is given by $p=p(Y,z)$ where p is price, Y market output and z a vector of other shift variables, an effective marginal revenue function can thus be defined as $MR=p-\lambda/\eta$ (where η is the price semi-elasticity of demand and λ is an index of market power).[13] The equilibrium condition that the industry (or the firm) sets its marginal revenue equal to its marginal cost can then be presented as $p=MC(Y,w)+\lambda/\eta$ (Bresnahan, 1982).[14]

This method involves using data to estimate market demand, production or cost functions along with pricing equations derived from profit maximising conditions, whose parameters allow inference of the degree of market power. If data for each firm in the market are available, a complete model can be estimated and a firm-level parameter λ can be obtained. This parameter provides information on the conduct of firm i, as λ_i moves farther from zero the conduct of firm i moves farther from that of a perfect competitor. If only aggregate data for the industry are available, the equilibrium condition is inferred from aggregate (demand and/or cost) functions and the conduct parameter λ indicates the industry average ($\lambda=0$ indicates the market is competitive, $\lambda=1$ denotes a monopolistic market while with n identical firms playing Cournot, λ equals $1/n$).

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[13] Under the assumption of homogenous products and quantity setting firms.

[14] The parameter λ is called the 'conjectural variation', which indicates a firm's anticipated response by its rival(s) to an output change. This parameter is a valid parameterisation of any type of oligopoly equilibrium, however, it has no connection with conjectures (Bresnahan, 1989).

This structural method has been applied to Uruguayan banks by Spiller and Favaro (1984) and Gelfand and Spiller (1987), to samples of U.S. banks by Shaffer (1989) and Shaffer and DiSalvo (1994), to Canadian banks by Shaffer (1993), to Finnish banks by Suominen (1994), to Norwegian banks by Berg and Kim (1994, 1998), to Italian banks by Angelini and Cetorelli (1999), to European banks by Neven and Röller (1999), to Israeli banks by Ribon and Yosha (1999), to a sample of Argentine banks by Burdisso et al. (2001) and to a sample of industrialised countries by Shaffer (2001). Table 3.1 presents the data sources and main findings of these works. Many such studies find competitive conduct at the overall bank level while others provide evidence of some degree of market power among banks in the industry. Some of these studies, however, have been hampered by limitations of data and methodology.

Most of these studies rely on aggregate industry data (due to data constraints), which are limiting for at least two reasons. Firstly, most studies are based on the assumption that firms have identical cost functions, which may lead to misleading results, if firms are heterogeneous. Neven and Roller (1999) try to fix this flaw and estimate a model under the assumption that marginal cost functions differ across firms. Secondly, because the industry is represented in terms of monopoly rather than oligopoly framework since the latter requires modelling individual decision-making units (Morrison Paul, 2001a). Spiller and Favaro (1984) and Berg and Kim (1994, 1998) using firm level data incorporate the oligopolistic nature of the banking industry into the (conventional) structural model finding different types of oligopolistic interactions among firms. Following a similar approach Burdisso et al. (2001) find competitive conduct in the retail and corporate segments of the Argentine banking industry.

Table 3.1

Empirical studies of market power in the banking industry using structural models

Author	Sample	Findings
Spiller and Favaro (1984)	22 banks in Uruguay, 1977-1980 (monthly)	Stackelberg dominant-firm market.
Gelfand and Spiller (1987)	22 banks in Uruguay, 1977-1980 (monthly)	Market power in national and foreign currency denominated loans.
Shaffer (1989)	U.S. (aggregate) commercial banks, 1941-1983	Coefficient of market power not different from zero. Collusion rejected but not perfect competition.
Shaffer (1993)	Canadian (aggregate) chartered banks, 1965-1989.	Coefficient of market power not different from zero. Perfect competition not rejected.
Berg and Kim (1994)	Norwegian banks, 1988.	Coefficient of market power different from zero. Cournot rejected.
Shaffer and DiSalvo (1994)	Fulton County (aggregate) banks, 1970-1986.	Perfect competition, collusion and Cournot rejected. Degree of competition between competitive and Cournot levels.
Suominen (1994)	Finnish (aggregate) banks, 1986-1989.	Coefficients of market power different from zero after deregulation (but not for the pre-deregulation period)
Berg and Kim (1998)	Norwegian banks, 1990-1992	Coefficient of market power different from zero in retail and corporate markets. Corporate market close to perfect competition.
Angelini and Cetorelli (1999)	Italian banks, 1983-1997.	Coefficient of market power different from zero.
Neven and Röller (1999)	Banks in 7 European countries: Belgium, Denmark, France, Germany, The Netherlands, Spain and U.K. (aggregate), 1981-1989	Coefficients of market power different from zero in mortgage and corporate markets. Perfect collusion not rejected.
Ribon and Yosha (1999)	Israeli (aggregate) banks, 1989-1996 (monthly)	Coefficients of market power different from zero in loans and deposits markets. Loans market more competitive than deposits market.
Burdisso et al. (2001)	70 banks in Argentina, 1996-1999	Coefficients of market power not different from zero in retail and corporate markets.
Shaffer (2001)	Banks in 15 (North American, European and Asian) countries (aggregate), 1979-1991	Coefficient of market power different from zero in 5 countries (Belgium, Denmark, France, Japan and U.S.).

While only a few studies in this methodology follow the production approach for the definition of outputs and inputs most of them adopt the intermediation approach. This view describes banking activities as the 'transformation' of money borrowed from depositors into money lent to borrowers and thus considers labour, physical as well as financial capital (deposits and funds borrowed from financial markets) as inputs while the volume of loans and investment outstanding represent outputs. In general, banks are assumed to be price takers in the inputs markets, but if banks have market power in deposits the results may be biased. Ribon and Yosha (1999) appear to be the only ones to consider the possibility of oligopsony power in the deposits market and find that a certain degree of market power in this market seems to exist.

The studies discussed above analyse market power either by relying on measures of market concentration or by exploring firms' behaviour in terms of prices or output settings without consideration of firms' cost structure. However, many studies focus instead on firms' cost structure by applying various methods to differing data sets for the purpose of estimating the degree of scale and scope economies and the contribution of technical change to reducing costs. Humphrey (1990) and Berger et. al. (1993) provide good summaries of such studies in the banking industry. This line of research focuses on the properties of the cost function, and most studies assume output to be exogenous to the individual bank and hence the process by which it is determined is not specified in the models estimated. Thus, performance is assumed not to be affected by market power. Berg and Kim (1994) analyse the effects of market power on scale economies and find that measures of scale economies are not independent of market structure characteristics.

None of the studies mentioned above analyse the impact of market power and cost economies, in a concentrated banking industry, on economic welfare. In a different context, Barnea et. al. (2000) estimate a welfare function, which depends on the degree of competition, the stability and the operational efficiency of the banking system, to compare the size distribution of banks in the Israeli banking industry with the optimal one. Notwithstanding this study is subject to some limitations, the findings suggest that a move towards a distribution with equal size banks, a fewer number of large and small banks and more medium banks, will tend to increase total welfare. [15]

In view of the limitations of previous empirical studies and in order to analyse the impact of both market power and cost economies on economic welfare in a consolidating banking industry, the next section introduces a structural model based on Morrison Paul (2001a,b,c). The model consists of a cost function along with pricing equations derived from profit maximising conditions, and allows costs to differ across firms of differing size and to measure market power in the markets for loans and deposits, respectively, along with cost economies. The results from this model are then used to compute the variations in consumers' surplus and banks' profits to measure the changes in economic welfare.

3.3 Methodology

The basis of the model is the established principle that, in equilibrium, profit-maximising firms will choose quantities such that marginal cost equals their perceived marginal revenue, which coincides with the output price under perfect competition but with the industry's marginal revenue under perfect collusion. In the input market, firms

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[15] This study uses the Marshallian surplus concept to evaluate deadweight loss which is not an exact

will choose the quantity that corresponds to the equality between the marginal factor cost and its value marginal product which in a perfectly competitive market coincides with the input price while in a pure monopsony equals the firm's marginal factor cost. In this way, characterisation of market power depends on the cost structure because it involves comparing the price of the output or input to its associated marginal valuation (the marginal cost for the output or the marginal value for the input). Moreover, detailed representation of costs with recognition of cost economies is fundamental to the interpretation of market power measures.

The most direct way to measure market power and cost economies is via a cost function-based model which incorporates pricing equations capturing the differences between output and input market prices and marginal costs or benefits (Morrison Paul, 2001a). To represent the banking firm this study uses the following multi-output restricted cost function c (y,w,x,z), where y is a vector of m outputs, w is a vector of j variable input prices, x is a vector of input quantities and z a vector of control and shift variables. The adoption of the intermediation approach leads to the following definition of outputs and inputs: y includes loans (L) and securities (S), w includes the prices of labour (l), physical capital (k), materials (m) and other purchased funds (f), x represents the level instead of the price of deposits (d), z includes a trend variable to represent the effects of technical change and dummy variables to control for firm size.[16] This cost function expressed in terms of the level of deposits facilitates the incorporation of

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measure of welfare change (Hausman, 1981).

[16] In cost function models deposits may be specified as outputs, inputs or as having both input and output attributes. The *intermediation approach* views deposits as (intermediate) inputs, generated by the bank by offering means of payment services to depositors, and used in conjunction with other inputs to originate loans and other earning assets. In contrast, the *production approach* considers deposits as outputs while *the value-added approach* treats deposits as having both output and input characteristics.

market power in this input market that causes the demand equation to have a different structure than that implied by a Shephard's lemma condition.[17, 18]

A detailed representation of technological aspects such as scale economies, technical change and input substitution requires consideration of the functional form of the cost function. In particular, the functional form assumed for c(·) should be a second order form that allows for the cost-output relationship to be non-proportional and also to depend on all input prices (implying non-homotheticity if a full set of interaction terms between y and the w are included). Moreover, allowing for input substitution requires multiple inputs to be separately identified and a full pattern of cross effects or second-order terms across them allowed. This is facilitated by using a flexible functional form for c(·).

Characterising market power in output and input markets requires profit maximisation and potential deviations from competitive markets to be incorporated into the cost function model. In the mth output market, the profit maximising output supply decision can be represented by $MC_m=MR_m$ where $MC_m=\partial c_i/\partial y_{mi}$ represents marginal cost and $MR_m=p(Y_m)+y_{mi}(\partial p_m/\partial Y_m)\cdot(\partial Y_m/\partial y_{mi})$ is marginal revenue computed from an inverse demand function $p(Y_m)$ representing the output demand structure (Appelbaum, 1982). After some manipulation, this optimality condition for firm i can be presented as:

$$(3.1)\quad p_m = \frac{\lambda_{mi}}{\eta} + \frac{\partial c_i}{\partial y_m}$$

[17] In the presence of market power, the price of deposits becomes endogenous.

where m=L,S, $\lambda_{mi}=(\partial Y_m/\partial y_{mi})\cdot(y_{mi}/Y_m)$ is usually defined as the *conjectural elasticity* of total industry output with respect to the output of the ith firm and $\eta=-(\partial Y_m/\partial p_m)/Y_m$ is the market demand price semi-elasticity. Under perfect competition $\partial Y_m/\partial y_{mi}=0$ and $\lambda_{mi}=0$, while under pure monopoly $\lambda_{mi}=1$ since $Y_m=y_{mi}$.[19] From (3.1) the degree of market power for the ith firm, can be defined as $\tau_{mi}=(p_{mi}-\partial c_i/\partial y_{mi})/p_{mi}=\lambda_{mi}/\eta_p$, which is composed of two parts: the conjectural elasticity and the demand price elasticity (η_p).[20] It follows that the separate identification of λ_{mi} and η requires the simultaneous estimation of (3.1) along with a demand function from which the parameters necessary for the identification of η can be recovered.

A similar specification can be constructed for the x input market since the cost function is expressed in terms of the level instead of the price of x. In this market, profit maximisation implies the equality between the marginal factor cost and its marginal revenue product (or marginal value product if the product market is competitive), $MFC_d = w(X_d) + x_{di}(\partial W_d/\partial X_d)\cdot(\partial X_d/\partial x_{di}) = [p(Y)+y_i(\partial p/\partial Y)\cdot(\partial Y/\partial y_i)]\cdot(\partial y_i/\partial x_i) = MRP_d$ where MFC_d is computed from an inverse supply function $w(X_d)$. However, if the primal-based MRP_d is replaced by its dual equivalent $-\partial c_i/\partial x_{di}$, which is the shadow value of x_d or the variable-input cost-saving from an additional unit of x_d (Morrison Paul, 1999a), the cost-side version of the optimal input pricing equation can be expressed as:

[18] An alternative approach to measuring market power in the deposits market due to Schroeter (1988) requires restrictive assumptions on the cost structure (fixed proportions and separability of deposits from the other inputs) which may not be appropriate for the banking industry.
[19] In the special case of Cournot behaviour, λ is simply the output share of the ith firm.
[20] η_p is the price elasticity of demand, which equals η/p_m (where η is the price semi-elasticity of demand).

(3.2) $$w_{di} = -\frac{\lambda_{di}}{\varepsilon} - \frac{\partial c_i}{\partial x_{di}}$$

where w_{di} is the input market price, $\lambda_{di} = (\partial X_d/\partial x_{di})\cdot(x_{di}/X_d)$ is firm's i *conjectural elasticity* in market X_d, $\varepsilon=(\partial X_d/\partial w_d)/X_d$ is the industry input supply price semi-elasticity and $-\partial c_i/\partial x_{di}$ is the marginal shadow price of x_d for firm i.[21] From (3.2) the degree of market power for the ith firm, can be defined as $\tau_{di}=-(w_{di}+\partial c_i/\partial x_{di})/w_{di}=\lambda_{di}/\varepsilon_w$ where ε_w is the price elasticity of input supply. For the same reasons as above, estimation of λ_{di} and ε_w requires adding an input supply function to the model.

The estimating equations for implementation of the model include the cost function, output demand, input supply and pricing equations. The flexible functional form specified for the cost function is the following translog function (omitting firm and time subscripts):

(3.3) $$\begin{aligned} \ln c\,(y,w,x,z) = {} & \alpha_0 + \sum_j \beta_j \ln w_j + \sum_m \beta_m \ln y_m + \beta_d \ln x_d + \beta_t t + \frac{1}{2}\sum_j \sum_k \delta_{jk} \ln w_j \cdot \ln w_k \\ & + \frac{1}{2}\sum_m \sum_n \delta_{mn} \ln y_m \cdot \ln y_n + \frac{1}{2}\delta_{dd} \ln x_d \cdot \ln x_d + \frac{1}{2}\delta_{tt} t \cdot t \\ & + \sum_j \sum_m \delta_{jm} \ln w_j \cdot \ln y_m + \sum_j \delta_{jd} \ln w_j \cdot \ln x_d + \sum_j \delta_{jt} \ln w_j \cdot t \\ & + \sum_m \delta_{md} \ln y_m \cdot \ln x_d + \sum_m \delta_{mt} \ln y_m \cdot t + \delta_{dt} \ln x_d \cdot t + \sum_s \alpha_s D_s \end{aligned}$$

[21] In order to analyse market power in both output and input markets Schroeter (1988) uses the following expression: $p_m(1+\theta_m)=w_d(1+\theta_d)+MC$. However, stating the optimisation problem in this manner requires the imposition of restrictive assumptions on the cost structure (as stated above) and also the assumption

where c represents total cost, w denotes input prices, y_m represents the volume of output m and x_d is the volume of deposits for firm i in period t and subscripts j,k=l,k,m,f denote inputs labour, physical capital, materials and other funds and m,n=L,S denote outputs loans and securities. A time trend t is added to serve as an indicator of technological progress and D_S are dummy variables included to allow for differences across banks' size.

By partially differentiating the cost function with respect to each input price and using Shephard's lemma, the following input share equations are obtained:

$$(3.4) \quad s_j = \beta_j + \sum_k \delta_{jk} \ln w_k + \sum_m \delta_{jm} \ln y_m + \delta_{jd} \ln x_d + \delta_{jt} t$$

where $s_j = \partial \ln c / \partial \ln w_j = x_j \cdot w_j / c$ is the share of input j in total cost. These cost share equations are estimated along with the cost function to improve efficiency.

The hypothesis of profit maximisation implies that (3.3) satisfies the symmetry, linear homogeneity in input prices, monotonicity and concavity properties. A necessary and sufficient condition for the translog cost function to satisfy symmetry is that $\delta_{jk}=\delta_{kj}$ for all j, k. If the cost function is linearly homogeneous in input prices, the share equations will be homogeneous of degree zero in input prices. Then, to ensure symmetry and linear homogeneity in input prices, the following parameter restrictions on equations

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that θ_m and θ_d are equal, which leads to the same degree of market power in both input and output markets.

(3.3) and (3.4) are imposed: $\Sigma_j \beta_j$ $\Sigma_j \delta_{jk}=0$ $\delta_{jk}=\delta_{kj}$ for all j,k, $\Sigma_j \delta_{jm}=0$ $\Sigma_j \delta_{jd}=0$ $\Sigma_j \delta_{jt}=0$.[22]

Monotonicity and concavity are not general properties of the translog, unlike symmetry they cannot be conveniently summarised by linear restrictions on parameters of equations (3.3) and (3.4), instead the consistency of the estimated equations with respect to these properties must be evaluated. To satisfy the monotonicity conditions that the cost function is non-decreasing in output and increasing in input prices, the marginal cost of output and input cost shares must be positive and for concavity the matrix $A-\hat{s}+ss^T$ must be negative semidefinite where A is the symmetric matrix with elements $\{\delta_{jk}\}$, s is the share vector $s=[s_j]^T$ and $\hat{s}$ is a diagonal matrix which has the share vector s on the main diagonal (Diewert and Wales, 1987). Since the cost function includes the level instead of the price of x_d, additional regularity conditions require the restricted function (3.3) to be decreasing and convex in x_d, which is satisfied if the shadow value of x_d is positive and decreasing in x_d.

The marginal cost function for loans and marginal shadow price function for deposits are obtained from the cost function by partially differentiating (3.3) with respect to y_L and x_d respectively. As a result, the optimal pricing equations for loans and deposits stemming from (3.1) and (3.2) have the form: [23]

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[22] In the empirical implementation, linear homogeneity in input prices is imposed by normalising the dependent variable and all input price variables by one input price before taking logarithms.
[23] Since banks account for a very small part of the market for securities, following Klein (1971), Hannan (1991) and others, banks are assumed to be price-takers in this market. For that reason equation (3.5) refers to the loans market.

(3.5) $$p_L = \theta_L + \sum_s \theta_L \cdot D_S + \left(\frac{c}{y_L}\right) \cdot \left(\beta_L + \delta_{LL} \ln y_L + \delta_{LS} \ln y_S + \sum_j \delta_{Lj} \ln w_j + \delta_{Ld} \ln x_d + \delta_{Lt} t\right)$$

(3.6) $$w_d = -\theta_d - \sum_S \theta_d \cdot D_S - \left(\frac{c}{x_d}\right) \cdot \left(\beta_d + \sum_m \delta_{dm} \ln y_m + \sum_j \delta_{dj} \ln w_j + \delta_{dd} \ln x_d + \delta_{dt} t\right)$$

where p_L is the interest rate on loans and w_d the interest rate on deposits for firm i, $\theta_L = \lambda_L / \eta$ measures the difference between p and the marginal cost of loans, $\theta_d = \lambda_d / \varepsilon$ represents the gap between w_d and the marginal benefit from deposits, η is the price semi-elasticity of the demand for bank loans and ε the price semi-elasticity of the supply of deposits. Dummy variables D_S are also added to these equations to allow θ_L and θ_d to vary across banks' size.

In order to estimate η_p and ε_w the demand for loans and supply of deposits are specified as log-linear functions of the form:

(3.7) $\ln Y_L = \eta_0 + \eta_p \ln p_L + \eta_M \ln M + \eta_Z \ln Z$

(3.8) $\ln X_d = \varepsilon_0 + \varepsilon_w \ln w_d + \varepsilon_M \ln M + \varepsilon_Z \ln Z$

where Y_L is the aggregate demand for loans and X_d the aggregate supply of deposits expressed as functions of total income M, the price of a substitute Z, and the interest rate on loans p_L and deposits w_d, respectively. The parameter η_p is the price elasticity of demand for loans and ε_w the price elasticity of supply of deposits. Equations (3.7) and (3.8) can be viewed as first-order approximations to arbitrary demand functions.

The complete model consists of equations (3.3), (3.4), (3.5), (3.6), (3.7) and (3.8) and in principle may be estimated as a full system. In practice, however, it has proven to be difficult to estimate and is very demanding of data resources (Huang and Sexton, 1996). Additionally, the main interest of this study lies in the estimation of the parameter θ that captures the difference between price and marginal cost for loans or marginal valuation for deposits and that does not require price elasticity estimates. For these reasons, equations (3.3)-(3.6) are estimated as a system using annual bank level data. However, the analysis of the welfare effects of market power and cost economies requires estimation of a demand function of loans. Hence, the loans demand and the deposits supply functions (3.7) and (3.8) are estimated separately using quarterly time-series data.

3.3.1 Market Power and Cost Elasticities

From equations (3.5) and (3.6) two measures of market power can be obtained. First, the estimated parameter θ_L captures the difference between price and marginal cost in the market for loans while θ_d measures the gap between the interest rate and marginal shadow value of deposits. Hence, positive values of these parameters indicate the presence of market power. Second, the degree of market power can also be measured by means of a Lerner type index. In the loans market τ_L can be obtained dividing θ_L by the average interest rate on loans, p_L, while in the market for deposits τ_d can be computed dividing θ_d by the average interest rate on deposits, w_d.[24] In both cases, positive values indicate the presence of market power.

[24] These measures can also be calculated by using the estimated cost function, predicted costs and observed output and input prices in order to estimate marginal costs (marginal shadow values).

From the parameters of (3.3) several cost elasticities representing the cost structure can be computed. The elasticity of cost with respect to output, which represents the cost changes associated with scale y, may be expressed as $\varepsilon_{cy} = \Sigma_m(\partial c/\partial y_m)\cdot(y_m/tc) = \Sigma_m(\partial \ln c/\partial \ln y)\cdot(c/tc)$ where $tc = c(\cdot) + w(X_d)\cdot x_d$ and in terms of the coefficients of (3.3) as:

$$(3.9) \quad \varepsilon_{cy} = \sum_m \left(\beta_m + \delta_{mm} \ln y_m + \delta_{mn} \ln y_n + \sum_j \delta_{jm} \ln w_j + \delta_{dm} \ln x_d + \delta_{mt} t \right) \cdot \left(\frac{c}{tc} \right)$$

Since scale economies can be measured as $SCE = 1/\varepsilon_{cy}$ values of ε_{cy} lower (higher) than one indicate the presence of scale economies (diseconomies).

The elasticity of cost with respect to time often interpreted as technological change, which measures the rate of downward shift of the cost function over time, can be estimated by the restricted cost function as $\varepsilon_{ct} = (\partial c/\partial t)\cdot(1/tc) = (\partial \ln c/\partial t)\cdot(c/tc)$ and from (3.3) can be written as follows:

$$(3.10) \quad \varepsilon_{ct} = \left(\beta_t + \delta_{tt} t + \sum_j \delta_{jt} \ln w_j + \sum_m \delta_{mt} \ln y_m + \delta_{dt} \ln x_d \right) \cdot \left(\frac{c}{tc} \right)$$

where negative values indicate the contribution of technical change in reducing banking costs.

These elasticity measures are based on $c(\cdot)$, therefore depend on a given level of x_d. However, when output increases, x_d responses will have impacts on w_d (in the presence of market power in this market) which will appear as price-related cost economies or diseconomies. Two alternative approaches can be adopted to construct measures that incorporate such price-related adjustment: (i) including the 'desired' optimal condition for x from the input pricing equation into c(·) or (ii) using a 'combined' elasticity that directly appends the adjustment of x from a change in output. These approaches to the problem are similar empirically, but the latter is conceptually the most appealing (Morrison Paul, 1999b).

The second approach simply relies on the chain rule of differentiation. Since the desired level of x_d depends on the output produced, the c(·) function may be expressed as c(·,y,x(y)), where (·) represents all other arguments of the function. Then, the cost elasticity becomes: $\varepsilon_{cyd}=\sum_m(\partial tc/\partial y_m+\partial tc/\partial x_d \cdot \partial x_d/\partial y_m)\cdot(y_m/tc)=[\partial c/\partial y_m+(\partial c/\partial x_d+w(x_d)+x_d \cdot \partial w(x_d)/\partial x_d)\cdot(\partial x_d^*/\partial y_m)]\cdot(y_m/tc)$ where $x_d^*=x_d(y_m)$ results from solving for x_d from the pricing equation (3.6). However, x_d enters in both its level and logarithmic forms in (3.6) implying that no closed form analytic solution for x_d^* exists. Hence, the method developed by Brown and Christensen (1981) and used by Morrison (1992) and Considine (2001) in a somewhat different context is adopted, implicitly computing $\partial x_d/\partial y_m$ as $-(\partial \Phi/\partial y_m)/(\partial \Phi/\partial x_d)$ where Φ is an implicit function for optimal x_d^*:

$$(3.11)\quad \Phi = w_d + \theta_d + \left(\frac{c}{x_d}\right)\cdot\left(\beta_d + \sum_m \delta_{dm} \ln y_m + \sum_j \delta_{dj} \ln w_j + \delta_{dd} \ln x_d + \delta_{dt} t\right)$$

The cost-output and cost-time elasticities can be adjusted using (3.11) to incorporate the price-related adjustments. In the presence of market power in the deposits market, these 'adjusted' cost elasticities are the most appropriate measures for cost analysis since they represent the full range of cost impacts arising from output increases or technological change, including associated input price changes due to market imperfections. In a similar manner, marginal costs and market power measures can also be estimated, incorporating the impact of output increases on input prices due to market power.

3.4 Data and Variables

The data used to estimate the system of equations (3.3)-(3.6) consist of annual information from the Report of Condition and Income Statement of each stock retail bank over the period 1993-2000. Data for the 1993-1997 period were provided by the Banco Central de la República Argentina, while data for the 1998-2000 period were obtained from *Información de Entidades Financieras*, Banco Central de la República Argentina. Public-owned and mutual banks were not included in the sample since these banks may have different objectives than profit maximisation. The data set is an unbalanced panel of 476 observations. The banks in the sample are classified into three size bands (large, medium and small) based on average bank asset values. If a bank's average asset size is less than $150 million, the bank is classified as small-sized; when the asset size is greater than $150 million but less than $700 million, the bank is classified as medium-sized and when the asset size exceeds $700 million it is classified as a large bank.[25] The size dummy variables are then defined as follows: D_{lge}, D_{med} and D_{small} equal 1 for large, medium and small banks, respectively, and 0 otherwise.

The definition of outputs and inputs follows the intermediation approach. Hence, y_L is measured as the volume of loans, y_S as total assets minus loans, property and equipment and other fixed assets and x_d as the volume of deposits. The interest rates on loans and deposits are given by the ratios of interest income from loans to total loans and interest paid on deposits to total deposits, respectively.[26] Since loans are denominated in domestic (pesos) and foreign (dollars) currency, a quantity index is constructed by Divisia aggregation of loans in pesos and dollars as follows: $\ln y_t - \ln y_{t-1} = (1/2)\cdot\Sigma_i(s_{it} + s_{i,t-1})\cdot(\ln y_{i,t} - \ln y_{i,t-1})$ where y_i represents the ith type of loan, p_i the interest rate, $s_i = p_i \cdot y_i / \Sigma_i p_i \cdot y_i$ its share in total revenues and t represents the time period.[27] A Divisia quantity index of deposits (in pesos and dollars) is also constructed using the same methodology. The interest rates on loans p_L and deposits w_d are then estimated by dividing the interests income from loans and interest paid on deposits by the corresponding quantity indexes.

The prices for the inputs labour, capital, materials and other funds are computed as follows. The wage rate (w_l) is proxied by the ratio of personnel expenses (wages and insurance payments) to the number of employees. The price of capital for each bank (w_k) is constructed as sum of the depreciation rate and the opportunity cost of capital. The latter is approximated by the interest rate for loans less the expected rise in the value of the capital goods employed, which is proxied by the growth rate of the wholesale price index (Lang and Welzel, 1996). The price of materials (w_m) is constructed as administrative expenses minus personnel and capital costs divided by the value of total assets. The price of other funds (w_f) is given by the ratio of interest expenses on other purchased funds to other borrowed funds (including interbank funds

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[25] Different thresholds were used to classify banks, however, the results were not affected.

[26] Because the price data are subject to error from this estimation procedure, observations in which the prices on loans and deposits are more than 2.5 standard deviations from the mean value for that year were dropped. As a result 4 institutions were excluded due to negative or implausibly large prices.

[27] Banks provide different types of loans, which can be classified as retail or corporate loans. Retail loans include financing to households and small firms such as mortgages, personal loans and pledges. Corporate loans consist basically on financing to large corporations including overdrafts and promissory

purchased, commercial papers and other purchased funds). Total cost in each bank (c) includes all operating expenses and interest payments on other funds. All nominal data were converted into 2000 prices using the wholesale price index.

Table 3.2 displays descriptive statistics for cost, input and output variables for the sample of banks and by subgroups based on total asset size over the 1993-2000 period. The average-sized stock bank held $1,042 million of assets while the average large, medium- and small-sized bank had $4,131, $605 and $119 million of assets, respectively. Small-sized banks held fewer loans and similar amount of securities, measured as a proportion of total assets, and charged higher interest rates on loans than did larger banks. In terms of inputs, large banks used fewer employees per $ of assets than did small- and medium sized-banks, but paid them higher wages and benefits. This result suggests that larger institutions used labour inputs rather efficiently and/or pursued a less labour-intensive strategy. In terms of funds, large banks had similar amounts of deposits than smaller institutions but finance a larger proportion of their assets with purchased funds. In addition, these banks paid the lowest interest rates on deposits and on other purchased funds of the market.

The data for estimation of equations (3.7) and (3.8) consist of quarterly industry-level data for the period 1993-2000. The aggregate volume of loans (Y_L) and deposits (X_d) and the average interest rate on loans (p_L) and deposits (w_d) estimated as the ratio of interest on loans/deposits over total loans/deposits were obtained from the *Boletin*

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notes. Given that information on interest rates for both types of loans is only available from 1998, the analysis is restricted to total loans.

Table 3.2

Descriptive statistics

Stock domestic- and foreign-owned banks, 1993-2000

Variable[a]		Overall	Large	Medium	Small
Output quantities (% of assets)					
Loans	y_L	55.5	59.5	55.6	54.0
		(16.3)	(11.1)	(16.1)	(17.7)
Securities	y_S	33.2	33.9	32.8	33.3
		(16.4)	(13.1)	(15.8)	(18.1)
Output prices (%)					
Loans	p_L	19.0	13.8	16.7	23.0
		(10.3)	(2.7)	(7.7)	(12.3)
Securities	p_S	6.6	5.7	5.5	7.9
		(9.9)	(3.2)	(3.6)	(14.1)
Input quantities (% of assets)					
Deposits	x_d	48.8	49.3	48.8	48.5
		(22.2)	(8.7)	(14.4)	(29.8)
Labour (per million $ of assets)	x_l	1.6	0.8	1.4	1.9
		(1.1)	(0.4)	(0.8)	(1.3)
Capital	x_k	6.6	5.2	6.8	7.1
		(3.9)	(2.7)	(3.7)	(4.3)
Materials	x_m	3.0	2.0	2.7	3.7
		(1.6)	(0.7)	(1.2)	(1.9)
Other funds	x_f	26.0	32.4	27.6	22.0
		(14.2)	(9.6)	(14.3)	(14.6)
Input prices (%)					
Deposits	w_d	8.2	6.1	7.0	10.1
		(7.7)	(3.2)	(2.7)	(10.7)
Labour (thousand $ per employee)	w_l	33.4	42.3	32.8	30.3
		(12.2)	(9.4)	(9.2)	(13.4)
Capital	w_k	23.2	18.2	20.9	27.0
		(10.2)	(4.1)	(8.1)	(11.9)
Materials	w_m	3.0	2.0	2.7	3.7
		(1.6)	(0.7)	(1.2)	(1.8)
Other funds	w_f	9.9	6.5	8.0	12.7
		(13.3)	(3.6)	(5.9)	(18.6)
Other characteristics					
Costs (% of assets)[b]	c	10.9	8.2	10.2	12.6
		(4.7)	(2.4)	(3.9)	(5.4)
Assets (million $)		1,042.4	4,131.5	605.5	118.8
		(2246.0)	(3795.8)	(608.2)	(106.1)
Number of banks[c]		62 (51)	11 (9)	20 (18)	31 (24)

[a] Mean values and standard deviation in parenthesis. Constant pesos December 2000. [b] Excludes the cost of deposits. [c] Number of banks in 1993 (2000).

Estadístico, Banco Central de la Republic Argentina (2001). The activity level (M) is proxied by the GDP and the price of a substitute (Z) is estimated as sum of the LIBOR rate and the level of sovereign risk reflected in the price of the FRB bonds issued by the Argentine government.[28] This information was obtained from the *Informe Económico,* Ministerio de Economía y Obras y Servicios Públicos (2001).

3.5 Results

The system based on the cost function, input shares and pricing equations (3.3)-(3.6) was estimated on the basis of the bank-level data over the entire sample, over two subperiods 1993-1996 and 1997-2000, and also over three subsets of data comprising large, medium- and small-sized banks.[29] Additive error terms were appended to each equation, linear homogeneity in input prices and symmetry restrictions imposed across equations and one share equation was omitted to avoid singularity.[30] The system was estimated by (iterative) Three Stage Least Squares (3SLS) to take into account the joint endogeneity of prices and quantities in the loans and deposits markets that may be characterised by non-competitiveness.[31] Tables 3.3a and 3.3b present the parameter estimates for the system of equations (3.3)-(3.6) using the overall sample of banks and the subsamples of large, medium and small banks, respectively. The results show that most of the estimated parameters are statistically different from zero at significance

[28] This variable may be considered as a proxy for the market interest rate. Shaffer (1989, 1993) and Suominen (1994) have used the market interest rate as a proxy for Z while analysing market power in the U.S., Canadian and Finnish banking markets respectively.
[29] McAllister and McManus (1993) note that the fitting of a translog cost function over a population of banks that varies widely in terms of product mixes and size may result in specification bias and suggest the use of restricted samples of banks (similar in output mix and size). The sample of Argentine banks presents marked differences in terms of size and output composition. For these reasons the model is also estimated over subsamples of banks.
[30] The labour share equation was omitted. However, the estimates are invariant to the choice of share equation deleted since 3SLS provides maximum likelihood estimates.
[31] The instruments used include all exogenous variables, the lagged values of input prices, deposits and loan levels, interest rates on loans and deposits and input cost shares.

Table 3.3a

Parameter estimates for cost function, input cost share and pricing equations

All bank-size classes over 1993-2000, 1993-1996 and 1997-2000

	1993-2000		1993-1996		1997-2000	
Parameter [a]	Coef	z	Coef	z	Coef	z
α_0 [b]	2.264 ***	17.400	2.304 ***	6.710	1.750 ***	5.310
β_L	0.740 ***	19.540	0.810 ***	10.110	0.691 ***	8.970
β_S	0.358 ***	10.860	0.268 ***	3.680	0.338 ***	4.880
β_d	-0.207 ***	-7.990	-0.281 ***	-5.180	-0.035	-0.840
β_l	0.477 ***	18.713	0.508 ***	11.618	0.412 ***	9.089
β_k	0.115 ***	5.720	0.121 ***	3.620	0.091 **	2.180
β_m	0.392 ***	23.470	0.385 ***	13.490	0.488 ***	14.340
β_f	0.016	0.880	-0.014	-0.360	0.009	0.280
β_t	-0.040	-1.590	0.062	0.380	-0.024	-0.270
δ_{LL}	0.190 ***	25.540	0.219 ***	15.770	0.173 ***	17.530
δ_{SS}	0.187 ***	14.410	0.160 ***	8.200	0.254 ***	13.030
δ_{dd}	0.013	1.440	0.011	0.840	0.024 **	2.070
δ_{ll}	0.073 ***	7.593	0.083 ***	6.842	0.065 ***	4.962
δ_{kk}	0.048 ***	6.690	0.049 ***	5.030	0.043 ***	4.260
δ_{mm}	0.192 ***	50.510	0.185 ***	34.080	0.204 ***	46.070
δ_{ff}	0.068 ***	11.340	0.062 ***	6.420	0.069 ***	8.560
δ_{tt}	-0.003	-0.720	-0.024	-0.480	0.007	0.550
δ_{lL}	-0.012	-1.504	0.022 **	2.011	-0.037 ***	-3.584
δ_{kL}	0.017 ***	3.090	0.012 *	1.760	0.016 **	1.980
δ_{mL}	-0.027 ***	-5.120	-0.036 ***	-5.170	-0.023 ***	-3.240
δ_{fL}	0.021 ***	3.960	0.002	0.300	0.043 ***	6.110
δ_{lS}	-0.017 **	-2.499	-0.027 ***	-3.108	0.007	0.753
δ_{kS}	-0.011 **	-2.340	-0.010	-1.640	-0.028 ***	-3.570
δ_{mS}	0.000	0.100	0.003	0.550	0.003	0.470
δ_{fS}	0.028 ***	5.620	0.034 ***	4.380	0.017 **	2.490
δ_{ld}	0.010	1.327	-0.012	-1.152	0.011	1.177
δ_{kd}	-0.026 ***	-4.650	-0.023 ***	-3.330	-0.010	-1.240
δ_{md}	0.041 ***	8.240	0.046 ***	7.010	0.034 ***	5.470
δ_{fd}	-0.025 ***	-4.670	-0.012	-1.380	-0.035 ***	-6.360
δ_{lk}	0.016 ***	2.711	0.002	0.223	0.035 ***	4.204
δ_{lm}	-0.079 ***	-19.777	-0.079 ***	-16.405	-0.089 ***	-17.955
δ_{lf}	-0.011 *	-1.731	-0.006	-0.723	-0.012	-1.461
δ_{km}	-0.060 ***	-14.590	-0.050 ***	-8.820	-0.068 ***	-12.950
δ_{kf}	-0.005	-1.010	0.000	0.030	-0.011 *	-1.660
δ_{mf}	-0.053 ***	-17.860	-0.056 ***	-12.970	-0.047 ***	-12.840
δ_{Lt}	0.010 ***	3.150	-0.027	-1.610	0.010	1.110
δ_{St}	-0.012 ***	-2.920	0.014	0.890	-0.011	-1.240
δ_{dt}	0.006 *	1.840	0.015	1.070	-0.005	-0.950
δ_{lt}	-0.008 ***	-3.244	-0.016 *	-1.901	-0.004	-0.807
δ_{kt}	0.003	1.300	0.000	-0.010	0.009 **	1.990
δ_{mt}	0.004 **	1.980	0.000	0.080	-0.008 **	-1.980
δ_{ft}	0.002	0.940	0.016 **	1.960	0.003	0.910
δ_{dL}	-0.034 ***	-5.260	-0.042 ***	-4.610	-0.013	-1.640
δ_{LS}	-0.209 ***	-25.660	-0.210 ***	-19.070	-0.207 ***	-15.000
δ_{Sd}	0.051 ***	7.960	0.069 ***	7.630	-0.003	-0.400
θ_L [b]	0.049 ***	4.070	0.031 *	1.760	0.052 ***	3.350
θ_d [b]	-0.051 ***	-6.420	-0.049 ***	-3.330	-0.047 ***	-7.990
No.obs.	476		248		228	

***, **, * indicates significance at the 1%, 5% and 10% level, respectively. [a] l=labour, k=capital, m=materials, f=funds, L=loans, S=securities, d=deposits, t=time trend. [b] Dummy variables for differences across large, medium and small banks are insignificant.

Table 3.3b

Parameter estimates for cost function, input cost share and pricing equations

Subsamples of large, medium- and small-sized banks, 1993-2000

	Large		Medium		Small	
Parameter [a]	Coef	z	Coef	z	Coef	z
α_0	2.884 ***	14.830	3.082 ***	9.390	2.279 ***	10.260
β_L	0.383 ***	5.520	0.687 ***	9.420	0.773 ***	12.050
β_S	0.691 ***	13.940	0.166	1.630	0.309 ***	4.510
β_d	-0.306 ***	-3.660	-0.321 ***	-5.590	-0.201 ***	-5.320
β_l	0.657 ***	13.869	0.544 ***	9.958	0.432 ***	10.141
β_k	-0.003	-0.100	0.174 ***	4.140	0.113 ***	3.270
β_m	0.325 ***	13.200	0.285 ***	10.680	0.400 ***	12.300
β_f	0.021	0.590	-0.002	-0.050	0.055 **	2.030
β_t	-0.072 ***	-3.050	0.023	0.540	-0.030	-0.650
δ_{LL}	0.217 ***	13.260	0.151 ***	8.590	0.168 ***	12.230
δ_{SS}	0.194 ***	10.240	0.130 ***	4.660	0.161 ***	6.690
δ_{dd}	0.115 **	2.110	0.003	0.130	0.035 **	2.450
δ_{ll}	0.099 ***	5.189	0.059 ***	4.182	0.078 ***	5.265
δ_{kk}	0.064 ***	5.620	0.029 **	2.010	0.059 ***	5.680
δ_{mm}	0.188 ***	67.920	0.156 ***	40.170	0.199 ***	30.450
δ_{ff}	0.116 ***	9.390	0.085 ***	6.620	0.066 ***	9.210
δ_{tt}	0.006	1.570	-0.007	-1.300	-0.006	-0.860
δ_{lL}	-0.092 ***	-5.595	0.031 **	2.034	-0.011	-0.968
δ_{kL}	0.000	-0.020	-0.041 ***	-3.600	0.016 **	1.970
δ_{mL}	-0.031 ***	-4.450	-0.020 ***	-3.230	-0.017 *	-1.940
δ_{fL}	0.124 ***	9.320	0.030 **	2.320	0.012	1.640
δ_{lS}	-0.003	-0.215	-0.033 **	-2.484	-0.004	-0.400
δ_{kS}	-0.019 **	-2.340	-0.029 ***	-2.730	-0.016 **	-2.140
δ_{mS}	-0.021 ***	-3.650	0.008	1.210	0.005	0.700
δ_{fS}	0.042 ***	4.370	0.054 ***	4.370	0.015 **	2.160
δ_{ld}	0.058 **	2.431	-0.044 ***	-2.768	0.014	1.350
δ_{kd}	0.019	1.090	0.053 ***	4.120	-0.030 ***	-4.120
δ_{md}	0.069 ***	7.780	0.031 ***	5.220	0.038 ***	4.910
δ_{fd}	-0.146 ***	-7.380	-0.040 ***	-3.200	-0.022 ***	-3.310
δ_{lk}	0.005	0.410	0.025 **	2.570	0.012	1.319
δ_{lm}	-0.083 ***	-19.458	-0.080 ***	-21.340	0.076 ***	10.602
δ_{lf}	-0.022 *	-1.667	-0.004	-0.395	-0.014 *	-1.765
δ_{km}	-0.040 ***	-11.590	-0.025 ***	-4.730	-0.072 ***	-11.010
δ_{kf}	-0.029 ***	-3.330	-0.029 ***	-3.000	0.001	0.110
δ_{mf}	-0.066 ***	-18.080	-0.051 ***	-13.990	-0.052 ***	-11.860
δ_{Lt}	0.032 ***	4.190	-0.011	-1.500	0.000	-0.070
δ_{St}	-0.002	-0.280	0.015 *	1.840	0.000	0.000
δ_{dt}	-0.028 ***	-4.790	-0.004	-0.800	0.011 *	1.950
δ_{lt}	-0.013 ***	-3.002	0.003	0.737	-0.009 **	-2.402
δ_{kt}	-0.003	-1.230	0.001	0.220	0.004	1.220
δ_{mt}	0.006 **	2.460	0.001	0.330	0.000	0.060
δ_{ft}	0.010 ***	2.940	-0.005	-1.180	0.005 *	1.900
δ_{dL}	-0.036	-1.250	-0.015	-1.040	-0.044 ***	-4.350
δ_{LS}	-0.187 ***	-11.790	-0.137 ***	-6.520	-0.185 ***	-11.830
δ_{Sd}	-0.030	-1.450	0.044 ***	3.200	0.045 ***	4.970
θ_L	0.037 ***	5.710	0.036 ***	4.170	0.046 ***	3.540
θ_d	-0.033 ***	-6.050	-0.042 ***	-7.270	-0.064 ***	-6.030
No.obs.	87		177		212	

***, **, * indicates significance at the 1%, 5% and 10% level, respectively. [a] l=labour, k=capital, m=materials, f=funds, L=loans, S=securities, d=deposits, t=time trend.

levels of 10% or less.[32] The null hypothesis that the parameters are the same across subperiods was rejected by means of a Likelihood Ratio (LR) test. Additionally, a LR test rejected the null hypothesis that the sets of coefficients for the different size groups are the same.[33]

In order to explore the cost function properties, several regularity conditions were tested in addition to the linear homogeneity in input prices and symmetry, which were imposed *a priori* during estimation. Monotonicity in output and input prices was satisfied since marginal costs and the fitted input cost shares were positive at most data points in the sample. Concavity in input prices was also satisfied for the range of observations because the matrices computed using the fitted input cost share equations and the relevant parameter estimates were negative semidefinite.[34] The requirements with respect to deposits were also satisfied since the shadow price of deposits was positive at all data points[35] and the second partial derivative of costs with respect to deposits was positive, thus conforming with the convexity condition. Finally, the estimated costs were positive for all values of output satisfying the non-negativity condition, and continuity followed from the flexible functional form employed.

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[32] The model was also estimated with regional dummy variables. However, the hypothesis of differences across regions was rejected. The estimates presented in Tables 3.3a and 3.3b were obtained without these dummy variables.

[33] The LR test was performed by incorporating one (two) dummy variables for the subperiod 1993-1996 (medium- and small-sized banks) into the pooled estimation and allowing every parameter to vary across the periods 1993-1996 and 1997-2000 (large, medium- and small-sized banks). This unrestricted model was then compared to the restricted model, which imposed common coefficients for all subperiods (subgroups). The LR statistic was 137.24 (288.82) and the critical value was 57.34 (112.33) at the 1% confidence level.

[34] For the subsample of large banks, the concavity condition was not satisfied. For the sample of small banks the Hessian matrix presented one wrong sign.

[35] This result also suggests that deposits should be modelled as inputs in the Argentine banking industry. As Hughes et. al. (2000) pointed out, if deposits are outputs more variable inputs and, hence, variable expenditure will be required to produce y and the increased x_d, which implies that $\partial c/\partial x_d>0$. If deposits are inputs, an increase in x_d allows a reduction in the variable expenditure needed to produce y, which implies that $\partial c/\partial x_d<0$. In this case, the shadow value of deposits is positive, that is $\partial c/\partial x_d<0$ implying that deposits function as inputs in production.

Additional restrictions were then imposed on the parameters of the translog cost function in order to investigate the production structure of the industry. Five hypotheses were tested: (i) homotheticity (the cost function can be written as a separable function in output, factor prices/ levels and time, $\delta_{jm}=0$, $\delta_{md}=0$ and $\delta_{mt}=0$), (ii) homogeneity with respect to output (the elasticity of cost with respect to output is constant, $\delta_{jm}=0$, $\delta_{md}=0$, $\delta_{mt}=0$ and $\delta_{mn}=0$), (iii) unitary elasticity of substitution between inputs ($\delta_{jk}=0$), (iv) generalised Cobb-Douglas (unitary elasticity of substitution together with homogeneity, $\delta_{jm}=0$ $\delta_{md}=0$, $\delta_{mt}=0$ $\delta_{mn}=0$ and $\delta_{jk}=0$) and (v) no technical change ($\delta_{jt}=0$, $\delta_{mt}=0$ $\delta_{dt}=0$, $\delta_{t}=0$ and $\delta_{tt}=0$). Table 3.4 displays the Likelihood Ratio statistics for these structural tests. The results indicate that each restricted functional form of the production technology is strongly rejected at the 5% significance level. However, the null hypothesis of no technical change over the first half of the sample period cannot be rejected. These results suggest that the use of the translog flexible functional form to estimate the cost structure appears to be appropriate.

Table 3.4

Structural tests of the cost function

Restrictions	Likelihood Ratio test statistic: Overall			Subsamples			df	Chi-square[a]
	93-00	93-96	97-00	Large	Medium	Small		
(i) Homotheticity $\delta_{jm}=0, \delta_{md}=0, \delta_{mt}=0$	244.9	120.3	126.1	117.7	73.4	68.8	9	16.9
(ii) Homogeneity in output $\delta_{jm}=0, \delta_{md}=0, \delta_{mt}=0, \delta_{mn}=0$	862.6	444.2	524.5	316.7	168.3	323.2	13	22.4
(iii) Unitary elasticity of substitution $\delta_{jk}=0$	674.8	277.8	543.6	278.2	263.4	307.1	6	12.6
(iv) Generalised Cobb-Douglas $\delta_{jm}=0,\delta_{md}=0,\delta_{mt}=0,\delta_{mn}=0,\delta_{jk}=0$	1,245	644.3	840.0	472.4	411.3	543.7	19	30.1
(v) No technical change $\delta_{jt}=0,\delta_{mt}=0,\delta_{dt}=0,\delta_{t}=0,\delta_{tt}=0$	56.3	9.4	24.0	47.5	15.8	18.9	8	15.5

[a] Critical values at 5% level

Although most of the parameters are not readily interpretable individually, some relevant implications about market power are evident from the pricing equation estimates presented in the last rows of Tables 3.3a and 3.3b. These results suggest significant departures from marginal cost (benefit) pricing. In the loans market, the parameter θ_L (positive and highly significant) indicates that banks seem to price above marginal cost, implying a possible exploitation of oligopoly power in this market. In the market for deposits, the coefficient θ_d, which is also statistically significant but negative, suggests that banks seem to pay more than the full value of their marginal benefit for increases in deposits, implying no market power exertion in this market. More direct assessment of market power requires evaluating the τ estimates. Table 3.5 presents market power and cost economies indicators for the average bank. These measures were calculated by using the estimated cost functions in Tables 3.3a and 3.3b, predicted costs and observed output and input prices. The results presented in Panel A are derived from the parameter estimates for the overall sample and those from Panel B using parameter values for the subsamples of large, medium- and small-sized banks.

Table 3.5

Market power and cost elasticities measures

	Loans τ_L	Deposits τ_d	Cost-output elasticity ε_{cy}		Cost-time elasticity ε_{ct}	
A. Estimates derived using parameter values for overall sample of banks over periods 1993-2000, 1993-1996 and 1997-2000						
1993 - 2000	0.258	-0.615	0.826	(0.055)	-0.017	(0.015)
1993 – 1996	0.142	-0.516	0.850	(0.057)	0.014	(0.028)
1997 – 2000	0.302	-0.691	0.803	(0.030)	-0.019	(0.029)
B. Estimates derived using parameter values for subsamples of large, medium- and small-sized banks						
Large banks	0.271	-0.545	0.861	(0.046)	-0.032	(0.010)
Medium banks	0.212	-0.598	0.799	(0.056)	-0.014	(0.013)
Small banks	0.199	-0.636	0.774	(0.042)	-0.006	(0.017)

Standard deviation in parenthesis.

In the loans market, the estimated value of τ_L for the average bank indicates that banks are pricing 25.8% above marginal cost, moreover, the average margin increased from 14.2 to 30.2% over the sample period. The margins also display some interesting patterns across subgroups of banks. The estimated values of τ_L for large, medium- and small-sized banks are 27.1, 21.2 and 19.9% respectively, which suggests that large banks seem to exercise a higher degree of market power pricing than smaller financial institutions. Several characteristics of large banks such as financial strength, multimarket links, diversified operations and economies of scale could allow them to set prices above marginal costs.

For the deposits market, the average τ_d measure indicates that the average bank is paying 61.5% above the marginal shadow value of deposits. The results also show that this margin increased over the sample period from 51.6 to 69.1%. When analysed across subgroups of banks, the estimated value of τ_d indicates that small banks' interest rate on deposits is 63.6% above the marginal shadow value of deposits while larger banks pay just 54.5% above it. These results seem to suggest that small-sized banks, which may have limited access to other sources of funds, have to pay a higher margin in order to attract deposits while large financial institutions, probably having access to international lines of credit, for example, pay a lower margin for increases in deposits. In line with these findings, Carbo et al. (2001) using a different methodology find that saving banks in Spain also pay a margin above the marginal value of deposits. In contrast, Ribon and Yosha (1999) conclude that banks in the Israeli banking sector exercise market power in both the markets for loans and deposits.

The interpretation of these indicators of market power is reinforced with the consideration of the associated evidence of cost economy measures presented in Table 3.5. The cost-output elasticity for each bank was obtained using (3.9) and then averaged out to obtain the average cost elasticity of the appropriate period or subsample. The estimated value for the overall sample $\varepsilon_{cy} = 0.826$ suggests the presence of significant economies of scale which have increased over the sample period since ε_{cy} declined from 0.850 to 0.803 over the 1993-2000 period. Probably this is due to the fact that while on the one side banks are exploiting the economies of scale through the consolidation process, on the other, regulatory changes and advances in technology are increasing the optimal scale leading to an increase in scale economies over time. Since banks do not appear to exercise market power in the market for deposits, this is the most appropriate measure for cost analysis.

The results also show that scale economies diminish as firm size increases, however, the estimated ε_{cy} reveals the presence of significant increasing returns to scale for all size bands suggesting that the average cost curve is not U-shaped. However, there may be a particular level of output, outside the observed range in the sample, above which banks would operate under constant or decreasing returns to scale. In fact, for the U.S. banking industry Berger and Mester (1997) find increasing returns to scale for all size classes up through $25 billion (assets), with decreasing returns thereafter. In addition, Cavallo and Rossi (2001) for a sample of six European countries find constant returns to scale for large banks with average assets of $92 billion. In Argentina, the largest banks have less than $15 billion in assets, which may suggest that there still exist economies that can be exploited by an increase in the size of banks.

Table 3.5 also presents the estimates of time elasticities aimed at capturing the contribution of technical change in reducing average banking costs. This cost-time elasticity was computed for each bank using (3.10) and then averaged out to obtain the average elasticity of the appropriate period or subsample. The estimated value for the overall period $\varepsilon_{ct} = -0.017$ indicates that, costs were reduced by approximately 1.7% per year as a consequence of technical change. When analysed over time, the results suggest that cost savings occurred in the industry during the second half of the period, a result that may be connected to the incorporation of new technology, such as ATM or information systems technologies during the 1990s. When analysed over subgroups, the results appear to indicate that the effect of technical change on average costs has been significant for large and medium-sized banks, while it has been almost negligible for the group of smaller banks. These results may be due to cost increasing effects that have cancelled out technical innovations effects since technological change, defined as a trend, may capture not only production innovations but also the impact of other factors such as changes in organisational structure and processes on bank costs.

The demand for loans and supply of deposits were estimated by Two Stage least Squares (2SLS), because of the endogeneity of p_L and w_d, using industry-level data.[36] The estimated functions are:

$$\text{(3.12)}\quad \ln Y_L = \underset{(0.30)}{3.012} - \underset{(-2.48)}{1.538}\ \ln p_L + \underset{(1.71)}{0.524}\ \ln M + \underset{(3.43)}{0.591}\ \ln Z \qquad DW= 1.52$$

$$\text{(3.13)}\quad \ln X_d = \underset{(-3.49)}{-34.967} + \underset{(2.00)}{1.471}\ \ln w_d + \underset{(4.40)}{3.996}\ \ln M \qquad DW= 1.71$$

[36] The instruments used include all exogenous variables and the lagged values of Y_L, X_d, p_L and w_d.

where t statistics are indicated in parenthesis. All the coefficients have the expected signs and are statistically different from zero at significance levels of 10% or less (except the constant term in the demand equation). Based on the Durbin-Watson statistic the hypothesis of non-correlated disturbance terms cannot be rejected. The price elasticity of demand for loans equals $\eta_p = 1.54$, while the deposits supply price elasticity equals $\varepsilon_w = 1.47$ suggesting that borrowers and depositors are sensitive to variations in interest rates. Vesala (1995) finds similar estimates for the interest rate-elasticity of demand for loans in the Finnish banking sector. In contrast, Ribon and Yosha (1999) find lower estimates for both the elasticities of demand for loans and supply of deposits in the Israeli banking industry. However, they also find a small difference in the elasticities as in this case.

3.5.1 Welfare Analysis

The change in social welfare associated to the consolidation of the banking sector is evaluated in a partial equilibrium framework by adding up the changes in aggregate consumer and producer surplus. The aggregate consumer surplus is measured by the compensating variation defined as $CV(p)=e(p^1,v^0)-e(p^0,v^0)$, where $e(p,v)$ is the expenditure function, $v(p,m)$ represents the indirect utility function, p is the price vector and m represents monetary income. When prices decline $p^1<p^0$, CV is the negative of the area to the left of the Hicksian demand curve for base utility level v^0 between p^1 and p^0, and when $p^1<p^0$, CV is positive and simply equal to that area, that is, $CV(p)=\int_{p^0}^{p^1} x^H(p,v^0)dp$ where x^H is the Hicksian demand (Jehle and Reny, 2001).[37]

[37] Exact measures of consumer surplus are computable at least theoretically from the knowledge of the ordinary demand curve (Hausman, 1981). From Roy's identity, the indirect utility function, the expenditure function and the Hicksian demand function can be recovered. However, this method can be extremely difficult to implement since it involves solving a differential equation that depends on the

Breslaw and Smith (1995) show that when prices change from p^0 to p^1, expanding the expenditure function in a Taylor series about (p^0, v^0) and disregarding other terms than the quadratic yields:

$$(3.14)\quad CV(p) = x^H(p^0, v^0)\cdot(p^1 - p^0) + 0.5\frac{\partial x^H(p^0, v^0)}{\partial p}(p^1 - p^0)^2$$

since at the initial equilibrium $x^H(p^0,v^0)=x^M(p,m)$, the derivative of the Hicksian demand can be obtained from the Slutsky equation as $\partial x^H(p^0,v^0)/\partial p=[\partial x^M(p^0,m^0)/\partial p] +x^H\cdot[\partial x^M(p^0,m^0)/\partial m]$ where x^M is the Marshallian demand function. To compute the compensating variation they developed a numerical algorithm that involves splitting up the price change into smaller intervals, evaluating the CV for each small change using (3.14) and finally adding together the CV computed at each step. This numerical algorithm can be easily implemented and is valid for any demand function.

The aggregate producer surplus or aggregate profit $\Pi(p)$ equals the area between the market price and the industry marginal cost, and can be measured as follows:

$$(3.15)\quad \Pi(p) = \int_0^{x(p^*)}[p^* - c'(x)]\,dx$$

where c'(x) represents marginal cost. This producer surplus can be estimated as the difference between total revenue and total cost for the equilibrium level of output. Finally, the change in total surplus dW(p) can be measured as sum of CV(p) and $d\Pi(p)$.

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ordinary demand function, and this is analytically possible only in simple cases. An alternative methodology to approximate welfare measures is to use numerical methods. Vartia (1983) proposed a

The compensating variation over the sample period is computed applying Breslaw and Smith's algorithm with 300 steps using the parameters of the demand function estimated above while the change in profits is estimated as the difference between total revenue and total cost for the average bank in the sample. Table 3.6 presents the estimated compensating variation, change in profits and change in economic welfare over the sample period. The results show an increase in the consumers' surplus of $2.2 billion and in banks' profits of $5.1 billion implying an overall increase in economic welfare of $7.2 billion between 1993-1996 and 1997-2000.[38] These findings suggest that the expansion in the level of activity led to cost reductions as a result of cost economies, which might have counteracted the effect of increased market power.

Table 3.6

Welfare effects of market power and cost economies

Period	Lerner Index (%)	Interest rate loans (%)	Average cost ($)	CV[a]	d Π[a]	d W[a]
1993 - 1996	14.2	21.8	21.0			
1997 - 2000	30.2	17.2	12.2	2,188.1	5,057.3	7,245.4
1997 – 2000 (output at 1993 level)	23.1	22.5	17.5	-247.7	2,648.5	2,400.8

[a] Positive (negative) numbers represent welfare gains (losses) in million $.

numerical algorithm to compute the compensated income from any ordinary demand function. Breslaw and Smith (1995) improved on Vartia's method and proposed a quicker algorithm.

[38] Since the average number of loan and deposit accounts over 1993-2000 equal 7.1 and 12.9 million, respectively, the compensating variation per account equals $ 109.4. This figure can be compared with the average interest per account gained or lost by borrowers and depositors over the sample period as a result of changes in interest rates. The amount of the average loan is obtained by dividing total loans by the number of loan accounts in each year and then averaging over 1993-2000. The average interest rate on loans in subperiods 1993-1996 and 1997-2000 is then multiplied by the amount of the average loan to obtain the average interest paid by borrowers. Since the interest rate on loans fell over the sample period, borrowers benefited by paying on average $253 less per loan account between the subperiods considered. The average interest earned by depositors in subperiods 1993-1996 and 1997-2000 is obtained in a similar manner. The calculations suggest that depositors lost on average $126 per account as a result of a reduction in the interest rate paid on deposits. Adding the gain from loan accounts ($253) and subtracting

The effects of scale economies and market power on consumer's surplus and bank's profits are further analysed under an alternative scenario. The importance of growth in output in combination with increasing returns to scale is analysed by keeping output constant at the 1993-1996 levels when calculating interest rates and average costs for 1997-2000. Table 3.6 shows that the interest rate on loans and average costs for the 1997-2000 subperiod under this alternative scenario are higher than those obtained without keeping output levels constant. The compensating variation and change in profits over the sample period are then calculated using these values. Table 3.6 shows that the consumers' surplus is -$0.2 billion, the variation in banks' profits is $2.6 billion and total surplus equals $2.4 billion. The difference in economic welfare between the two scenarios ($7.2 against $2.4 billion) suggests that the change in total surplus over the sample period seem to have been driven by cost economies, which appear to have more than counteracted the effect of increased market power.

3.6 Conclusions

This study estimates a cost-function based model incorporating output- and input-market pricing decisions to evaluate the market and cost structure of the Argentine banking industry during the 1990s. The model is based on a flexible translog cost function that allows a detail representation of technological aspects such as scale economies and technical change, and also pricing equations for loan- and deposit-markets that allows measurement of market power in these markets. The model is estimated using bank-level data for Argentine stock retail banks over the period 1993-2000. This period is characterised by a notable increase in activity level as measured by

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the loss from deposit accounts ($126) provides a net gain of $127 per account between 1993-1996 and 1997-2000. This number roughly approximates the $109.4 compensating variation per account.

the volume of loans and deposits, but also by a significant increase in the degree of market concentration.

The results provide evidence of market power pricing in the loans markets, which increased during the 1990s possibly due to the consolidation process. In addition, the findings seem to suggest that larger banks exert a higher degree of market power pricing than small- and medium-sized financial institutions, which may be explained by the characteristics of large organisations such as financial strength, multimarket links, diversified operations and economies of scale, which could allow them to set prices above marginal costs. In contrast, the results indicate no market power pricing in the market for deposits, which may be explained by the fact that bank lending is information intensive, and requires relationship building between banks and customers, whereas bank deposits are a standard service. Moreover, these findings suggest that banks appear to pay interest rates on deposits in excess of their marginal shadow value of deposits. Additionally, small-sized banks seem to pay a higher margin over their marginal shadow value of deposits, a result possibly associated to their limited access to other sources of funds.

These indications of market power pricing seem to be related to cost economies. In fact, the measures of cost elasticity suggest that even relatively large banks operate with significant increasing returns to scale. This evidence indicates that there still exist economies that can be exploited by an increase in the size of banks and it points out that the consolidation process may proceed further. In addition, the results suggest that technological advances introduced during the 1990s contributed to lower the cost of bank production for large and medium-sized banks. However, the findings do not show any significant effect of technological change on average costs for small-sized financial institutions.

The implications of the cost and market structure patterns on economic welfare, evaluated in a partial equilibrium framework, suggest that both consumers and banks benefited over the sample period. In fact, the results indicate that consumers' surplus and banks' profits increased over the 1990s, possibly due to the expansion of banking activity in combination with the increasing returns to scale and the technological advances, which may have counteracted the effect of market power in the market for loans. These findings imply that policies forcing downsizing in industries characterised by high concentration levels may be misdirected if consolidation and resulting concentration are motivated by cost economies. Obviously, such action could limit the potential to lower costs in the industry, and thus ultimately reduce the product price for consumers.

Chapter 4

Ownership and Efficiency

4.1 Introduction

Post-deregulation developments in the Argentine banking industry led to changes in its ownership structure. During the 1990s several provincial banks were privatised, the number of mutual banks significantly decreased as a result of mergers and conversions to stock banks, and foreign financial institutions entered the domestic market primarily through acquisitions of domestic banks. A consequence of these developments was a switch from a sector dominated by domestic-owned banks, with similar participation of public and private financial institutions, to a liberalised system where foreign banks play a major role. At the end of the decade, public banks controlled just one third of the assets in the banking sector, having lost almost 20 percent to private banks, while foreign-owned banks controlled more than half of the assets, against less than one fifth by the early 1990s.

These developments were the result of banking sector reforms implemented under the assumption that a more competitive framework, with a major participation of private domestic- and foreign-owned banks, is more suitable to increase the efficiency of the banking system. On the one hand, the entry of foreign banks could improve the competitive environment and also have positive spillover effects on domestic banks derived from a (potential) better technology and expertise in offering specialised banking products. This could place domestic banks under peer pressure to improve operational efficiency. On the other hand, the privatisation of banks could also contribute to enhance the efficiency of the banking system by improving staff productivity or rationalising the branch network. These efficiency improvements could bring about benefits to consumers through reductions in prices and expansions in the amount and quality of services.

The literature has offered a diversity of theoretical arguments and mixed empirical evidence on the relationship between ownership and efficiency, though empirical studies have mainly concentrated on non-financial firms. Only few works have analysed ownership-efficiency in the banking industry, and the results have been diverse. This study contributes to this literature in different ways. Firstly, this study analyses efficiency characteristics of stock, mutual and public-owned banks. As such, it differs from previous works that mainly concentrate on efficiency differences between mutual and stock financial institutions and from the few studies that analyse private and public banks. Secondly, it also differs from past works in that it explores the relative efficiency of foreign- and domestic-owned banks in a developing country.[39] Consequently, this is the first work to consider efficiency differences among four ownership types. Thirdly, it is also distinct from past studies because it examines efficiency differences in a developing country while most of the empirical evidence explores the banking industry in developed economies, especially in the U.S..

This chapter uses data from the Argentine banking industry to estimate economic efficiency, scale economies and technical change using parametric techniques. It estimates cost and profit frontiers using the stochastic frontier approach - with different

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[39] It has been documented that the increasing presence of foreign banks in developing economies increases efficiency and reduces profitability of domestic-owned banks though the opposite occurs in developed countries (Claessens et al, 1999).

assumptions about the distribution of inefficiencies - and the distribution free approach on a panel data set over the 1993-2000 period. The evidence indicates that within the domestic-owned banking sector, stock banks seem to be more cost efficient than mutual and public-owned banks, that all banks operate under increasing returns to scale but that only stock banks benefited from technical progress. The findings also imply that domestic-owned stock banks appear to be as efficient as foreign-owned banks. The results also indicate an increase in efficiency for all ownership types over the period, however, the largest improvement in performance appear to be that of mutual and public-owned banks.

The rest of the chapter is organised as follows. Section 4.2 consists of two subsections. The first reviews theoretical studies on the relationship between ownership and efficiency while the second examines empirical studies related to efficiency differences in the banking industry. Section 4.3 presents the analytical foundations of efficiency measurement. Section 4.4 outlines the methodology employed, while Section 4.5 describes the data sources and the definition of variables and provides a brief overview of the data set. Section 4.6 discusses the results. The last section summarises and presents the conclusions.

4.2 Literature Review

4.2.1 Theoretical Studies

The economic literature provides several arguments to explain efficiency differences between public and private ownership. The dominant model considering the effect of ownership on performance uses the agency and public choice theories to stress the importance of management being constrained by market discipline. According to these theories private firms should outperform public firms. The *agency theory* argues that managers (the agent) in both types of firms are assumed to pursue their own interests rather than that of the firm or its owners (the principal). In private firms, however, this divergence is reduced through the following mechanisms: the existence of a market for ownership rights, which enables the owners to sell if they are not satisfied with managerial performance – this is the focus of the *property rights theory*; the threat of takeover and the labour market for managers, which may discourage managers from pursuing their personal agenda (Alchian, 1965; Manne, 1965; De Alessi, 1980; Fama, 1980). In the case of public firms all of these mechanisms are virtually absent.[40]

The *public choice theory* points to specific inefficiency factors that arise from government ownership irrespective of market conditions. According to this theory, government officials tend to pursue their own interests (or the interests of pressure groups), rather than the public interest. Government officials are inclined to impose goals on public firms that could lead them to gain votes, but achievement of such goals could be in conflict with efficiency. Moreover, government's attempts to accommodate diverse interest groups leads to multiple and frequently changing objectives in these firms, which intensify agency problems since managerial decisions' outcomes become more difficult to monitor (Estrin and Perotin, 1991).[41]

Several theoretical contributions raise doubts over the predictions of the property rights and public choice arguments. Grossman and Hart (1980) argue that the takeover threat

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[40] The managerial labour market may not be absent. Two separate markets can be observed for private- and public-owned firms' managers, respectively. However, the latter is generally dominated by political decisions, making it useless as a threat to managerial discretion. Cragg and Dyck (1997a,b,1998) provide empirical evidence about this fact.

[41] Other approaches, based on the agency and public choice theories, focus on the differences between private and public firms in terms of organisational characteristics (Parker, 1995).

in private firms may be empty due to the existence of free rider problems while Mueller (1989) and Wintrobe (1987) suggest that the voting market might operate as a substitute for the market for corporate control in disciplining public firms. Caves and Christensen (1980), Borcherding et al. (1982) and Millward (1988) argue that competition might have a greater impact on performance than ownership. More recently, Martin (1993) shows that in some cases more competition might increase managerial slack.[42] In addition, Willner (1999) suggests that the nature of the managers' motivation may sometimes have a greater impact on efficiency than the ownership or objectives of an organisation.

The arguments presented above refer to efficiency differences between public and private firms. In the case of private firms, the literature offers alternative arguments to explain differences in efficiency between mutual and stock firms. The dominant model also uses *agency theory* to explain these differences.[43] This theory does not provide, however, sufficient arguments in favour of an ownership type. Mayers and Smith (1981) argue that firms with alternative organisational forms are sorted into market segments where they have comparative advantages in dealing with various types of principal-agent conflicts. According to this view, stock firms are expected to be more efficient than mutual firms in controlling agency problems between owners and manager because stock ownership provides more effective mechanisms for controlling management, either through the market for corporate control or the managerial labour

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[42] He shows that if demand is linear, an increase in the number of firms in an oligopoly will actually increase managerial slack.

[43] In a mutual organisation the customers are the owners with very limited control over management. In stock institutions on the other hand, there is a separation between owners and customers, and managers are periodically monitored by owners (stockholder)

market (Nicols, 1967; O'Hara, 1981).[44] However, mutual firms are expected to be more effective in controlling owner-customer conflicts because the ownership and customer functions are merged in the mutual firm (Mayers and Smith, 1988).

The literature also provides several arguments to explain the relative efficiency of domestic- and foreign-owned firms. Several authors argue that multinational enterprises (MNEs) operating abroad face higher costs relative to domestic firms. These costs may arise from several sources. Zaheer and Mosakowski (1997) group these costs as spatial, unfamiliarity and home and host country environment costs. Spatial costs refer to transportation costs and coordination over distance; unfamiliarity costs consider lack of knowledge of host environments or lack of information networks and political influence; host country environment costs refer to the differential government treatment of domestic versus foreign firms or nationalistic buyers' reluctance to buy from foreign firms; and home country environment costs relate to regulatory restrictions imposed by a firm's home government.

These arguments do not provide though support in favour of an ownership type. Counter arguments suggest that in order to overcome these additional costs and compete successfully against local firms, MNEs need to provide their overseas subunits with some firm-specific advantages, often in the form of organisational or managerial capabilities (Buckley and Casson, 1976; Caves, 1982; Hennart, 1982). These arguments suggest that multinationals' subunits try to overcome the higher costs of operating abroad by importing organisational or managerial capabilities from their parent firms,

[44] Fama and Jensen (1983) argue that customers of mutuals have other form of controlling management i.e. by withdrawing their funds from the control of management, which is a form of partial takeover or liquidation.

particularly if the subunits are competing in an undifferentiated product market in which other sources of imported competitive advantage, such as a brand name, a superior technology or factor-cost advantages, have little role to play (Zaheer, 1995).

The preceding analysis suggests that there is no simple relationship between ownership and efficiency. The theoretical arguments do not provide conclusive predictions: it is not obvious that stock firms are more efficient than mutual or public-owned organisations or that domestic firms outperform foreign-owned institutions. On the one hand, the property rights theory suggests that private firms should be more efficient than public firms, as private ownership provides more effective mechanisms for controlling management. This argument is also valid for stock as compared to mutual firms. On the other hand, other theoretical contributions suggest that there is no simple relationship between ownership and efficiency. These works challenge the effective functioning of the market for corporate control for private firms or the absence of this market for public firms and point to the effectiveness of mutual firms in controlling customer-owner problems. These conflicting arguments suggest empirical analyses could contribute to shed some light on the direction of this ownership-efficiency relationship.

4.2.2 Empirical Studies

Empirical evidence on efficiency differences between private- and public-owned firms largely concentrates on non-financial firms.[45] The studies that examine the relative

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[45] The results of these studies are mixed. On the one hand, Millward (1982), Millward and Parker (1983) and Martin and Parker (1997) conclude that there is no evidence to suggest that public firms are less efficient than private firms. On the other hand, Borcherding et al (1982) conclude that the evidence seems to indicate that private firms are more efficient than their public counterparts, but that these

efficiency of public-owned and private financial institutions are more recent. Table 4.1 summarises these empirical studies. Tulkens (1993) uses non-parametric techniques to analyse the relative performance of branches of two large banks in Belgium (one private and one public). He finds the public bank's branches to be relatively more efficient than those of the private bank. Zaim (1995) uses Data Envelopment Analysis to investigate the efficiency differences among banks in Turkey. He finds that public banks are more efficient than their private counterparts. Bhattacharyya et al. (1997) also use Data Envelopment Analysis to examine the relative performance of banks in India. They find public-owned banks appear to be more efficient than private-owned banks. Burdisso et al. (1998) use parametric techniques and report that private banks in Argentina seem to be more cost efficient than public financial institutions. Altunbas et al. (2001) using data for Germany find that public banks have slight cost and profit advantages over stock financial institutions.

The results of studies analysing the relative performance of mutual and stock financial institutions are not conclusive. Verbrugge and Goldstein (1981) explore the cost structure of saving and loan associations (S&Ls) in the U.S. concluding that mutual organisations exhibit higher costs than stock institutions while Blair and Placone (1988) find no differences between stock and mutual S&Ls. More recent studies use cost frontier methodologies and also reach mixed conclusions. Mester (1993) finds mutual S&Ls in the U.S. to be more cost efficient than stock institutions while Cebenoyan et

differences are related to differences in competition. In contrast, Vining & Boardman (1992) argue that private firms outperform public firms even after controlling for competition.

Table 4.1

Empirical studies of efficiency differences across ownership types

Author	Method[a]	Sample[b]	Findings [c]
		Private vs. public ownership	
Tulkens (1993)	FDH	Branches of 2 banks in Belgium (one private and one public)	Public bank's branches have higher efficiency than those of the private bank (0.97 and 0.93).
Zaim (1995)	DEA	Sample of banks in Turkey (public, private and foreign)	Public banks have higher efficiency than private and foreign banks (0.93, 0.77 and 0.92). Foreign banks have higher efficiency than private banks.
Bhattacharyya et al. (1997)	DEA	Sample of banks in India (28 public, 23 private and 23 foreign), 1986-1991	Public banks have higher efficiency than private and foreign banks (0.86, 0.75 and 0.79). Foreign banks have slightly higher efficiency than private banks.
Burdisso et al. (1998)	DFA	71 banks in Argentina (public and private), 1991-1996	Public banks have lower cost efficiency than private banks (0.28 and 0.62).
Altunbas et al. (2001)	SFA and DFA	Sample of banks in Germany (public, stock and mutual), 1989-1996	Public and mutual banks are more cost and profit efficient than stock banks (0.82, 0.83 and 0.74).
		Stock vs. mutual ownership	
Mester (1993)	SFA	1,015 S&Ls in the U.S., 1991	Mutual S&Ls have higher cost efficiency than stock S&Ls (0.92 and 0.87).
Cebenoyan et al. (1993)	SFA	S&Ls in the fourth district U.S., 1988	Mutual S&Ls are as efficient as stock S&Ls (0.87 and 0.86).
Lozano-Vivas (2002)	SFA	Sample of commercial (stock) and savings (mutual) banks in Spain, 1986-1995	Mutual banks have lower cost efficiency than stock banks (0.87 and 0.96)
		Domestic vs. foreign ownership	
DeYoung and Nolle (1996)	SFA	62 foreign and 240 domestic banks in the U.S., 1985-1990	Domestic banks have higher profit efficiency than foreign banks (0.73 and 0.56).
Hasan and Hunter (1996)	SFA and TFA	Sample of Japanese and domestic banks in the U.S.	Domestic banks have higher cost efficiency than foreign banks (0.82 and 0.79).
Mahajan et al. (1996)	TFA	Sample of multinational and domestic banks in the U.S., 1987-1990	Domestic banks have higher cost efficiency than foreign banks (0.88 and 0.77).
Elyasiani and Mehdian (1997)	DEA	Sample of foreign and domestic banks in the U.S., 1988	Domestic banks are as efficient as foreign banks.
Berger et al. (2001)	DFA	2,123 U.S. banks, 1993-1998. 215 banks in France, 206 banks in Germany, 76 banks in Spain, 124 banks in the U.K., 1992-1997	Domestic banks have lower cost and profit efficiency than foreign banks. In the U.S. domestic banks have higher cost and profit efficiency than foreign banks.

[a]SFA: Stochastic Frontier Approach; DFA: Distribution Free Approach; TFA: Thick Frontier Approach; DEA: Data Envelopment Analysis; FDH: Free Disposal Hull. [b] S&Ls: Savings and loans. [c] Average efficiency in parenthesis.

al. (1993) find no difference.[46] Altunbas et al. (2001) find that mutual banks in Germany have cost and profit advantages over stock financial institutions. Finally, Hasan and Lozano-Vivas (2002) report Spanish savings banks (mutual institutions) to be more inefficient than commercial banks.

Studies analysing efficiency differences associated with foreign and domestic ownership provide mixed conclusions. DeYoung and Nolle (1996), Mahajan et al. (1996) and Hasan and Hunter (1996) find that foreign-owned banks in the U.S. are significantly less efficient than domestic banks, while Elyasiani and Mehdian (1997) find that, on average, foreign-owned banks are as efficient as U.S.-owned banks. Studies for other countries also provide mixed evidence. Bhattacharyya et al. (1997) find foreign-owned banks in India to be more efficient than private-owned domestic banks (but government-owned banks to be more efficient than both of them). Zaim (1995) finds similar results for banks in Turkey. Berger et al. (2001) report that foreign-owned banks in France, Germany, Spain and the U.K. are more cost and profit efficient than domestic-owned banks. In contrast, in the U.S. foreign banks are less cost and profit efficient than U.S.-owned banks. In line with this, they also find that in France, Germany, Spain and the U.K., foreign banks from the U.S. generally exceed the cost- and profit-efficiencies of domestic banks.

To sum up, theoretical contributions and empirical evidence both suggest that there is no simple relationship between ownership and efficiency. However, most studies focus on the experiences of developed economies characterised by well functioning capital

[46] Gardner and Grace (1993) and Berger et al. (1996a) analyse the U.S. life insurance industry and the U.S. property-liability insurance industry respectively finding no significant differences between stocks

markets. The particular characteristics of developing countries may make the analysis of the ownership-efficiency relationship even more complex. Developing economies are characterised by information poverty (which affects the effectiveness of shareholder monitoring), high transaction costs, stringent takeover regulations and also by the fact that the success or failure of a takeover may depend on the ability of firms or individuals to gather government support (Sarkar et al., 1998). Additionally, the few empirical studies that have analysed the ownership-efficiency relationship within a developing country have not offered conclusive evidence. This calls for further analysis of the banking industry in developing economies.

4.3 Efficiency Measurement

4.3.1 Efficiency Concept

Productive efficiency can be defined as the degree of success firms achieve in allocating inputs at their disposal to produce outputs in an effort to meet some objective (Kumbhakar and Lovell, 2000). Technical efficiency focuses on levels of inputs relative to levels of outputs. To be technically efficient, a firm must either minimise its inputs given outputs or maximise its outputs given inputs. Economic efficiency is a broader concept than technical efficiency, in that it also involves choosing the optimal levels and mixes of inputs and/or outputs based on reactions to market prices. To be economically efficient, a firm has to choose its inputs and/or outputs (levels and mixes) so as to optimise an economic objective, usually cost minimisation or profit maximisation. Economic efficiency requires both technical efficiency and allocative

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and mutuals in terms of cost efficiency, but stock firms providing property liability insurance present higher profit efficiency than mutuals.

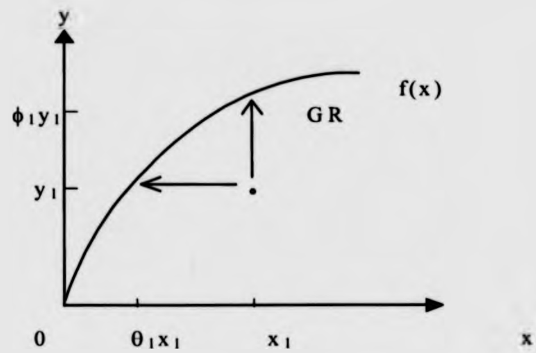
efficiency: the optimal inputs and/or outputs are chosen based on both the production technology and the relative prices in the market.

Technical efficiency is generally defined as the ability to produce maximum outputs from given inputs (input-oriented) or the ability to minimise input use in the production of given outputs (output-oriented) and is measured in terms of distance to a production frontier. Figure 4.1 illustrates the simple case in which variable input x is utilised to produce a single output y. The production frontier is $f(x)=\max\{y:y \in P(x)\} = \max\{y:x \in L(y)\}$, where P(x) and L(y) are the output and inputs sets respectively, which describes the maximum output that can be produced with any given input vector. The input-output combination of each firm is located on or beneath the production frontier.

A firm using x_I to produce y_I is technically inefficient, since it operates beneath the production frontier f(x). The input-oriented technical efficiency measure, measured on the x axis, is given by the function $TE_I(y,x)=\min\{\theta:y\leq f(\theta x)\}$, where $TE_I(y_I,x_I)$ measures the maximum decrease in x_I that enables continued production of y_I, and $TE_I(y_I,x_I)=\theta_I<1$, since $y_I=f(\theta_I x_I)$. The output-oriented measure, measured on the y axis, is given by $TE_O(y,x)=[\max\ \{\phi:\phi y\leq f(\theta x)\}]^{-1}$, then $TE_O(y_I,x_I)$ measures the reciprocal of the maximum increase in y_I that is achievable with x_I, and $TE_O(y_I,x_I)=(\phi_I)^{-1}<1$, since $\phi_I y_I=f(x_I)$. A thorough discussion of these concepts is provided in Kumbhakar and Lovell (2000).

Figure 4.1

Input-oriented and output-oriented technical efficiency



Economic efficiency can be measured in terms of distance to a cost, revenue or profit frontier. *Cost efficiency* is measured from a cost frontier derived under the assumption that firms face input prices w and seek to minimise the costs incurred in producing output y:

(4.1) $c(y,w) = \min_x \{w^T x: x \in L(y)\} = \min_x \{w^T x: y \leq f(x)\}$

which represents the minimum expenditure required to produce y, given input prices. In the case of multiple outputs, the cost frontier becomes: $c(y,w)=\min_x\{w^T x: x \in L(y)\}=\min_x\{w^T x: D_I(y,x)\geq 1\}$ where $D_I(y,x)$ is an input distance function.[47] A measure of cost efficiency is then a function of:

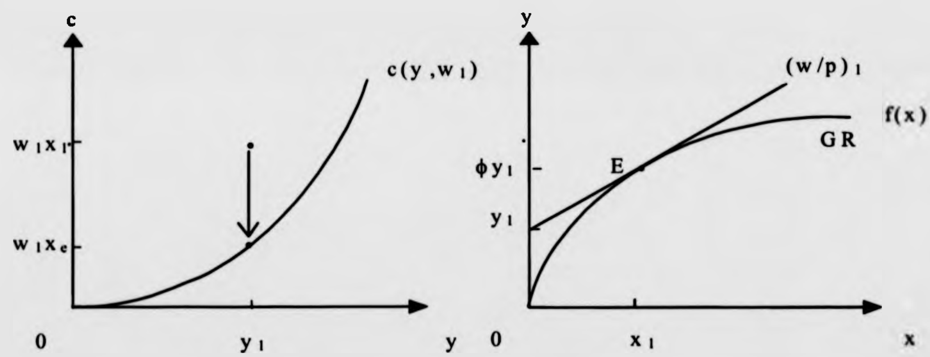
(4.2) $CE(y,x,w) = c(y,w)/w^T x$

[47] When multiple inputs are used to produce multiple outputs, distance functions provide a characterisation of the structure of production technology.

which is the ratio of minimum cost to observed cost. In Figure 4.2 (a) the cost efficiency of a firm using inputs x_1 at price w_1 to produce y_1 is measured by the ratio of minimum cost $c(y_1,w_1)=w_1x_e$ to actual cost w_1x_1, where x_e is the optimal input use to produce y_1 given w_1. Thus the measure of cost efficiency ranges between zero and one, and equals one if the firm uses a cost-minimising input vector.[48]

Figure 4.2

Economic efficiency: cost and profit efficiency



(a) **(b)**

Profit efficiency is measured in terms of distance to a profit frontier derived under the assumption of perfect competition in output and input markets. Firms face output prices p and input prices w and seek to maximise profits by solving: max $\pi = p^Ty-w^Tx$, s.t. $(y, x) \in GR$ where $GR = \{(y,x):x \text{ can produce } y\}$ describes the set of feasible input-output vectors. The standard profit frontier is given by: $\pi(p,w)=\max_{y,x} \{p^Ty-w^Tx: (y,x) \in GR\}$

[48] Revenue efficiency requires the assumption that firms face output prices p and seek to maximise revenue p^Ty they can generate from the input vector x they employ. A measure of revenue efficiency is given by the function: $RE(x,y,p)=p^Ty/r(x,p)$.

which shows the maximum profit obtainable from using x to produce y, given input and output prices. A measure of profit efficiency is given by the function: $\pi E(y,x,p,w)=(p^T y-w^T x)/\pi(p,w)$, provided $\pi(p,w)>0$, which is the ratio of actual profit to maximum profit. In Figure 4.2 (b) a firm facing prices (p_1,w_1) achieves $\pi E(y,x,p,w)=1$ at output-input combination E, and $\pi E(y,x,p,w)<1$ for all other feasible output-input combinations.

If product markets are not perfectly competitive, profit efficiency can be measured in terms of distance to an alternative profit function consistent with firms having some control over output prices (Humphrey and Pulley, 1997). Instead of taking output prices as given, firms are assumed to maximise profits for given output quantities y and input prices w, by choosing output prices p along with input quantities x. The alternative profit frontier is given by:

(4.3) $\pi(y,w)=\max_{p,x} \{p^T y-w^T x: (y,x) \in GR\}$

and a measure of profit efficiency is given by the function:

(4.4) $\pi E_a(y,x,p,w)=(p^T y-w^T x)/\pi(y,w)$

provided maximum profit $\pi(y,w)$ is positive. This measure equals 1 if the firm uses profit-maximising input quantities and output price vectors.

Most studies in the literature of efficiency of financial institutions focus on the estimation of economic efficiency. Bauer et al. (1998) argue that economic efficiency is a better measure to be used by regulators, to evaluate the costs and benefits to society of different policies, than is technical efficiency since the latter does not consider the value of inputs wasted or outputs not produced. Most of these studies have analysed cost efficiency, but more recently some works have also estimated profit efficiency using standard and/or alternative profit frontiers (DeYoung and Nolle, 1996; Berger and Mester, 1997; Humphrey and Pulley, 1997; Lozano-Vivas 1997; Berger et al. 2001; Kumbhakar et al. 2001; Berger and Mester, 2003).

Berger and Mester (1997) argue that the analysis of profit efficiency of financial institutions is to be preferred for at least two reasons. Firstly, while the use of a cost function allows for measurement of inefficiencies on the input side, the profit function incorporates both the revenue effects of producing at incorrect levels or mixes of outputs and the cost effects of using the incorrect levels or mixes of inputs.[49] Secondly, profit efficiency is based on the more accepted economic objective of profit maximisation, which requires that managerial attention be directed to raising revenues as well as to reducing costs. Several authors also argue that the alternative profit function is to be preferred to the standard profit function mainly due to the fact that the standard assumption of perfect competition in the financial services industry is difficult to sustain in some cases (Berger and Mester, 1997; Berger et al., 2001). However, the use of a cost frontier may be more appropriate to evaluate the efficiency of banks that have different objectives than profit maximisation.

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[49] Moreover, the input (output) inefficiencies measured using the cost (revenue) function assume that the output (input) inefficiencies are zero. If either assumption is not satisfied, the inefficiencies obtained from a profit function will be more accurate than those obtained from a cost (revenue) function alone (Lozano-Vivas, 1997).

The use of cost or profit frontiers to evaluate economic efficiency is then related to owners' and managers' objectives in different organisations. In stock banks, for example, the owners are possibly requesting maximum profits and market forces may discipline managers to maximise profits. However, it is not clear whether managers of mutual and public banks have similar objectives. The owners' objectives in mutual banks may be related to the minimisation of the spread between the rates offered to depositors and those charged to borrowers while in public ownership may be the maximisation of social welfare. Since the objectives of each ownership type are not clear, the evaluation of each bank's capability to achieve its superior goals should be left aside. The solution to this problem could be to focus on subobjectives that are unambiguous for the different ownership types. Cost minimisation might be a good candidate in this respect to analyse the efficiency differences of stock, mutual and public-owned banks. In contrast, stock domestic- and foreign-owned banks should have similar objectives i.e. profit maximisation, then, profit frontiers could also be used to evaluate these banks' efficiency.

4.3.2 Frontier Efficiency Approaches

The empirical measurement of technical efficiency requires the specification of a production function such as $y_i=f(x_i,\beta)\cdot TE_i$, where y_i is the output of firm i, x_i is a vector of inputs, $f(x,\beta)$ is the production frontier, β is a vector of technology parameters to be estimated and TE is technical efficiency, which equals $y/f(x_i,\beta)$.Using logarithms the production frontier can be written as:

(4.5) $\ln y_i = \ln f(x_i,\beta) - u_i$

where $u_i = -\ln TE_i$ reflects technical inefficiency that forces production to be below the frontier i.e. if $u_i=0$ firm i is fully efficient. Similarly, a cost function can be written as follows: $\ln c_i = \ln f(y_i, w_i, \beta) + u^c_i$ where u^c_i represents cost inefficiency that makes costs to be above the frontier. In addition, the (alternative) profit function is given by: $\ln \pi_i = \ln f(y_i, w_i, \beta) - u^{\pi}_i$ where u^{π}_i represents profit inefficiency that forces profits to be beneath the frontier.

Two different approaches can be used to estimate efficiency: parametric and non-parametric. The *parametric approaches* to efficiency measurement specify a functional form for the frontier and allow for random error as follows: $\ln y_i = \alpha + x_i'\beta + \varepsilon_i$ where $\varepsilon_i = v_i - u_i$, v_i represents random error and u_i reflects technical inefficiency. The main disadvantage of parametric techniques is given by the imposition of a particular functional form that presupposes the form of the frontier. If the functional form is misspecified, measured efficiency may be confounded with the specification errors. Several parametric methods can be used to estimate efficiency: Stochastic Frontier Approach (SFA), Distribution Free Approach (DFA) and Thick Frontier Approach (TFA). These approaches differ in the distributional assumptions imposed to disentangle random error from inefficiency.

In the SFA inefficiencies u_i are assumed to follow an asymmetric distribution (for example, half-normal or truncated-normal) while random errors v_i follow a symmetric distribution (Aigner et al., 1977; Meeusen and van den Broeck, 1977). The frontier is estimated using maximum likelihood methods and the estimated inefficiency for any firm is taken as the conditional mean or mode of the distribution of the inefficiency term, given the observation of the composed error term. When panel data is available, efficiency can be also estimated using two alternative methods: fixed-effects and random-effects estimators. These methods allow estimation of efficiency without any assumption about the distribution of the error term (Schmidt and Sickles, 1984). Studies by Ferrier and Lovell (1990), Cebenoyan et al. (1993), Bauer et al. (1993, 1998), Esho and Sharpe (1996) and Maudos et al. (2002), for example, have used this approach to analyse efficiency of financial institutions.

As panel data techniques, DFA imposes no distributional assumptions on the error term representing inefficiency. This approach for efficiency measurement assumes that the inefficiency of each firm is stable over time, whereas random error tends to average out to zero through time (Berger, 1993). This approach requires estimation of separate production (cost) functions for each time period and the residuals for each firm averaged out over time. The estimate of efficiency for each firm is then determined as the difference between its average residual and the average residual of the firm on the frontier, which is the firm with the highest (lowest) residual when a production (cost) frontier is estimated. Some truncation is then performed to account for the failure of the random error to average out to zero fully. The main disadvantage of this approach is the requirement that efficiency is time-invariant, however, a main virtue is that it allows the structure of production technology to vary flexibly through time. Berger (1993), Berger and Mester (1997), Bauer et al. (1998) and Berger et al. (2001) have undertaken work in this area.

As with the previous approach, TFA imposes no distributional assumptions on the inefficiency error term. However, TFA assumes that inefficiencies differ between the highest and lowest quartiles and that random error exists within these quartiles. This approach requires estimation of separate production (cost) functions for firms in the highest and lowest quartiles, stratified by size class. Variation in residuals *within* the highest and lowest performance quartiles of observations is then assumed to represent random error, while deviations in the average level of predicted output (costs) *between* the highest and lowest quartiles is assumed to reflect inefficiencies (Berger and Humphrey, 1991). The main shortcoming of this approach is that it does not generate efficiency estimates for each firm in the sample. Studies by Berger and Humphrey (1991), Bauer et al. (1993) and Berger and Mester (2003) have applied this approach to banking firms.

The *non-parametric approaches* to efficiency estimation impose less structure on the frontier than the parametric methods but do not allow for random error, which may cause measured efficiency to be confounded with random deviations from the efficiency frontier if random error exists. Two non-parametric approaches can be used to estimate efficiency: Data Envelopment Analysis (DEA) and Free Disposable Hull analysis (FDH). DEA assumes that all deviations from the estimated frontier represent inefficiency. DEA is a linear programming technique where the set of best-practice or frontier observations are those for which no other firm or linear combination of firms has as much or more of every output (given inputs) or as little or less of every input (given outputs). The DEA frontier is formed as the piecewise linear combinations that connect the set of these best-practice observations, yielding a convex production possibilities set. As such, DEA does not require the explicit specification of the form of the underlying production relationship. FDH is a special case of DEA. These approaches have been applied to financial institutions by Elysiani and Mehdian (1990), Miller and Noulas (1996), Drake and Weyman-Jones (1996), Worthington (1996) and Isik and Hasan (2002).

There is no consensus in the literature regarding a preferred frontier method for evaluating efficiency of financial institutions. For this reason, some studies have compared different techniques, usually applying two efficiency methods to the same data set.[50] The most recent studies that compare several parametric and non-parametric techniques as applied to financial institutions (Bauer et al., 1998 and Cummins and Zi, 1998) conclude that parametric approaches tend to yield about the same distribution of efficiency and rank banks in about the same order. But parametric and non-parametric methods are not consistent with each other in those dimensions. They also indicate that the parametric techniques appear to be more consistent with measures of bank performance such as returns on assets or various cost ratios that are often used by regulators. In this context, Cummins and Zi (1998) further suggest the use of more than one methodology when analysing efficiency to avoid specification errors affecting the findings.

4.4 Methodology

Two approaches can be used to analyse efficiency differences across ownership types. It would be possible: (i) to estimate an industry frontier, including all ownership types, from which efficiencies can be calculated or alternatively, (ii) to estimate frontiers for each ownership type. The former would allow comparisons between ownership types relative to the industry best-practice cost or profit frontier, whereas the latter would

[50] Several studies have compared SFA and DEA (e.g. Ferrier and Lovell, 1990; Giokas, 1991; Ferrier et al., 1993; Eisenbeis et al., 1997; Resti, 1997). In contrast, only few studies have compared two or three

only permit comparison between banks of the same ownership type. This study uses the first approach, for two reasons. Firstly, one objective of this work is to estimate efficiency differences across ownership types and this would not be possible by estimating separate frontiers. Secondly, there is no evidence to suggest that in Argentina banks of different ownership type have access to different technologies. A cost frontier is then estimated using pooled data on all banks, regardless of their ownership type, while a profit frontier is estimated from data of stock domestic- and foreign-owned banks.

To measure cost efficiency, the cost function for bank i, which takes exogenous output quantities y and input prices w, is specified as:

$$(4.6) \quad \ln c = f(y,w,z) + \ln u^c + \ln v^c$$

where c is total cost, $f(y,w,z)$ is a cost function with outputs, variable input prices and other control and shift variables as arguments, $\ln u^c$ denotes an inefficiency factor that may increase costs above the best-practice level, and $\ln v^c$ denotes the random error that incorporates measurement error and any other statistical noise that may temporarily give firms high or low costs. The term $\ln u^c + \ln v^c$ is a composite error term. The efficiency measurement techniques used in this study separate the two components making different assumptions.

To measure profit efficiency, the alternative profit function that takes output quantities y and exogenous input prices w, is written as follows:

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parametric methods (e.g. Berger and Mester, 1997), or two or three non-parametric techniques

(4.7) $\ln \pi^* = f(y,w,z) - \ln u^\pi + \ln v^\pi$

where $\pi^*=\pi+\theta$ such that π is total profit of bank i and θ is a constant added to every bank's profit so that the natural logarithm is taken of a positive number; $\ln u^\pi$ represents inefficiency that reduces profits and $\ln v^\pi$ represents random error.

The functional form adopted for the cost and profit function is the translog. This is the functional form most frequently used in the literature. However, McAllister and McManus (1993) and Mitchell and Onvural (1996) show that the fitting of a translog over a wide range of firm sizes, could lead to specification bias. They suggest that the use of a more flexible functional form could alleviate this problem. One such function is the Fourier flexible form, which augments the translog by including Fourier trigonometric terms. Several studies show that the Fourier fits the data for U.S. financial institutions better than does the translog (see McAllister and McManus, 1993; Mitchell and Onvural, 1996; Berger and DeYoung, 1997). However, with regard to efficiency estimates, there appears to be little economic gain from the additional trigonometric terms. Berger and Mester (1997) and Vander Vennet (2002) report that the translog and the Fourier flexible form yield similar average level and dispersion of measured efficiency and rank individual banks in almost the same order. In this study, the translog and the Fourier flexible specifications provide similar efficiency scores and ranking of firms, hence, results reported are those for the translog function.[51]

(DeBorger et al., 1995).
[51] Efficiency scores obtained with the Fourier flexible form are presented in the Appendix.

The translog cost function can be written as follows (omitting firm and time subscript):[52]

$$(4.8) \quad \ln c\,(y,w,z) = \alpha_0 + \sum_j \beta_j \ln w_j + \sum_m \beta_m \ln y_m + \beta_t\, t + \frac{1}{2}\sum_j \sum_k \delta_{jk} \ln w_j \ln w_k$$

$$+ \frac{1}{2}\sum_m \sum_n \delta_{mn} \ln y_m \cdot \ln y_n + \frac{1}{2}\delta_{tt} t \cdot t + \sum_j \sum_m \delta_{jm} \ln w_j \cdot \ln y_m$$

$$+ \sum_j \delta_{jt} \ln w_j \cdot t + \sum_m \delta_{mt} \ln y_m \cdot t + \ln u^c + \ln v^c$$

where c represents total cost (operating and interest costs), w_j denotes input prices, y_m represents the volume of output of firm i in period t and subscripts j,k=d,l,k,m,f denote inputs deposits, labour, physical capital, materials and other funds and m,n=L,S denote outputs loans and securities.[53] A time trend t is added to serve as an indicator of technological progress, u is the inefficiency term and v the random error term.[54]

The alternative profit function has the same translog specification as the cost function. The use of the same functional form for the cost and profit functions assures that any observed differences in measured cost and profit efficiency are due to the efficiency concept (i.e. cost efficiency or profit efficiency) and not to the choice of functional form. The use of the same functional form therefore avoids confounding inefficiency

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[52] Input cost (output revenue) share equations embodying Shephard's Lemma (Hotelling's Lemma) restrictions are excluded because this would impose the assumption of no allocative inefficiencies.

[53] Berger and Mester (1997) include financial capital as a fixed input in the cost function to control for risk. Efficiency scores obtained with the translog cost function including financial capital as a fixed input are presented in the Appendix.

[54] Berger and Mester (1997) include the ratio of non-performing to total loans to control for output quality. They report negligible differences in cost and profit efficiency measures obtained after adding this control variable. In addition, Berger and DeYoung (1997) point out that if loan quality is driven by bad management, controlling for non-performing loans in cost and profit functions will artificially increase measured efficiency. For these reasons, the ratio of non-performing loans is not included in the analysis.

differences with specification differences. The cost function and the alternative profit function not only have the same functional form but also have exactly the same right-hand side variables, the only difference being the dependent variable: total costs and total pre-tax profits, respectively. Following Berger and Mester (1997), the constant $\theta=|\pi^{min}|+1$ is added to every firm's profits so that the natural logarithm is taken of a positive number, since the minimum profits are typically negative.[55]

To ensure symmetry and linear homogeneity in input prices, the following parameter restrictions on the cost function are imposed *a priori*: $\Sigma_j \beta_j=1$, $\Sigma_j \delta_{jk}=0$, $\delta_{jk}=\delta_{kj}$ for all j,k, $\Sigma_j \delta_{jm}=0$ and $\Sigma_j \delta_{jt}=0$.[56] The homogeneity restriction does not have to be imposed on the alternative profit function, but following Berger and Mester (1997) it is imposed to keep the functional forms equivalent. In contrast, monotonicity with respect to output quantities and input prices are not general properties of the translog functional forms and unlike symmetry, they cannot be conveniently summarised by linear restrictions on parameters of equation (4.8). Consequently, the consistency of the estimated equations with respect to these properties must be evaluated.[57]

Cost and profit efficiencies are estimated using the parametric approaches SFA and DFA, allowing efficiency to vary across banks. The TFA is not applied since it does not provide estimates of efficiency at the firm level. Four different techniques are used within the SFA to estimate bank efficiency; all use the same translog cost (profit)

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[55] The value of one plus the absolute value of the largest negative profit in the sample is included in π^*. The dependent variable for firm i at time t is then: $\ln \pi^*_{it}=\ln(\pi_{it}+|\pi^{min}|+1)$, where π is measured profits and min indicates the sample minimum, which is negative. This modification is made for all observations and for the firm with the lowest value of π the dependent variable will be ln(1)=0.
[56] In the empirical implementation, linear homogeneity in input prices is imposed by normalising the dependent variable and all input price variables by one input price before taking logarithms.

specification. Two panel estimation techniques are based on Schmidt and Sickles (1984): a fixed-effects model (FEM) and a random-effects model (REM). The other two are Maximum Likelihood (MLE) techniques, which are based on Battese and Coelli (1988).

In the FEM the inefficiency term u_i is treated as a firm-specific constant and the error term v_{it} is assumed to be iid $(0,\sigma^2_v)$ and uncorrelated with the regressors. The model is estimated by Ordinary Least Squares with Dummy Variables using the within-groups (WITHIN) transformation (since the number of firms is too large to accommodate with simple OLS). If a cost function is estimated, the firm with the lowest fixed effect is assumed to be the most efficient in the sample, and efficiency is measured by the distance between the fixed effect of each firm and that of the most efficient one:

(4.9) $CE_i = \exp[-(\alpha_{oi} - \alpha_{oi}^{min})]$

where $\alpha_{oi}=\alpha_o+u_i$ are the fixed effects. The fixed-effects are intended to capture variation across firms in time-invariant efficiency. However, they also capture the effects of all firm time-invariant events (Kumbhakar and Lovell, 2000). The random-effects model that follows is intended to address this drawback.

In the REM the inefficiency term u_i is randomly distributed but is assumed to be uncorrelated with the regressors and with the v_{it}, which are assumed to have zero mean and constant variance. The model is estimated by the two-step Generalised Least

[57] In the case of the alternative profit function, even when it is not possible to specify the properties satisfied by π, it is reasonable to assume that it is non-decreasing in output quantities and non-increasing in input prices (Kumbhakar and Lovell, 2000).

Squares (GLS) method. In this model, the inefficiency term forms part of the random error, and efficiency is computed as follows:

$$(4.10)\quad CE_i = \exp[-(\ln \varepsilon_i^* - \ln \varepsilon_i^{*min})]$$

where $\ln \varepsilon_i^* = (1/T_i)\cdot\sum \ln \varepsilon_{it}$, $\ln \varepsilon_{it}$ are the residuals and T_i is the number of observations for firm i.

The MLE techniques assume the random error v_{it} is two-sided while the inefficiency term u_i is one-sided. The model is estimated by MLE and the inefficiency component is inferred from the composite error $\varepsilon_{it} = u_i + v_{it}$, where $v_{it} \sim iid\ N(0,\sigma^2_v)$ and u_i and v_{it} are distributed independently of each other, and of the regressors. If the inefficiency term is assumed to follow a truncated normal distribution, $u_i \sim iid\ N^+(\mu,\sigma^2_u)$, the efficiency estimate for firm i is given by (Battese and Coelli, 1988):

$$(4.11)\quad CE_i = E[\exp(-u_i)|\varepsilon_{it}] = \frac{1-\Phi[\sigma_i^* - (\mu_i^*/\sigma_i^*)]}{1-\Phi(-\mu_i^*/\sigma_i^*)}\cdot \exp[\mu_i^* + \frac{1}{2}\sigma_i^{*2}]$$

where Φ is the cumulative density function of the standard normal distribution, $\mu_i^* = \{(\mu\cdot\sigma^2_v + T_i\cdot\sigma^2_u\cdot\varepsilon_i^*)/[\sigma^2_v + (\sigma^2_u\cdot T_i)]\}$, $\sigma_i^* = \{(\sigma^2_u\cdot\sigma^2_v)/[\sigma^2_v + (\sigma^2_u\cdot T_i)]\}^{1/2}$, $\varepsilon_i^* = (1/T_i)\cdot\sum \ln \varepsilon_{it}$ and T_i is the number of observations for firm i.[58] If the inefficiency component is assumed to follow a half normal distribution, $u_i \sim iid\ N^+(0,\sigma^2_u)$, the firm-specific time-invariant efficiency estimates can be produced simply by restricting μ to equal 0 in

(4.11).[59] Efficiency is measured relative to the estimated frontier rather than the best-practice bank (that with a zero value for ln u), which may not be achieved by any bank in the sample. To make the efficiency measures comparable across techniques, the efficiency estimates are normalised to be deviations from the smallest observed expected value of ln u, so the most efficient bank in the sample will have efficiency of one (Berger and Mester, 1997).

The other parametric technique used to analyse efficiency is the DFA. This approach makes no assumptions on the distribution of the inefficiency term u_i and disentangles inefficiency u_i from random error v_{it} by assuming that the former is constant and that the latter tend to average out to zero over time. The cost and profit functions are estimated separately for each year over the sample period and the average residual for each bank is an estimate of ln u_i. Despite the assumption that random errors average out to zero over time, the extreme values of these inefficiency estimates may reflect substantial random components. Hence, truncation is used to give less extreme values to banks with the most extreme values in each of different bank size classes.[60] The time–invariant efficiency estimate for firm i is calculated as follows:

(4.12) $CE_i = \exp[-(\ln \varepsilon_i^* - \ln \varepsilon_i^{*min})]$

[58] The parameter $\gamma=\sigma^2_u/\sigma^2$ represents the share of inefficiency in the overall residual variance and ranges between 0 and 1. A value of 1 suggests the existence of a deterministic frontier, whereas a value of 0 can be seen as evidence in favour of a standard OLS estimation (no inefficiency effects).
[59] Berger and Humphrey (1997) point out that even when the half-normal assumption for the distribution of inefficiencies is relatively inflexible (and presupposes that most firms are clustered near full efficiency), the use of other distributions such as the gamma or truncated normal distributions, which are more flexible, may make it difficult to separate inefficiency from random error.
[60] Each bank at the top and bottom 5% of the distribution of the average residuals in a size category is assigned the value for the bank that is just at 5^{th} or 95^{th} percentile, respectively. Truncation is performed within size class quartiles (by total assets) (DeYoung and Nolle, 1996).

where $\ln \varepsilon_i^* = (1/T) \cdot \sum \ln \varepsilon_{it}$ and $\ln \varepsilon_{it}$ are the residuals of the estimation of the model for each year.[61]

The preceding analysis is based on the assumption that efficiency is time-invariant. Several techniques can be used to model time-varying efficiency, however, these methods are subject to several limitations, especially when technical change is considered in the analysis. Two different approaches can be used to model time-varying efficiency using fixed- or random-effects. One of these techniques assumes $u_{it}=u_i \cdot \beta_t$, where the β_t are time-effects represented by time dummies and the u_i can be either firm-specific fixed- or random-effects (Lee and Schmidt, 1993). This model is only suitable in cases where the number of firms is large and the number of time-series observations is relatively small (Kumbhakar and Lovell, 2000). The main drawback of this method is that it assumes a common temporary pattern of variation on efficiency across firms. The other approach assumes u_{it} to be $u_{it}=\Omega_{1i}+\Omega_{2i}t+\Omega_{3i}t^2$, where the Ωs are firm-specific parameters (Cornwell, Schmidt and Sickles, 1990). Hence, this method allows temporal efficiency changes to differ across firms. However, if technical change is proxied by a time trend, it is impossible to separate the effects of technical change and of time-varying technical efficiency using this approach (Kumbhakar, Heshmati and Hjalmarsson, 1997).

A maximum likelihood approach can be used to solve this problem by positing a non-linear specification on the time trend in the function identifying the temporal pattern of

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[61] Profit efficiency can be measured using (4.9), (4.10) and (4.12) with some sign changes and with respect to the firm with the highest fixed-effect or average residual and using (4.11) with some sign changes. However, since θ is subtracted from π, these expressions can no longer be used. Instead profit efficiency needs to be computed as the ratio of predicted actual profits to predicted maximum profits for a best-practice bank as follows: $\{\{\exp[\ln(\hat{\pi}+\theta)] \cdot \exp[\ln(\hat{u}^*)]\}-\theta\}/\{\{\exp[\ln(\hat{\pi}+\theta)] \cdot \exp[\ln(\hat{u}^{max})]\}-\theta\}$.

inefficiency. This method assumes that $u_{it}=u_i \cdot \beta(t)$, where $\beta(t)$ is a parametric function of time and u_i is a nonnegative random variable (Kumbhakar, 1990; Battese and Coelli, 1992). In this case the time effects can be separated by using a non-linear specification for $\beta(t)$. However, the main drawback of this approach is the assumption that efficiency change is the same for all banks and that the ranking of banks according to efficiency is the same at all time periods. This model does not account for situations in which some firms are relatively inefficient initially but become more efficient in later periods.

Another maximum likelihood approach allows for the temporary pattern of variation on efficiency to differ across firms (Battese and Coelli, 1995). The inefficiency term is assumed to follow a truncated distribution with different means for each individual. The distribution of the inefficiency effects is assumed to be a function of observable variables. The u_{it} are non-negative random variables independently distributed, and obtained by truncation of the $N^{+}(\mu_{it},\sigma^2_u)$ distribution:

$$(4.13)\quad \mu_{it} = m_{it} \cdot \xi$$

where m_{it} is a vector of observable explanatory variables and ξ is a vector of unknown parameters. Consequently the inefficiency effects are defined as:

$$(4.14)\quad u_{it} = m_{it} \cdot \xi + w_{it}$$

where w_{it} is defined by truncation of a normal distribution being $m_{it}\cdot\xi$ the truncation point. These assumptions are consistent with u_{it} being the non-negative truncation of the $N^{+}(m_{it}\cdot\xi, \sigma^2_u)$ distribution.

The efficiency estimate for firm i at time t is given by (Battese and Coelli, 1995):

$$(4.15)\quad CE_{it} = E[\exp(-u_{it})|\varepsilon_{it}] = \frac{\Phi[(\mu^{*}_{it}/\sigma^{*})-\sigma^{*}]}{\Phi(\mu^{*}_{it}/\sigma^{*})}\cdot\exp[\mu^{*}_{it}+\frac{1}{2}\sigma^{*2}]$$

where $\mu_i^{*}=(\sigma^2_v\cdot m_{it}\cdot\xi+\sigma^2_u\cdot\varepsilon_{it})/(\sigma^2_u+\sigma^2_v)$ and $\sigma^{*}=[(\sigma^2_u\cdot\sigma^2_v)/(\sigma^2_v+\sigma^2_u)]^{1/2}$. The goal of this technique is to analyse the determinants of inefficiencies among firms, however, it can also be used to measure time-varying efficiency. Even though the inclusion of a time trend among the explanatory variables in the inefficiency function leads to the same identification problems mentioned above, the use of time-varying variables allows estimation of inefficiencies that vary across firms and time. This approach is used to analyse efficiency changes over time.[62]

The preceding analysis refers to the measurement of economic efficiency from the estimation of a cost or profit function. Several cost elasticities can be also computed from the parameters of the cost function (4.8). The elasticity of cost with respect to output, which represents the cost changes associated with scale y may be expressed as $\varepsilon_{cy}=\Sigma_m(\partial c/\partial y_m)\cdot(y_m/c)=\Sigma_m(\partial \ln c/\partial \ln y)$. In terms of the coefficients of (4.8), the elasticity of cost with respect to output can be written as:

[62] Only few studies in the banking literature analyse time-varying efficiency or the determinants of inefficiencies using parametric approaches (Lang and Welzel, 1999; Esho, 2001; Frame and Coelli, 2001; Cavallo and Rossi, 2002).

$$(4.16) \quad \varepsilon_{cy} = \sum_m \left(\beta_m + \delta_{mm} \ln y_m + \delta_{mn} \ln y_n + \sum_j \delta_{jm} \ln w_j + \delta_{mt} t \right)$$

Since scale economies can be measured as SCE=1/ε_{cy} values of ε_{cy} lower (higher) than one indicate the presence of scale economies (diseconomies). The elasticity of cost with respect to time often interpreted as technological change, which measures the rate of downward shift of the cost function over time, can be estimated from the cost function as $\varepsilon_{ct}=(\partial c/\partial t)\cdot(1/c)=(\partial \ln c/\partial t)$, which from (4.8) can be written as follows:

$$(4.17) \quad \varepsilon_{ct} = \beta_t + \delta_{tt} t + \sum_j \delta_{jt} \ln w_j + \sum_m \delta_{mt} \ln y_m$$

where negative values indicate the contribution of technical change in reducing firm costs.

4.5 Data and Variables

The data used to estimate the cost and profit frontiers consist of annual information from the Report of Condition and Income Statement of each retail bank over the period 1993-2000. Data for the 1993-1997 period were provided by the Banco Central de la República Argentina, while data for the 1998-2000 period were obtained from *Información de Entidades Financieras*, Banco Central de la República Argentina. Banks are classified as stock, mutual, public- and foreign-owned. The data set is an unbalanced panel of 715 observations: 124 refer to public banks, 346 to stock banks, 115 to mutual banks and 130 to foreign banks. The unbalanced nature of the panel is due to: (i) privatisation of public banks; (ii) mergers among mutual financial institutions; (iii) mergers in the stock (domestic) sector and (iv) entry of foreign banks, which mainly occurred through acquisition of domestic banks. The following dummy variables D_{stock}, D_{mut}, D_{pub} and D_{for} equal 1 for stock, mutual, public- and foreign-owned banks, respectively, and 0 otherwise.

The definition of outputs and inputs follows the intermediation approach. Thus, y_L is measured as the volume of loans and y_S as total assets minus loans, property and equipment and other fixed assets. Since loans are denominated in domestic (pesos) and foreign (dollars) currency, a quantity index is constructed by Divisia aggregation of loans in pesos and dollars as follows: $\ln y_t - \ln y_{t-1} = (1/2)\Sigma_i(s_{it}+s_{i,t-1}) \cdot (\ln y_{i,t} - \ln y_{i,t-1})$ where y_i represents the ith type of loan, p_i the interest rate, $s_i = p_i \cdot y_i / \Sigma_i p_i \cdot y_i$ its share in total revenues and t represents the time period.[63]

The input prices (labour, capital, materials and other funds) are computed as follows. The wage rate for each bank (w_l) is proxied by the ratio of personnel expenses (wages and insurance payments) to the number of employees. The price of capital for each bank (w_k) is constructed as sum of the depreciation rate and the opportunity cost of capital. The latter is approximated by the interest rate for loans less the expected rise in the value of the investment goods employed, which is proxied by the growth rate of the wholesale price index (Lang and Welzel, 1996). The price of materials (w_m) is constructed as administrative expenses minus personnel and capital costs divided by the value of total assets. The price of other funds (w_f) is given by the ratio of interest expenses on other purchased funds to other borrowed funds (including interbank funds purchased, commercial papers and other purchased funds). Total cost in each bank (c)

[63] 11 institutions were excluded due to negative or implausibly large prices.

includes all operating expenses and interest payments on deposits and other purchased funds while total profit (π) is given by net income before tax adjusted to exclude negative values. All nominal data were converted into 2000 prices using the wholesale price index.

Table 4.2 displays descriptive statistics by ownership type. The data indicate that banks differ in terms of assets. On average, stock banks held $610 million of assets, mutual banks had $258 million of assets and public-owned banks held assets for $2.2 billion. The average foreign-owned bank also had $2.2 billion of assets. On the output side, foreign-owned banks held fewer loans as proportion of total assets and charged lower interest rates than did domestic-owned banks. In the domestic-owned sector, stock banks held fewer loans than their mutual and public sector counterparts and mutual banks paid the highest interest rates on loans of the market.

On the inputs side, foreign-owned banks used fewer employees per million of assets than did domestic-owned banks, but paid them higher wages and benefits. This result suggests that foreign-owned banks used labour inputs rather efficiently and/or pursued a less labour-intensive strategy. In the domestic-owned sector, mutual banks relied more heavily on labour than public-owned and stock banks. Mutual banks, however, paid lower salaries. In terms of funds, foreign-owned banks had fewer deposits than domestic-owned banks financing a larger proportion of their assets with purchased funds. This result may indicate that foreign-owned banks had difficulty competing for deposits from domestic customers and/or that they have access to foreign sources of funds. However, foreign-owned banks paid the lowest interest rate on deposits but similar rates on purchased funds. In the domestic-owned sector, mutual banks had more

Table 4.2

Descriptive statistics

Stock, mutual, public- and foreign-owned retail banks, 1993-2000

Variable[a]		All banks	Domestic banks			Foreign banks
			Stock	Mutual	Public	
Output quantities (% of assets)						
Loans	y_L	57.6	55.0	65.2	60.8	54.8
		(16.3)	(16.8)	(9.0)	(18.5)	(15.5)
Securities	y_S	31.2	33.1	20.4	31.6	35.4
		(16.2)	(17.1)	(9.2)	(14.8)	(16.2)
Output prices (%)						
Loans	p_L	19.8	20.7	26.1	17.3	14.2
		(9.9)	(11.0)	(6.7)	(8.9)	(5.7)
Securities	p_S	6.5	6.7	6.7	6.2	6.1
		(11.7)	(11.2)	(7.6)	(19.4)	(4.4)
Input quantities (% of assets)						
Employees (per million $ of assets)	x_l	1.8	1.8	3.2	1.8	0.9
		(1.3)	(1.2)	(1.3)	(0.9)	(0.5)
Capital	x_k	6.9	6.6	8.8	6.4	6.6
		(3.7)	(3.9)	(3.4)	(3.1)	(3.6)
Materials	x_m	3.2	3.2	4.9	2.3	2.3
		(1.9)	(1.6)	(2.4)	(1.3)	(1.6)
Deposits	x_d	50.1	49.5	58.8	48.3	45.7
		(20.1)	(24.5)	(11.9)	(15.2)	(14.1)
Other funds	x_f	24.6	24.5	13.3	27.5	32.0
		(14.9)	(14.4)	(9.4)	(14.4)	(14.7)
Input prices (%)						
Labour (thousand $ per employee)	w_l	31.8	30.2	24.5	31.2	43.2
		(11.5)	(10.4)	(5.8)	(8.9)	(12.4)
Capital	w_k	23.5	24.7	28.8	19.7	19.1
		(10.0)	(10.7)	(6.8)	(9.6)	(7.4)
Materials	w_m	3.2	3.2	4.9	2.3	2.3
		(1.9)	(1.6)	(2.4)	(1.3)	(1.6)
Deposits	w_d	8.8	9.0	11.5	9.7	6.0
		(7.5)	(8.8)	(6.9)	(7.0)	(1.8)
Other funds	w_f	12.1	10.4	22.2	12.0	8.0
		(17.6)	(10.4)	(30.1)	(13.1)	(18.9)
Other characteristics (% of assets)						
Costs[b]	c	16.2	15.7	23.2	16.2	11.7
		(7.8)	(6.7)	(7.3)	(7.8)	(4.8)
Profits	π	0.45	1.53	0.92	0.46	1.14
		(7.3)	(5.5)	(2.6)	(7.3)	(3.2)
Assets (million $)		1,132.1	610.4	258.1	2,237.4	2,239.5
		(2,615.4)	(1,548.4)	(407.4)	(4,297.1)	(3,142.2)
Number of banks[c]		123 (62)	49 (31)	39 (1)	22 (10)	13 (20)

[a] Mean values and standard deviation in parenthesis. Constant pesos December 2000. [b] Includes operating and financial costs. [c] Number of banks in 1993 (2000) respectively.

deposits than non-mutual banks and paid the highest rates for deposits and purchased funds.

4.6 Results

Results are analysed in several sections. Cost frontiers are estimated using SFA and DFA techniques on pooled data for retail banks over the 1993-2000 period. Profit frontiers are estimated for the pooled data of stock domestic- and foreign-owned banks. The first sections analyse time-invariant efficiency measures. Section 4.6.1 presents the average cost efficiency scores obtained for the pooled data. This section also examines the consistency across measurement techniques. Section 4.6.2 reports and discusses the differences in cost efficiency, economies of scale and the effects of technical progress across ownership types. Section 4.6.3 presents profit efficiency differences across stock domestic- and foreign-owned banks. The last section analyses time-varying efficiency indicators. Section 4.6.4 reports the changes in efficiency across ownership types over the subperiods 1993-1996 and 1997-2000.

4.6.1 Cost Efficiency Scores and Rankings across Techniques

Cost frontiers based on the pooled data are estimated within the SFA using MLE and panel estimation techniques (GLS and WITHIN) and also using the DFA. MLE assumes the inefficiency error term follows a half normal and a truncated normal distribution. Table A1 in the Appendix presents the parameter estimates for the cost function using MLE, GLS and WITHIN techniques. The MLE for the normal and truncated normal models show that the estimates of γ, the share of inefficiency in the overall residual variance, are statistically significant at the 1% level. These estimates indicate that more than half of residual variation is due to the inefficiency effect. In addition, the one-sided Likelihood Ratio (LR) test of the standard cost function (OLS) versus the frontier model exceeds the 1% mixed chi-square critical value.[64] This result implies that the restrictions imposed by OLS can be rejected for both the half-normal and the truncated-normal models. For the truncated normal model, the estimate of μ is statistically significant at the 1% level. The value of μ suggests that the peak of the density function of inefficiency terms is 0.37. The LR test of the half-normal versus the truncated normal model exceeds the 1% mixed chi-square critical value.[65] This result suggests that the truncated-normal specification appear to be a more adequate representation of inefficiency effects. Table A2 in the Appendix reports LR statistics for structural tests of the cost function. In all cases, the restricted functional form is rejected at the 5% level, which suggests that the use of the translog flexible form appears to be appropriate to estimate the cost structure.

Table A1 also presents the GLS and WITHIN estimates, the Breush-Pagan Langrangian Multiplier (LM) test of the difference between the random-effects and the Pooled OLS estimators and the Hausman test of the difference between the GLS and WITHIN estimators. The LM test exceeds the chi-square critical value with 1 d.f. at 1% significance level suggesting that the random-effects model is a more adequate representation of the data when compared with the Pooled OLS model. The Hausman test statistics also exceeds the chi-square critical value at 1% significance level implying that the correlation between the individual effects and the explanatory variables is different from zero. This result suggests that GLS estimates are inconsistent. However, GLS generate similar efficiency scores than MLE while

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[64] For the half normal (truncated normal) model, the null hypothesis in this test is $\gamma=0$ ($\gamma=0$, $\mu=0$ versus the alternative $\gamma>0$ ($\gamma>0$, $\mu\neq0$). If H_0 is true the LR statistic has asymptotic distribution (with one (two) degrees of freedom), which is a mixture of chi-square distributions (Coelli and Battese, 1996).

WITHIN estimators produce significantly lower efficiency measures. Hence, GLS estimates are still used in the analysis. Table A3 in the Appendix reports Sum of Squares statistics for structural tests of the cost function. In all cases, the restricted functional form is rejected at the 5% level, which suggests that the use of the translog flexible form appears to be appropriate to analyse the cost structure.

The cost function estimates are used to compute efficiency scores for each bank using (4.9), (4.10), (4.11) and (4.12). Table 4.3 reports a number of distributional characteristics of the cost efficiency scores that allow comparison across the different techniques (see also figures A1 and A2 in the Appendix). The results based on the estimations performed using MLE techniques show that average cost efficiencies are lower (and dispersion higher) with the truncated normal model than with the half normal model, as average efficiencies are 0.696 and 0.820, respectively. These results also reveal that the panel estimation techniques and DFA method provide lower efficiency estimates than the MLE, as average efficiency scores are 0.563 and 0.309 for GLS and WITHIN techniques, respectively, and 0.661 for the DFA model.[66] These figures are within the range found in the literature.[67] Overall, these results suggest that the choice of methodology has an important impact on the estimated average efficiency scores.

[65] The null hypothesis in this test is $\mu=0$ versus the alternative $\mu\neq0$.

[66] Burdisso et al. (1998) find average efficiency scores for a sample of (stock and public) Argentine banks over the 1991-1996 period of 0.486 and 0.717 using the WITHIN and DFA methods respectively.

[67] Berger and Humphrey (1997) survey 122 frontier studies that apply efficiency analysis to depository institutions. They find that the distribution of average cost efficiency from parametric studies of U.S. (non U.S.) financial institutions has a mean of 0.84 (0.76) with standard deviation of 0.06 (0.12) and range of 0.61-0.95 (0.20-0.90).

Table 4.3

Descriptive statistics of cost efficiency scores by technique

Method [a]	Mean	Median	Standard Deviation	Maximum	Minimum
Stochastic frontier approach- SFA					
MLE Half Normal	0.820	0.829	0.096	1.000	0.409
MLE Truncated Normal	0.696	0.685	0.103	1.000	0.374
GLS Random-effects	0.563	0.556	0.105	1.000	0.362
WITHIN Fixed-effects	0.309	0.285	0.150	1.000	0.141
Distribution free approach – DFA	0.661	0.662	0.076	1.000	0.390

[a] MLE Half Normal (Truncated Normal): maximum likelihood estimates under the assumption of half-normal (truncated normal) distribution for the inefficiency error term; GLS Random effects: generalised least square estimates of random effects model; WITHIN Fixed effects: LS estimates of fixed effects model using within transformation.

Table 4.4 displays pairwise Spearman rank correlation coefficients of the efficiency scores obtained with the different methods. These correlation coefficients are useful to analyse the consistency of methods in ranking banks, as they show how close the rankings of banks (given by the different frontier techniques) are among each other. The MLE methods appear to be highly consistent in ranking banks according to cost efficiency, with a pairwise correlation coefficient of 97.8 (also see figures A3 to A6 in the Appendix). The rank correlation among the panel estimation techniques is lower – at 62.3 percent. The DFA method is highly correlated with MLE and GLS techniques, however, the correlation with the WITHIN estimators is low – 41.1 percent. In addition, the MLE methods and GLS model appear to be consistent in ranking banks according to cost efficiency with pairwise correlation coefficients of 94.5 and 95.1 percent. However, the rank correlations are lower when comparing the MLE and WITHIN estimators, ranging from 49.5 to 58.7 percent. Despite the WITHIN-fixed effects, the GLS-random effects and the DFA methods produce lower efficiency scores than the MLE techniques, these results suggest that the measurement techniques produce comparable efficiency rankings. These results are consistent with previous studies.[68]

Table 4.4

Spearman rank-order correlations among efficiency scores

Method	Stochastic Frontier Approach: MLE Half Normal	MLE Truncated Normal	GLS Random effects	WITHIN Fixed effects	Distribution Free Approach
Stochastic frontier approach- SFA					
MLE Half Normal	1.000	0.978 ***	0.945 ***	0.495 ***	0.827 ***
MLE Truncated Normal		1.000	0.951 ***	0.587 ***	0.806 ***
GLS Random-effects			1.000	0.623 ***	0.795 ***
WITHIN Fixed-effects				1.000	0.411 ***
Distribution free approach – DFA					1.000

***, **, * indicates significance at the 1%, 5% and 10% level, respectively.

Table 4.5 reports the proportions of banks that are identified by one technique as having efficiency scores in the top 10% that are also identified in the top decile by other technique. This information is useful to determine the degree to which different techniques identify the same banks as being in the highest and lowest efficiency groups. The results show that MLE methods are reasonably consistent in identifying the most and least efficient firms, as 86.7 percent of banks identified as in the best and worst 10% practice by the MLE Half normal technique are also identified in the highest and lowest decile by the MLE Truncated normal technique. The results also reveal that the

[68] Bauer et al. (1993) compare results obtained from MLE and panel data techniques (WITIHN and GLS) using U.S. banking data over 1977-1988. They report correlation of 89 percent between WITHIN and GLS efficiency estimates, but correlation between these two estimates and MLE estimates in the range 38.0-50.0 percent. For the same sample of U.S. banks Bauer et al. (1998) compare MLE, WITHIN, GLS, DFA, TFA and DEA estimates. They find that correlation between MLE and WITHIN and GLS estimates are 49.5 and 56.6 percent respectively, while the correlation between the later two is 93.6 percent. They also report correlation of 96.4 between MLE and DFA estimates but correlation between the later and WITHIN and GLS estimates of 48.4 and 56.7 percent respectively. Furthermore, Berger and Mester (1997) compare results obtained from MLE and DFA approaches (assuming a half normal distribution for the inefficiency error term) using U.S. banking data. They report a rank-order correlation coefficient of 98.8 percent.

correspondence of the best and worst practice 10% of banks between the WITHIN and GLS techniques are lower at 53.3 and 46.7 percent, respectively. In addition, the MLE methods and GLS technique are highly consistent in identifying the most and least efficient banks, though the correspondence with WITHIN and DFA techniques are lower. These results suggest that the different methods generate similar efficiency rankings, particularly at the top and bottom of the distribution.

Table 4.5

Correspondence of best practice and worst practice banks across techniques

Method	Stochastic Frontier Approach				Distribution
	MLE Half Normal	MLE Truncated Normal	GLS Random effects	WITHIN Fixed effects	Free Approach
Stochastic frontier approach- SFA					
MLE Half Normal		0.867	0.800	0.533	0.467
MLE Truncated Normal	0.867		0.867	0.600	0.467
GLS Random-effects	0.800	0.733		0.533	0.533
WITHIN Fixed-effects	0.333	0.333	0.467		0.400
Distribution free approach – DFA	0.600	0.533	0.600	0.333	

Each number above (below) the diagonal represents the proportion of banks that are identified by one technique as having efficiency scores in the most (least) efficient decile of banks that are also identified in the most (least) efficient decile by the other technique.

4.6.2 Cost Efficiency, Scale Economies and Technical Change Differences across Ownership Types

Despite producing different efficiency scores, the analysis of the previous section indicates that the measurement techniques produce comparable efficiency rankings, particularly at the top and bottom of the distribution.[69] The cost functions estimated above are used to analyse the differences across stock, mutual, public- and foreign-owned banks in terms of efficiency, scale economies and technical change over the 1993-2000 period. The efficiency scores for each bank computed above are averaged out to obtain the average cost efficiency of each ownership type. Cost elasticities are computed for each bank using the cost function estimates and (4.16) and (4.17), and they are then averaged out for each ownership group. Table 4.6 presents the average cost efficiency, scale elasticities and technical change for each ownership type.[70] The data show that all models generate similar results, except the fixed-effects model, which provides lower efficiency and scale economies measures.

The results for the domestic private-owned banks are presented in Panels A and B. The cost efficiency measures for stock banks reported in Panel A indicate that cost efficiency is 62.3 percent on average (range from 31.1 to 84.6 percent). This finding suggests that if all stock banks operate on the efficient frontier they could produce the same level of output with 62.3 percent of current inputs. Altunbas et al. (2001) and Bhattacharyya et al. (1997) report higher average cost efficiencies for stock banks in Germany and India (of about 80 and 76 percent, respectively).[71] Burdisso et al. (1998) find that the average efficiency for stock banks in Argentina over the 1991-1996 period is 61.8 percent.[72] The results also show that the average scale elasticity for stock banks is 0.873, which indicates that a 10% increase in output would raise costs by 8.73% holding other variables constant. This result suggests that stock banks operate under increasing returns to scale, and that an increase in the size of stock banks would lead to costs reductions. Finally, the findings indicate that technical change has reduced costs by less than 0.5 percent per year.

[69] However, the WITHIN method appears to be the least consistent with respect to the others.
[70] Table A4 in the Appendix reports the average efficiency scores obtained using the Translog including financial capital as a fixed input. Table A5 also reports the average efficiency measures obtained from the Fourier flexible form. The efficiency differences and ranking of banks across specifications are very small.
[71] The former uses SFA and DFA and the latter uses DEA.
[72] They use WITHIN fixed-effects.

Table 4.6

Cost efficiency, scale economies and technical change

Stock, mutual, public- and foreign-owned banks, 1993-2000

Type of bank	MLE Half normal	MLE Truncated normal	GLS Random effects	WITHIN Fixed effects	DFA	Average
Panel A. Private (stock) banks						
Cost efficiency	0.846 (0.09)	0.726 (0.10)	0.587 (0.10)	0.331 (0.14)	0.686 (0.08)	0.623
Scale elasticity	0.953 (0.07)	0.917 (0.07)	0.938 (0.07)	0.685 (0.09)	0.963 (0.05)	0.873
Technical change	-0.010 (0.02)	-0.010 (0.02)	-0.008 (0.02)	0.020 (0.01)		-0.002
Panel B. Private (mutual) banks						
Cost efficiency	0.804 (0.06)	0.676 (0.08)	0.554 (0.09)	0.305 (0.15)	0.643 (0.06)	0.585
Scale elasticity	0.944 (0.06)	0.904 (0.07)	0.932 (0.07)	0.669 (0.09)	0.966 (0.03)	0.862
Technical change	0.011 (0.01)	0.020 (0.01)	0.013 (0.01)	0.037 (0.01)		0.020
Panel C. Public banks						
Cost efficiency	0.723 (0.12)	0.610 (0.10)	0.491 (0.08)	0.222 (0.08)	0.609 (0.08)	0.511
Scale elasticity	0.977 (0.07)	0.956 (0.09)	0.967 (0.08)	0.722 (0.10)	0.986 (0.07)	0.906
Technical change	0.005 (0.02)	0.008 (0.02)	0.005 (0.01)	0.027 (0.01)		0.011
Panel D. Foreign banks						
Cost efficiency	0.844 (0.09)	0.720 (0.11)	0.567 (0.13)	0.324 (0.21)	0.668 (0.05)	0.614
Scale elasticity	0.961 (0.07)	0.946 (0.09)	0.935 (0.08)	0.709 (0.09)	0.969 (0.05)	0.888
Technical change	-0.015 (0.02)	-0.016 (0.01)	-0.015 (0.02)	0.016 (0.01)		-0.008
Panel E. Overall average						
Cost efficiency	0.820 (0.09)	0.696 (0.10)	0.563 (0.11)	0.309 (0.15)	0.661 (0.08)	0.597
Scale elasticity	0.955 (0.07)	0.923 (0.08)	0.940 (0.07)	0.688 (0.09)	0.968 (0.05)	0.876
Technical change	-0.001 (0.02)	-0.001 (0.02)	-0.001 (0.02)	0.027 (0.01)		0.006

Mean and standard deviation in parenthesis.

The results for the mutual banking sector shown in Panel B reveal that these banks exhibit lower cost efficiencies and higher scale economies than stock banks. The average cost efficiency is 58.5 percent across the different techniques, however, it varies from 30.5 to 80.4 percent depending on the method. This result suggests that if all mutual banks operate on the efficient frontier they could produce the same level of output with 58.5 percent of current inputs. The findings reveal that mutual banks also operate under increasing returns to scale with an average scale elasticity of 0.862 percent. Altunbas et al. (2002) report similar scale economies estimates but higher average cost efficiencies (about 85 percent) for mutual banks in Germany. In addition, technical change has not made a positive contribution to reducing costs, with costs having increased around 2 percent per year. This result may be due to cost increasing effects that have cancelled out technical innovations effects since technological change, defined as a trend, may capture not only production innovations but also the impact of other factors such as changes in organisational structure and processes on bank costs.

The cost efficiency measures for the public-owned banking sector shown in Panel C appear to be lower when compared with the private-owned – stock and mutual - banks. Cost efficiency for public banks ranges from 22.2 to 72.3 percent, with an average of 51.1 percent. These figures suggest that, on average, about 50 percent of costs are wasted relative to a best-practice bank. Altunbas et al (2002) and Bhattacharyya et al (1997) report higher average cost efficiencies for public-owned banks of around 84 and 87 percent, respectively. Burdisso et al. (1998) find that the average cost efficiency for public-owned banks in Argentina is 28.3 percent. The results also show that the average scale elasticity for stock banks is 0.906, which indicates that a 10% increase in output would raise costs by 9.06% holding other variables constant. This finding suggests that public-owned banks also operate under increasing returns to scale. As for mutual banks, technical progress does not appear to have reduced costs in the public banking sector.

The results for foreign-owned banks presented in Panel D reveal similar cost efficiency and scale economies, but higher technical progress than domestic-owned stock banks. The average cost efficiency is 61.4 percent, which ranges between 32.4 and 84.4

percent depending on the technique used. Bhattacharyya et al. (1997) find similar cost efficiency for domestic private- and foreign-owned banks in India of around 75 percent. Berger et al. (2001) report that domestic-owned banks in France, Germany, Spain and the U.K. are more cost efficient than foreign-owned competitors while the opposite is true for banks in the U.S. The findings also show that foreign banks also operate under increasing returns to scale with scale elasticities averaging about 0.888. Finally, the results indicate that technical change has reduced costs by about 1 percent per year.

These results suggest that within the domestic-owned banking sector, stock banks seem to be more cost efficient than mutual and public-owned banks. The findings also imply that domestic-owned stock banks appear to be as efficient as foreign-owned banks. To further test whether these differences are statistically significant, the non-parametric Mann-Whitney rank test is used to infer whether different ownership types have identical or different populations.[73] Table 4.7 presents the results of the tests undertaken. These results suggest that the efficiency differences between stock, mutual and public-owned banks are statistically significant at levels of 10% or less in most cases. The findings also imply that cost efficiency differences between stock domestic- and foreign-owned banks are not statistically significant but that differences between the latter and mutual and public-owned banks are statistically significant in most cases.

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[73] The Mann-Whitney statistic is obtained by pooling the groups that are to be compared, ranking in increasing order of magnitude according to efficiency and calculating the rank sum S of the first group. Then, the distribution of the rank sum statistic S is approximately normal with mean $m(m + n + 1)/2$ and variance $m \cdot n \cdot (m + n + 1)/12$ where m is the number of observations in the first group and n is the number of observations in the second group. By normalising S, the test statistic obtained is: $Z = \{[S - (n+m+1)/2]/[m \cdot n \cdot (m+m+1)/12]^{1/2}$, which has an approximated normal distribution if n and m are large.

Table 4.7

Mann-Whitney tests of cost efficiency differences across ownership types

Stock, mutual, public- and foreign-owned banks, 1993-2000

Differences between ownership types:	MLE Half normal	MLE Truncated normal	GLS Random effects	WITHIN Fixed effects	DFA
Difference within domestic-owned banks					
Stock - Mutual banks	-2.660 ***	-3.010 ***	-2.491 **	-0.912	-3.016 ***
Stock - Public banks	-4.073 ***	-3.901 ***	-3.666 ***	-3.834 ***	-3.316 ***
Mutual - Public banks	-2.948 ***	-2.258 **	-2.450 **	-3.270 ***	-0.988
Differences between domestic- and foreign-owned banks					
Stock - Foreign banks	-0.100	-0.259	-0.909	-0.717	-1.422
Mutual - Foreign banks	-1.640 *	-1.884 *	-1.012	-2.590 ***	-1.169
Public - Foreign banks	-3.109 ***	-2.895 ***	-2.088 **	-2.595 ***	-1.768 *

***, **, * indicates significance at the 1%, 5% and 10% level, respectively.

4.6.3 Profit Efficiency of Stock Domestic- and Foreign-owned Banks

The analysis of the previous section suggests that cost efficiency differences between stock domestic- and foreign-owned banks are not statistically significant. However, since stock banks may seek to maximise profits, this section examines profit efficiency differences between stock domestic- and foreign-owned banks using SFA and DFA. Table A6 in the Appendix presents the parameter estimates for the profit function using MLE, GLS and WITHIN techniques. From these frontier estimates, the profit efficiency for each domestic- and foreign-owned bank is calculated as the ratio of predicted actual profits to predicted maximum profits. The average alternative profit efficiency for each ownership type is then obtained by averaging out the efficiency of individual banks belonging to each ownership group. Table 4.8 presents the average profit efficiency scores for domestic- and foreign-owned banks. These results show that all models generate similar results except for the fixed-effects model, which provides lower efficiency measures.

Table 4.8

Profit efficiency

Stock domestic- and foreign-owned banks, 1993-2000

Type of bank [a]	MLE Half normal	MLE Truncated normal	GLS Random effects	WITHIN Fixed effects	DFA	Average
Overall average	0.300 (0.09)	0.261 (0.09)	0.272 (0.11)	0.161 (0.15)	0.326 (0.09)	0.264
Domestic banks	0.301 (0.10)	0.263 (0.10)	0.281 (0.12)	0.173 (0.14)	0.330 (0.11)	0.270
Foreign banks	0.295 (0.05)	0.255 (0.04)	0.236 (0.06)	0.105 (0.18)	0.322 (0.06)	0.243
Mann-Whitney [b]	-0.445 (0.66)	-0.455 (0.65)	-1.183 (0.24)	-0.848 (0.37)	-0.446 (0.66)	

[a] Standard deviation in parenthesis. [b] p values in parenthesis.

The results show that the average estimated alternative profit efficiency for stock domestic- and foreign-owned banks is 26.4 percent (range from 16.1 to 32.6 percent). These values indicate that the average domestic/foreign-owned stock bank earns 26.4 percent of the profits of a best-practice bank producing the same output bundle. This overall profit efficiency estimate is consistent with the findings of previous studies. Berger and Mester (1997) find average profit efficiencies of U.S. banks of 46.3 and 35.1 percent using DFA and MLE respectively. Berger et al. (2001) also use DFA to examine profit efficiency in various countries and report average alternative profit efficiency of 44.2 percent for banks in France, 52.2 percent in Germany and 67.1 and 66.1 percent in Spain and the U.K., respectively.

The findings for Argentina show that the average profit efficiency of domestic-owned stock banks ranges from 17.3 to 33.0 percent, depending on the technique used to compute the estimates. The results further reveal that the average alternative profit efficiency of foreign-owned banks varies from 10.5 to 31.1 percent. The Mann-Whitney statistics suggest that the efficiency differences between domestic- and foreign-owned banks are not statistically significant. This result differs from the findings of Berger et al. (2001), who report that domestic banks in France, Germany, Spain and the U.K. are more profit efficient than foreign-owned competitors, although these profit efficiency differences are not statistically significant. However, they also find that foreign banks in the U.S. are less profit efficient than domestic-owned banks.

A further decomposition of foreign banks by country of origin provides mixed results. The MLE estimates suggest that Latin American banks are slightly more profit efficient than U.S. and European banks but the WITHIN, GLS and DFA estimates suggest that U.S. banks are slightly more efficient than other foreign-owned banks (Latin American and European). However, these profit efficiency differences across banks classified by country of origin are small. Berger et al. (2001) find that U.S. banks operating in France, Germany, Spain and the U.K., generally exceed the cost- and profit-efficiencies of domestic banks.

4.6.4 Cost Efficiency Differences Over Time

The preceding analysis is based on time-invariant efficiency measures. This section estimates time-varying efficiency scores using the MLE technique proposed by Battese and Coelli (1995) to analyse the changes in efficiency of each ownership type over the sample period. The cost function (4.8), based on the pooled data, is estimated along with the inefficiency function (4.14), which includes ownership dummy variables and size as explanatory variables. Table A7 in the Appendix presents the parameters estimates for the cost frontier. The results show that the estimate of γ is significant at the 1% level. The one-sided LR test of the standard cost function versus the frontier model exceeds the 1% mixed chi-square critical value.

Table A7 also reports the parameter estimates for the inefficiency function. The results show that most of the parameter estimates of the inefficiency function are significant at the 1% level. The coefficient on Dpub is positive and highly significant, which confirms the previous results that public-owned banks are more inefficient than stock banks. The coefficient on Dfor is insignificant implying that the efficiency differences between stock foreign- and domestic-owned banks are insignificant. The estimate for Dmut is positive and statistically significant, which also confirms the previous findings that mutual banks are less efficient than stock banks. Finally, the coefficient on Size (measured as the logarithm of total assets) is negative and highly significant suggesting that cost inefficiencies decline as bank total assets grow.

The cost and inefficiency function estimates are used to compute efficiency scores for each bank in each year using (4.15). These efficiency indicators are then averaged out to obtain the average cost efficiency of each ownership type in each year over the sample period. Table 4.9 presents the average cost efficiency for each ownership group and for different subperiods. The results show that the efficiency of the banking system increased from 0.837 to 0.863 between the first and the second half of the sample period as a result of an increase in the average efficiency of all ownership types. The developments that occurred during this post-deregulation period might explain this finding. The privatisation of highly inefficient public banks, the failures and acquisitions of stock and mutual banks characterised by poor performance and the higher pressure from foreign banks may explain this improvement in efficiency over the post-deregulation period.

The findings show that the efficiency of stock banks increased from 0.851 during 1993-1996 to 0.864 over 1997-2000 (and dispersion declined from 0.12 to 0.09). Mutual banks also show an improvement over the sample period from 0.833 to 0.858. The efficiency of public-owned banks increased (and dispersion declined) from 0.777 to 0.810 over the subperiods analysed. Finally, foreign-owned banks became more efficient over the sample period since average efficiency increased from 0.884 to 0.891 between 1993-1996 and 1997-2000.

The results also show that the ranking of ownership types is the same across time. Public-owned banks are the least efficient banks and stock and foreign-owned banks are the most efficient banks over the sample period, however, during 1999-2000 mutuals appear to be more efficient than stock banks.[74] The findings also show that the performance of mutuals and public-owned banks improved significantly over the sample period. The efficiency of public-owned banks increased notably over time, a result that could be explained by the effects of the privatisation of (potentially) high inefficient provincial banks and of the higher pressure resulting from the entry of foreign banks, as mentioned above. Additionally, the performance of mutual banks also improved notably over the sample period, a result that could be explained by the acquisition or failure of (highly) inefficient mutuals.

Zaim (1995) reports that public-owned banks in Turkey are the most efficient while private domestic-owned banks the least efficient in both pre- and post liberalisation periods. They also find that all ownership types (private, public- and foreign-owned)

[74] This result could be explained by the structural changes observed in the mutual banking sector. As a result of several M&A, failures and conversions to stock banks, only one mutual bank is left operating in the system at the end of the sample period.

became more efficient after the liberalisation of the banking sector. In line with these findings, Bhattacharyya et al. (1997) report that public-owned banks in India are the most efficient over the early stages of the liberalisation period. They also find that foreign-owned banks are the least efficient at the beginning of the period, but that they are as efficient as public-owned banks by the end of the sample period (the efficiency of the latter decreased while the former became more efficient after the liberalisation of the sector).

Table 4.9

Efficiency differences across ownership types and over time

Stock, mutual, public- and foreign-owned banks, 1993-2000

Period	Overall	Stock	Mutual	Public	Foreign
1993-1996	0.837 (0.12)	0.851 (0.12)	0.833 (0.07)	0.777 (0.15)	0.884 (0.07)
1997-2000	0.863 (0.10)	0.864 (0.09)	0.858 (0.05)	0.810 (0.11)	0.891 (0.07)
1993-1994	0.852 (0.09)	0.880 (0.08)	0.840 (0.06)	0.795 (0.11)	0.874 (0.10)
1995-1996	0.823 (0.15)	0.821 (0.16)	0.818 (0.07)	0.759 (0.19)	0.893 (0.04)
1997-1998	0.874 (0.08)	0.888 (0.07)	0.821 (0.10)	0.803 (0.12)	0.904 (0.04)
1999-2000	0.851 (0.11)	0.841 (0.11)	0.906 (0.00)	0.817 (0.10)	0.879 (0.10)

Mean and standard deviation in parenthesis.

To sum up, the cost efficiency measures presented in Section 4.6.2 suggest that stock banks are more cost efficient than mutual banks. This result may be explained by the higher proportion of employees and deposits used and also by the higher interest costs faced by mutuals. The findings also reveal that stock banks appear to out-perform public-owned banks in terms of cost efficiency. Overall, this evidence indicates agency problems for both mutual and public-owned banks in Argentina. The cost and profit efficiency measures presented in Section 4.6.2 and 4.6.3 indicate that efficiency differences between foreign- and domestic-owned banks are not significant. This result may be explained in part by the fact that foreign-owned banks use more purchased funds and pay significantly higher salaries than domestic-owned banks. These findings may be related to organisational diseconomies to operate and monitor an institution from a distance, which increases costs relative to domestic institutions. However, foreign-owned banks use fewer employees than domestic institutions, which may probably be indicative of the access by foreign-banks to best–practice procedures and policies. Finally, the findings from Section 4.6.4 suggest that the post-deregulation developments appear to have induced significant efficiency improvements since all ownership types, but especially public-owned and mutual banks, increased their cost efficiency over the post-deregulation period.

4.7 Conclusions

This chapter adds new evidence on the conflictive link between ownership and efficiency in the banking industry by examining efficiency differences between stock, mutual, public- and foreign-owned banks in Argentina over the 1993-2000 period. The cost and profit characteristics of these bank ownership types are compared by using a variety of techniques to evaluate differences in cost and profit efficiency, scale economies and the impact of technical progress across these ownership groups. Cost frontiers from pooled data of all banks are estimated using different parametric techniques to analyse the consistency across the different methods. From these cost frontiers, the differences between stock, mutual, public- and foreign-owned banks are examined by computing cost efficiency scores and cost elasticities measures. Profit frontiers from data of stock domestic- and foreign-owned banks are also estimated to explore profit efficiency differences between these profit maximising ownership types. Finally, the changes in cost efficiency over the post-deregulation period are analysed across ownership groups.

The results suggest that the choice of methodology has an important impact on the estimated efficiency scores. However, the different methods generate similar efficiency rankings, particularly at the top and bottom of the distribution, where managerial interest is concentrated. Cost efficiency measures suggest that within the domestic-owned banking sector stock banks seem to be more cost efficient than mutual and public-owned banks, but that the differences between stock domestic- and foreign-owned banks do not appear to be significant. The findings also show that all banks appear to benefit from widespread economies of scale, though, only stock and foreign-banks seem to have benefited from the cost reduction effects of technical progress. Profit efficiency measures show that stock domestic- and foreign-owned banks do not differ in terms of profit efficiency. Finally, the results further reveal that the efficiency of the banking system increased over the sample period as a result of an improved performance of all ownership types, but especially that of mutual and public-owned banks.

A conclusion that arises from the empirical investigation seems to be that banks can gain by increasing their scale of operations and, especially, by identifying and tackling the sources of inefficiencies. The evidence also shows that differences in efficiency between public and private-owned banks are much more relevant than differences within private banks. These findings are coherent with theoretical predictions that point towards agency problems in public-owned banks as responsible for lower efficiency levels. The empirical evidence also suggests that differences between domestic- and foreign-owned financial institutions are not significant A conclusion which can be drawn from these findings seems to be that foreign-banks appear to offset the costs of operating abroad by importing capabilities from their parent organisations. Finally, the finding that efficiency increased for all ownership types over the sample period suggests that post-deregulation developments: privatisation of (inefficient) public banks, mergers and acquisitions among stock and mutual banks and the (higher pressure from) the entry of foreign banks played a significant role in the banking industry.

The previous results have important policy implications. First, the results suggest that the use of multiple techniques could prove useful for regulatory analyses. If the methods provide similar efficiency scores and ranking of firms, especially at the top and bottom of the distributions, regulators could be more confident about the conclusions drawn. Second, the findings indicate that public-owned banks are more inefficient than private banks, however, the efficiency of the former notably increased over the post-deregulation period. This evidence suggests that privatisation policies may contribute to improve the performance of the banking sector. This finding could help policy makers by providing additional information on the beneficial effects of privatisation policies, given that the negative effects, such as credit availability to small and medium-sized customers, are not too high. Third, the results also suggest that the efficiency of the banking sector increased over a period characterised by strong foreign bank entry. This finding implies that foreign bank entry may contribute to improve the functioning of domestic banking markets. These results could provide policy makers in developing countries with information regarding the benefits of liberalising entry into their banking sectors, provided any adverse effects of foreign bank entry are not too severe.

Appendix

Table A1

Parameter estimates for cost function using MLE, GLS and WITHIN methods

Parameter	MLE Half normal [a]		MLE Truncated normal [a]		GLS Random effects		WITHIN Fixed effects	
	Coef.	t ratio	Coef.	t ratio	Coef	t ratio	Coef.	t ratio
α	0.991	0.906	0.809	0.844	-1.034	-0.829		
β_L	0.123	0.756	0.037	0.191	0.894 ***	5.608	0.635 ***	3.460
β_S	0.794 ***	5.619	0.659 ***	3.289	0.153	1.118	-0.096	-0.649
β_d	0.231	1.009	0.351	0.775	0.067	0.265	-0.165	-0.656
β_l	0.455	1.320	0.909 **	2.562	0.788 **	2.026	0.866 **	1.994
β_k	-0.029	-0.092	-0.550	-1.085	0.276	0.815	0.546	1.636
β_m	0.603 **	2.256	0.455	0.659	0.474 *	1.655	-0.090	-0.293
β_t	0.067	1.155	0.131 **	2.219	0.124 *	1.942	0.110 *	1.731
δ_{LL}	0.222 ***	12.449	0.214 ***	11.410	0.096 ***	13.886	0.074 ***	10.630
δ_{SS}	0.243 ***	14.413	0.224 ***	12.397	0.183 ***	12.118	0.121 ***	7.225
δ_{dd}	0.156 ***	3.469	0.176 ***	3.573	0.175 ***	3.608	0.127 ***	2.907
δ_{ll}	0.047	0.763	-0.043	-0.698	0.036	0.535	0.031	0.432
δ_{kk}	0.179 **	2.521	0.128	1.613	0.316 ***	4.067	0.346 ***	4.777
δ_{mm}	0.185 ***	3.312	0.187 **	2.355	0.230 ***	3.803	0.204 ***	3.397
δ_{tt}	-0.003	-0.814	-0.001	-0.135	-0.003	-0.673	0.001	0.389
δ_{Ld}	-0.021	-0.942	-0.035	-1.165	-0.027	-1.149	-0.012	-0.537
δ_{Ll}	0.036	1.464	0.031	1.165	0.001	0.029	-0.033	-1.202
δ_{Lk}	-0.024	-1.063	-0.024	-1.033	-0.059 **	-2.491	-0.033	-1.523
δ_{Lm}	0.005	0.185	0.021	0.548	0.050 *	1.854	0.077 ***	2.901
δ_{Sd}	0.085 ***	3.805	0.092 ***	3.938	0.107 ***	4.388	0.085 ***	3.751
δ_{Sl}	-0.108 ***	-4.301	-0.094 ***	-2.761	-0.090 ***	-3.158	-0.040	-1.520
δ_{Sk}	-0.025	-1.040	-0.018	-0.704	-0.011	-0.418	-0.032	-1.289
δ_{Sm}	0.056 **	2.134	0.032	1.061	0.016	0.574	-0.001	-0.044
δ_{dl}	-0.109 ***	-2.888	-0.117 **	-1.976	-0.091 **	-2.188	-0.056	-1.458
δ_{dk}	-0.109 **	-2.211	-0.125 **	-2.353	-0.156 ***	-2.976	-0.093 *	-1.926
δ_{dm}	0.043	1.072	0.029	0.681	0.055	1.273	0.015	0.348
δ_{lk}	0.077	1.507	0.159 **	2.284	0.042	0.751	-0.019	-0.365
δ_{lm}	-0.089 *	-1.888	-0.054	-0.652	-0.074	-1.478	-0.020	-0.390
δ_{km}	-0.110 **	-2.366	-0.119 **	-2.460	-0.154 ***	-3.050	-0.168 ***	-3.462
δ_{Lt}	0.003	0.542	0.003	0.458	-0.012 *	-1.895	-0.002	-0.292
δ_{St}	0.002	0.348	0.000	-0.065	0.014 **	1.967	0.001	0.125
δ_{dt}	0.030 **	2.446	0.031 **	2.500	0.015	1.108	0.001	0.098
δ_{lt}	-0.016	-1.576	-0.021 **	-2.087	-0.014	-1.207	-0.009	-0.878
δ_{kt}	-0.030 **	-2.271	-0.030 **	-2.248	-0.035 **	-2.375	-0.017	-1.267
δ_{mt}	0.002	0.223	0.003	0.290	0.009	0.830	0.007	0.802
δ_{LS}	-0.207 ***	-13.395	-0.188 ***	-11.338	-0.114 ***	-12.293	-0.064 ***	-5.578
γ	0.655 ***	11.980	0.515 ***	9.802				
μ			0.370 ***	7.577				
σ^2	0.104 ***	7.333	0.066 ***	7.600				
Log likelihood	85.15		97.65					
LR test								
$\gamma = 0$	114.94 ***		139.94 ***					
$\mu = 0$			24.99 ***					
Adj R^2					0.981		0.990	
LM test					158.43 ***			
Hausman test					225.06 ***			

***, **, * indicates significance at the 1%, 5% and 10% level, respectively.[a] The cost residuals have the correct (rightward) skew in all cases. Number of observations: 715.

Table A2

Structural tests of the cost function - MLE

Stock, mutual, public- and foreign-owned banks, 1993-2000

Hypothesis	Likelihood Ratio test statistic [a]		df	Chi-square [b]
	MLE Half normal	MLE Truc normal		
(i) Homotheticity $\delta_{jm}=0$, $\delta_{mt}=0$	55.1	58.4	10	18.3
(ii) Homogeneity $\delta_{jm}=0$, $\delta_{mt}=0$, $\delta_{mn}=0$	336.2	332.2	13	22.4
(iii) Unitary elasticity of substitution $\delta_{jk}=0$	68.2	70.4	10	18.3
(iv) Cobb-Douglas: $\delta_{jm}=0$, $\delta_{mt}=0$, $\delta_{mn}=0$, $\delta_{jk}=0$	446.7	449.1	23	35.2
(vi) Technical change $\delta_{mt}=0$, $\delta_{jt}=0$, $\delta_{t}=0$, $\delta_{tt}=0$	25.5	16.8	8	15.5

[a] $LR=-2[L(H_0)-L(H_1)]$, $L(H_0)$ and $L(H_1)$ are the values of the log-likelihood function under the null and alternative hypotheses, respectively. If the null hypothesis is true, LR has approximately a Chi-square distribution with degrees of freedom equal to the number of restrictions. [b] Critical value at 5% level.

Table A3

Structural tests of the cost function – GLS and WITHIN

Stock, mutual, public- and foreign-owned banks, 1993-2000

Statistic	F test statistic [a]		df [b]	F [c]
	GLS Random-effects	WITHIN Fixed-effects		
(i) Homotheticity $\delta_{jm}=0$, $\delta_{mt}=0$	102.3	81.2	10	1.831
(ii) Homogeneity $\delta_{jm}=0$, $\delta_{mt}=0$, $\delta_{mn}=0$	1,607.0	546.0	13	1.752
(iii) Unitary elasticity of substitution $\delta_{jk}=0$	65.3	94.1	10	1.831
(iv) Cobb-Douglas: $\delta_{jm}=0$, $\delta_{mt}=0$, $\delta_{mn}=0$, $\delta_{jk}=0$	1,511.0	627.9	23	1.517
(vi) Technical change $\delta_{mt}=0$, $\delta_{jt}=0$, $\delta_{t}=0$, $\delta_{tt}=0$	30.6	39.1	8	1.938

[a] F=[(URSS-RSSS)/n1] / [URSS/n2] where URSS and RSSS are the residual sum of squares of the unrestricted and restricted models, respectively, n1 is the number of restrictions and n2 equals the sample size minus the parameters of the unrestricted model. Under the null hypothesis, the test has an F distribution with n1 and n2 degrees of freedom. [b] Numerator d.f. Denominator d.f.: 532 (GLS) and 679 (WITHIN). [c] Critical value at 5% level.

Table A4

Cost efficiency using Translog cost function (including financial capital)

Stock, mutual, public- and foreign-owned banks, 1993-2000

Type of bank	MLE Half normal	MLE Trunc normal	GLS Random effects	WITHIN Fixed effects	DFA
A. Excluding financial capital					
Private (stock) banks	0.846	0.726	0.587	0.331	0.686
	(0.090)	(0.102)	(0.104)	(0.138)	(0.079)
Private (mutual) banks	0.804	0.676	0.554	0.305	0.643
	(0.060)	(0.075)	(0.092)	(0.153)	(0.059)
Public banks	0.723	0.610	0.491	0.222	0.609
	(0.120)	(0.098)	(0.080)	(0.079)	(0.084)
Foreign banks	0.844	0.720	0.567	0.324	0.658
	(0.086)	(0.108)	(0.130)	(0.211)	(0.049)
Overall average	0.820	0.696	0.563	0.309	0.661
	(0.096)	(0.103)	(0.105)	(0.150)	(0.076)
B. Including financial capital					
Private (stock) banks	0.825	0.682	0.673	0.429	0.698
	(0.103)	(0.115)	(0.113)	(0.158)	(0.075)
Private (mutual) banks	0.782	0.630	0.620	0.393	0.657
	(0.066)	(0.082)	(0.083)	(0.127)	(0.056)
Public banks	0.701	0.567	0.559	0.295	0.641
	(0.107)	(0.083)	(0.076)	(0.077)	(0.049)
Foreign banks	0.817	0.675	0.667	0.415	0.670
	(0.102)	(0.126)	(0.136)	(0.226)	(0.047)
Overall average	0.799	0.651	0.643	0.397	0.676
	(0.102)	(0.111)	(0.111)	(0.157)	(0.068)

Mean and standard deviation in parenthesis.

Financial capital is added to the translog cost specification to capture default risk and the risk preferences of bank management. The translog cost function, including financial capital as a fixed input, is specified as follows:

$$\ln c\,(y,w,z) = \text{translog} + \beta_r \ln r + \frac{1}{2}\cdot\delta_{rr} \ln r\cdot\ln r + \sum_m \delta_{rm} \ln r\cdot\ln y_m$$
$$+ \sum_j \delta_{rj} \ln r\cdot\ln w_j + \delta_{rt} \ln r\cdot t + \ln u^c + \ln v^c$$

where r is financial capital measured as total equity. Berger and Mester (1997) report similar efficiency scores from including and excluding financial capital.

Table A5

Cost efficiency using Fourier flexible cost function

Stock, mutual, public- and foreign-owned banks, 1993-2000

Type of bank	MLE Half normal	MLE Trunc normal	GLS Random effects	WITHIN Fixed effects	DFA
A. Translog					
Private (stock) banks	0.846	0.726	0.587	0.331	0.686
	(0.090)	(0.102)	(0.104)	(0.138)	(0.079)
Private (mutual) banks	0.804	0.676	0.554	0.305	0.643
	(0.060)	(0.075)	(0.092)	(0.153)	(0.059)
Public banks	0.723	0.610	0.491	0.222	0.609
	(0.120)	(0.098)	(0.080)	(0.079)	(0.084)
Foreign banks	0.844	0.720	0.567	0.324	0.658
	(0.086)	(0.108)	(0.130)	(0.211)	(0.049)
Overall average	0.820	0.696	0.563	0.309	0.661
	(0.096)	(0.103)	(0.105)	(0.150)	(0.076)
B. Fourier Flexible					
Private (stock) banks	0.848	0.737	0.624	0.387	0.765
	(0.091)	(0.099)	(0.100)	(0.151)	(0.077)
Private (mutual) banks	0.802	0.685	0.580	0.366	0.720
	(0.061)	(0.070)	(0.062)	(0.131)	(0.059)
Public banks	0.725	0.626	0.524	0.268	0.698
	(0.117)	(0.096)	(0.082)	(0.085)	(0.083)
Foreign banks	0.847	0.726	0.620	0.375	0.736
	(0.086)	(0.105)	(0.127)	(0.232)	(0.055)
Overall average	0.821	0.707	0.598	0.361	0.740
	(0.096)	(0.100)	(0.099)	(0.155)	(0.075)

Mean and standard deviation in parenthesis.

The Fourier flexible form is a global approximation that augments that translog by adding Fourier trigonometric terms. For the cost function is written as follows:

$$\ln c\,(y,w,z) = \text{translog} + \sum_{n}[\varphi_n \cos(x_n) + \omega_n \sin(x_n)] +$$
$$+ \sum_{n}\sum_{q}[\varphi_{nq} \cos(x_n + x_q) + \omega_{nq} \sin(x_n + x_q)] + \ln u^c + \ln v^c$$

where x_n are re-scaled values of the $\ln y_m$, such that each of the x_n is in the interval $[0,2\pi]$, and π refers to the number of radians. However, each end of the $[0,2\pi]$ is cut

10% to reduce approximation problems near the endpoints. The formula for x_n is $0.2\pi - \mu \cdot a + \mu \cdot \ln y$, where (a,b) is the range of variation of ln y and $\mu = (0.9 \cdot 2\pi - 0.1 \cdot 2\pi)/(b-a)$. Following Berger, Leusner and Mingo (1997), the Fourier terms are applied to the outputs leaving the input price effects to be defined by the translog terms. In addition, the linear homogeneity and symmetry restrictions are also applied to the translog portion of the function.

Table A6

Parameter estimates for profit function using MLE, GLS and WITHIN methods

Parameter	MLE Half normal [a]		MLE Truncated normal [a]		GLS Random effects		WITHIN Fixed effects	
	Coef.	t ratio	Coef.	t ratio	Coef	t ratio	Coef.	t ratio
α	27.077 ***	4.044	26.354 ***	21.239	16.269 ***	3.547		
β_L	-1.667 *	-1.845	-1.630 **	-2.445	-1.012	-1.595	-3.970 ***	-4.667
β_S	0.981	1.276	1.036	1.414	0.441	0.811	1.310 *	1.754
β_d	-2.883 **	-2.194	-2.888 ***	-2.824	-1.993 **	-2.137	-0.293	-0.263
β_l	-3.239	-1.583	-3.221 ***	-3.713	-0.221	-0.157	-3.139	-1.570
β_k	2.775	1.542	2.747 ***	2.909	1.542	1.214	2.214	1.439
β_m	0.674	0.455	0.619	0.612	0.326	0.315	0.967	0.711
β_t	0.080	0.235	0.086	0.260	0.012	0.051	-0.058	-0.196
δ_{LL}	0.292 ***	2.793	0.291 ***	2.809	0.260 ***	3.553	0.398 ***	4.366
δ_{SS}	-0.158	-1.616	-0.147	-1.528	-0.126 *	-1.799	-0.543 ***	-4.994
δ_{dd}	-0.052	-0.191	-0.033	-0.127	-0.069	-0.357	0.006	0.030
δ_{ll}	0.472	1.368	0.486 **	2.159	0.096	0.402	0.437	1.327
δ_{kk}	0.268	0.737	0.269	0.756	0.471 *	1.826	0.269	0.901
δ_{mm}	0.105	0.318	0.138	0.473	0.076	0.326	0.017	0.062
δ_{tt}	-0.010	-0.433	-0.010	-0.411	-0.009	-0.516	0.005	0.272
δ_{Ld}	0.339 ***	2.735	0.339 ***	2.905	0.261 ***	2.991	-0.006	-0.058
δ_{Ll}	-0.265 *	-1.802	-0.258 *	-1.894	-0.268 **	-2.572	-0.283 **	-2.297
δ_{Lk}	0.254 *	1.901	0.249 *	1.835	0.191 **	2.013	0.105	0.976
δ_{Lm}	-0.299 **	-2.096	-0.299 **	-2.143	-0.225 **	-2.220	0.134	1.102
δ_{Sd}	-0.063	-0.462	-0.060	-0.439	-0.079	-0.817	0.170	1.520
δ_{Sl}	0.386 **	2.471	0.367 **	2.388	0.365 ***	3.302	0.453 ***	3.518
δ_{Sk}	-0.119	-0.748	-0.113	-0.726	-0.073	-0.648	0.031	0.238
δ_{Sm}	0.204	1.336	0.211	1.382	0.080	0.735	-0.257 **	-1.968
δ_{dl}	-0.281	-1.283	-0.286	-1.484	-0.191	-1.230	-0.360 **	-2.062
δ_{dk}	0.548 **	1.981	0.546 **	2.044	0.427 **	2.200	0.268	1.195
δ_{dm}	-0.319	-1.277	-0.337	-1.451	-0.247	-1.391	-0.069	-0.344
δ_{lk}	-0.662 **	-2.291	-0.656 ***	-2.938	-0.492 **	-2.418	-0.563 **	-2.330
δ_{lm}	0.118	0.440	0.125	0.548	0.308	1.637	0.092	0.409
δ_{km}	0.092	0.385	0.075	0.315	-0.183	-1.079	0.145	0.713
δ_{Lt}	0.085 **	2.282	0.083 **	2.226	0.085 ***	3.213	0.067 **	2.297
δ_{St}	-0.107 ***	-2.599	-0.106 **	-2.575	-0.093 ***	-3.173	-0.098 ***	-3.017
δ_{dt}	0.131 *	1.712	0.128 *	1.694	0.149 ***	2.731	0.152 **	2.515
δ_{lt}	0.043	0.744	0.044	0.788	0.020	0.476	0.046	0.928
δ_{kt}	-0.087	-1.119	-0.090	-1.192	-0.080	-1.448	-0.048	-0.790
δ_{mt}	-0.048	-0.827	-0.048	-0.835	-0.032	-0.779	-0.082 *	-1.884
δ_{LS}	-0.083	-0.930	-0.088	-0.987	-0.085	-1.339	0.140	1.587
γ	0.285 ***	3.354	0.536 ***	3.150				
μ			-1.937	-1.278				
σ^2	1.139 ***	9.030	1.751 ***	3.183				
Log likelihood	-630.5		-629.7					
LR test								
$\gamma = 0$	16.65 ***		18.10 ***					
$\mu = 0$			1.46					
Adj R^2					0.638		0.690	
LM test					12.79 ***			
Hausman test					93.53 ***			

***, **, * indicates significance at the 1%, 5% and 10% level, respectively. [a] The profit residuals have the correct (leftward) skew in all cases. Number of observations: 476.

Table A7

Parameter estimates for cost function using time-varying MLE

Parameter	Cost function Coef.	t ratio	Parameter	Inefficiency function Coef.	t ratio
α	1.928 **	2.158	ξ_0	5.362 ***	12.139
β_L	0.185	1.221	ξ_{Dpub}	1.780 ***	7.749
β_S	0.889 ***	6.532	ξ_{Dfor}	-0.053	-0.273
β_d	0.138	0.707	ξ_{Dmut}	0.826 ***	2.254
β_l	-0.098	-0.358	ξ_{Size}	-0.674 ***	-15.468
β_k	0.106	0.356			
β_m	1.071 ***	4.667			
β_t	0.026	0.495			
δ_{LL}	0.226 ***	13.517			
δ_{SS}	0.257 ***	15.718			
δ_{dd}	-0.012	-0.271			
δ_{ll}	0.022	0.428			
δ_{kk}	0.136 **	2.083			
δ_{mm}	0.103 **	2.151			
δ_{tt}	-0.004	-0.853			
δ_{Ld}	0.034	1.586			
δ_{Ll}	0.074 ***	3.143			
δ_{Lk}	-0.027	-1.148			
δ_{Lm}	-0.089 ***	-3.818			
δ_{Sd}	-0.003	-0.113			
δ_{Sl}	-0.080 ***	-3.292			
δ_{Sk}	-0.023	-0.910			
δ_{Sm}	0.078 ***	3.370			
δ_{dl}	-0.025	-0.675			
δ_{dk}	-0.086	-1.637			
δ_{dm}	0.078 **	2.008			
δ_{lk}	0.047	0.942			
δ_{lm}	-0.037	-0.888			
δ_{km}	-0.124 ***	-2.866			
δ_{Lt}	0.000	0.053			
δ_{St}	0.009	1.390			
δ_{dt}	0.026 **	2.051			
δ_{lt}	-0.018 *	-1.907			
δ_{kt}	-0.014	-1.144			
δ_{mt}	0.004	0.442			
δ_{LS}	-0.242 ***	-16.179			
γ	0.965 ***	17.624			
σ^2	0.510 ***	8.566			
Log likelihood	138.95				
LR test					
$\gamma = 0$	222.54 ***				

***, **, * indicates significance at the 1%, 5% and 10% level, respectively.[a] The cost residuals have the correct (rightward) skew. Number of observations: 715.

Figure A1
Half-normal, Truncated-normal and GLS cost efficiency scores

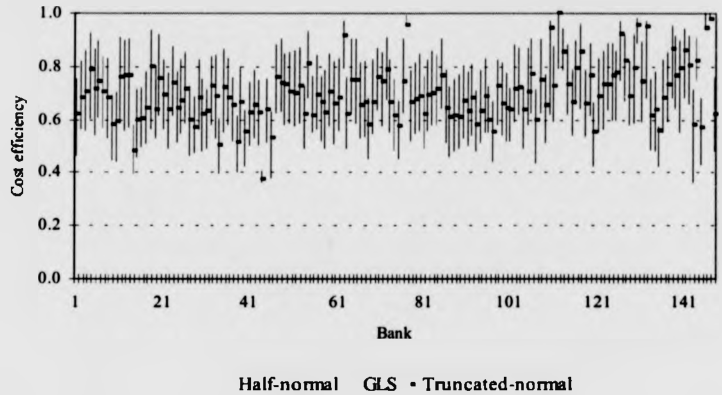


Figure A2
WITHIN, GLS and DFA cost efficiency scores

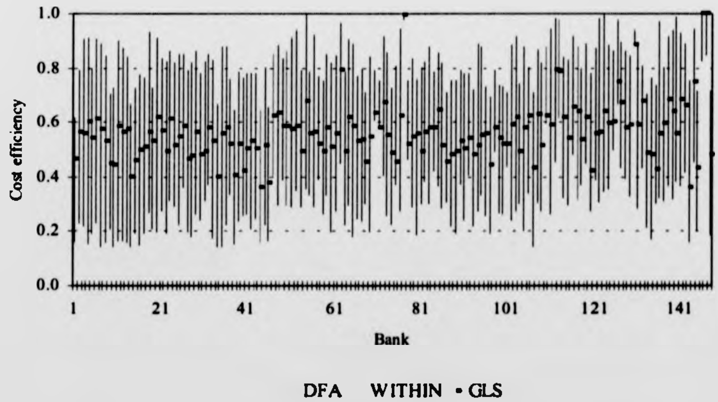


Figure A3

Correlation Half-normal/Truncated-normal (ρ=0.978)

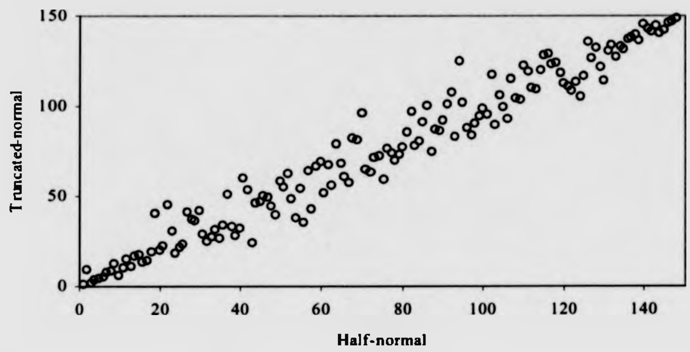


Figure A4

Correlation Half-normal/GLS (ρ=0.945)

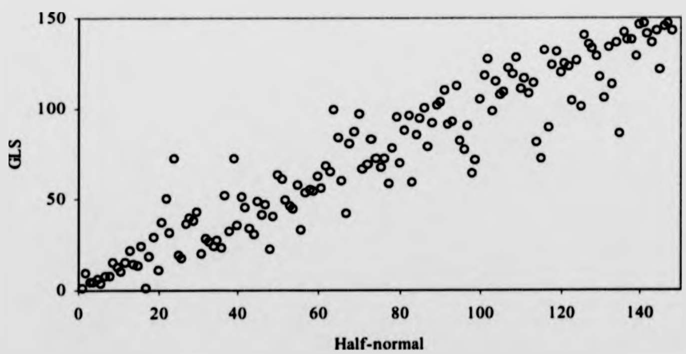


Figure A5

Correlation GLS/WITHIN (ρ=0.623)

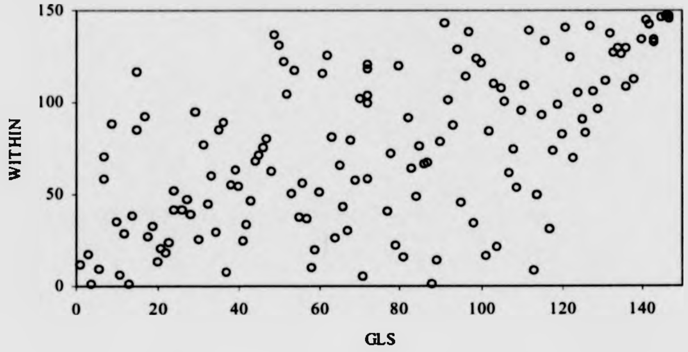
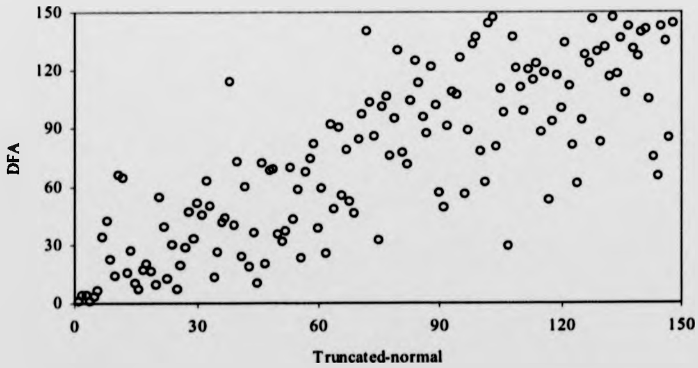


Figure A6

Correlation Truncated-normal/DFA (ρ=0.806)



Chapter 5

Multimarket Contact and Market Entry Dynamics

5.1 Introduction

The reforms implemented in Argentina throughout the decade of the 1990s led to changes in the structure of the banking sector towards greater consolidation. During the decade a number of mergers and acquisitions among domestic banks and also several other transactions involving foreign financial institutions led to a significant reduction in the number of banks operating in the system. As a result of this process, the industry became increasingly dominated by larger and more geographically diverse entities that encounter each other in multiple geographic markets. In fact, the average bank's network of branches more than doubled while the number of geographic markets served increased by three-quarters over the 1990s.

The increasing geographic expansion of large banks with the consequent increase of multimarket contact raises concerns about the effects of contacts in multiple markets on interfirm relationships and competition. Theoretical studies of multimarket contact argue that firms facing each other in multiple markets are more likely to act collusively, as contact in multiple markets gives greater scope for firms to respond to their competitors' actions. Firms recognise that aggressive behaviour in a particular market may be met with retaliation by a rival in other common markets. For the banking industry, however, previous empirical studies on the effects of multimarket contact on competition yield ambiguous results; some studies suggest that multimarket contact may reduce competition while others find the opposite effect or no effect at all of multimarket contact.

Several limitations of previous research may account for these ambiguous results. Firstly, most studies focus on outcomes of rivalry (using for example profitability, price-cost margins, prices or changes in market shares as proxies for competition), rather than on the rivalry process itself. Secondly, many works use either market- or firm-level indexes of multimarket contact, while collusive agreements should not vary so much across firms or markets as from firm to firm in a given market(s). Thirdly, many studies use cross-section data assuming that observations are in long-run equilibrium. Fourthly, some works do not include adequate controls for industry, market and firm characteristics and also for moderators of the relationship between multimarket contact and competition (Baum and Korn, 1999).

This chapter analyses the relationship between multimarket contact and competition in the Argentine banking industry over the 1994-2000 period.[75] The focus of the analysis is on the effects of multimarket contact on banks' entry into new markets taking into account the influences of firm- and market-level conditions on banks' choices of entry and of other competitive and market factors affecting the relationship between multimarket contact and entry. The results suggest that banks with large asset bases and greater experience are more likely to expand into new markets when the level of demographic variables such as population density, demand or market growth are favourable. The findings imply that multimarket contact reduces the likelihood of entry into new markets and that other factors such as market dominance and market concentration also have a negative impact on entry. Finally, the results reveal that strategic similarity among multimarket competitors amplifies the negative effect of multimarket contact on the hazard of entry.

The rest of the chapter is organised as follows. Section 5.2 reviews theoretical and empirical studies on the relationship between multimarket contact and competition. Section 5.3 discusses the link between multimarket contact and market entry, the factors that moderate this relationship and the firm and market characteristics that influence market entry. Section 5.4 presents the methodology. Section 5.5 describes the data sources and the definition of variables and provides a brief overview of the dataset. Section 5.6 reports and discusses the results. Finally, the last section summarises and presents the conclusions.

5.2 Literature Review

5.2.1 Theoretical Studies

Multimarket contact refers to a situation in which the same firms meet each other in multiple geographic-product markets. Although multimarket contact increases the opportunity that rivals have to compete with each other, the theory of multimarket competition suggests that such contact in multiple geographic-product markets leads to mutual forbearance i.e. less vigorous competitive interaction in all markets in which they meet, and more stable and predictable behaviour over time (Edwards, 1955). Mutual forbearance among multimarket competitors is proposed to occur as a result of two different processes: deterrence (Bernheim and Whinston, 1990; Edwards, 1955;

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[75] The explanatory variables are measured at the start of the year, but data for 1993 are only available for the end of that year. For this reason the sample period spans from 1994 to 2000.

Porter, 1980, 1981) and familiarity (Williamson, 1965; Scott, 1993; Baum and Korn, 1999).[76]

Several authors argue that strategic deterrence may be responsible for mutual forbearance among multimarket competitors. Edwards (1955) and Porter (1980, 1981) suggest that deterrence strategies are more likely to emerge when firms face each other in multiple markets for at least two reasons. On the one hand, because retaliation involving simultaneous attacks in several markets where the firms meet could be more damaging than retaliation within a single market. On the other, because retaliation could take place in markets in which the retaliator's potential losses are small or the aggressor's potential losses are large, forcing the aggressor to bear a higher relative cost for its competitive attacks.

Bernheim and Whinston (1990) formalise these intuitions into a game theoretic framework in which they analyse the effect of multimarket contact on the degree of collusion.[77] They show that when identical firms meet in identical markets and the technology exhibits constant returns to scale, multimarket contact does not facilitate cooperation, the so-called *irrelevance result*. However, they also demonstrate that under a variety of asymmetric conditions with respect to firms and markets, multimarket contact can facilitate tacit collusion by relaxing the incentive constraints governing the implicit agreements between firms. They show that if demand growth rates differ across markets, multimarket contact contributes to shift punishment power

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[76] Deterrence is the extent to which a firm is capable of preventing its rivals from initiating offensive actions that may damage its interests in a particular market. Familiarity is the extent to which a firm's knowledge of its rivals contributes to facilitate tacit cooperation (Jayachandran et al., 1999).
[77] A previous work by Bulow, Geanakoplos, and Klemperer (1985) investigate the effects of cost- and demand-based linkages across markets in the context of static oligopolistic models. However, their analysis does not address the issue that multimarket contact may facilitate tacit collusion among firms.

from rapidly to slowly growing markets. They also demonstrate that when firm production costs differ across markets or when scale economies are present, collusion can be sustained through the development of spheres of influence. Similarly if a single firm maintains a cost advantage over its rivals, or if the number of competitors varies across markets, firms can pool the incentive constraints across markets and transfer the ability to collude from markets in which cooperation is easy to sustain to those in which more rivalry exist.

Spagnolo (1999) further identifies an additional circumstance in which multimarket contact facilitates collusion, which is independent of asymmetries. He shows that when firms' objective function is strictly concave in profits, multimarket contact always facilitates tacit cooperation. He demonstrates that a strictly concave objective function has the effect of making the strategic interactions interdependent i.e. firms' evaluation of profits in one market depends on profits accumulated in other markets. In this context, multimarket contact has two effects that enhance firms' abilities to collude. On the one hand, it makes the expected losses from simultaneous retaliations in more markets to be larger than the sum of those from retaliations in independent markets. On the other, the threat of simultaneous retaliation ensures that firms' optimal deviation is simultaneous in all markets, which makes short-run gains from deviating less valuable.[78] These two effects always facilitate collusion. In addition, when the asymmetric conditions identified by Bernheim and Whinston are also present, the effect of multimarket contact as a facilitator of collusion is strengthened.

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[78] Because the marginal utility of profits is decreasing.

Other authors suggest that the increased familiarity among multimarket rivals may be responsible for mutual forbearance. Williamson (1965) argues that communication among firms is essential to coordinated responses. He suggests that the degree of coordination among firms increases as their level of communication raises. However, at high levels of familiarity, subsequent increases in communication produce successively smaller increases in the level of adherence to group goals. This can result from two possible effects. On the one hand, the early communications may be concerned with more essential matters for obtaining coordination among rivals than are the later. On the other, the susceptibility to influence is almost certainly going to reach a saturation point as long as the difference between individual and group goals exists.

Scott (1993, 2001) also points to increased familiarity as the reason for the effect of multimarket contact on firms' behaviour. He argues that the *irrelevance result* of Bernheim and Whinston does not show that multimarket contact has no effect on collusion. Scott (1982) argues that multimarket contact may facilitate collusion through the provision of the communication required to select a desirable Nash equilibrium from among the many equilibria that exist in multiperiod games. The repeated interactions in multiple markets could provide firms with enough experience to choose an equilibrium that is better from their private perspectives. This view about multimarket contact and increased experience helping firms solve the equilibrium selection problem applies even in the Bernheim and Whinston and Spagnolo frameworks.

5.2.2 Empirical Studies

Several empirical studies analyse the relationship between multimarket contact and competition. Some of these works examine firms meeting in different manufacturing industries (Scott, 1982, 1991, 2001; Feinberg, 1985; Hughes and Oughton, 1993). Other studies explore intra-industry multimarket contact across geographic markets for firms operating in airlines (Sandler, 1988; Singal, 1993; Evans and Kessides, 1994; Baum and Korn, 1996, 1999; Gimeno and Woo, 1996, 1999; Gimeno, 1999), telephone-equipment manufacturers (Barnett, 1993), cellular telephone service providers (Parker and Röller, 1997; Busse, 2000), cement manufacturers (Jans and Rosenbaum, 1997), hospitals (Boecker et al., 1997), hotels (Fernandez and Marin, 1998) and computer software (Young et al., 2000),. These studies generally find a positive link between prices, profits or market share stability and multimarket contact among firms, the exceptions being Sandler (1988) and Baum and Korn (1999). Sandler (1988) finds that multimarket contact is negatively related to airlines' market share stability while Baum and Korn (1999) find that multimarket contact has an inverted U relationship with rate of entry and exit in the airlines sector.

Empirical studies examining the relationship between multimarket contact and competition in the banking industry provide mixed results. These studies proxy competition with measures such as profitability, interest rates, service charges or changes in market shares. Contact is primarily measured with variables that capture either the number of links among a specified set of banks (either all banks in a market or some subset of leading institutions) or the level of deposits held by those banks. Table 5.1 presents empirical studies of multimarket contact in the banking industry. Some works find a positive link between multimarket contact and forbearance

(Heggested and Rhoades, 1978; Pilloff, 1999), others find a negative link (Whitehead, 1978; Alexander, 1985; Mester, 1987) and some get mixed findings (Rhoades and Heggested, 1985).[79]

Table 5.1

Empirical studies of multimarket contact in the banking industry

Author	Sample	Findings [a]	Support for forbearance
Profitability, prices, stability of market shares and multimarket contact			
Heggested and Rhoades (1978)	Top 3 U.S. bank holding companies in 187 major markets, 1966-1972	Market share stability higher in markets with higher MMC	Positive
Whitehead (1978)	U.S. bank holding companies in Florida, 1976	Market share stability and service charges on deposits lower (but loan rates and fees higher) in markets with high MMC	Negative
Alexander (1985)	U.S. bank holding companies in 6 states, 1975	Service charges on deposits higher in markets with high MMC. No effect of MMC on interest rates.	Negative
Rhoades and Heggested (1985)	1,074 U.S. banks in 154 markets, 1970-1979	No effect of MMC on ROA, service charges, or interest rates and fees	None
Mester (1987)	171 U.S. savings and loans in 56 county markets in California, 1982	Deposits rates higher, and market share stability and ROA lower in markets with high MMC	Negative
Pilloff (1999)	6,233 U.S. banks, 1992-1995	ROA higher in markets with high MMC	Positive
Market entry and multimarket contact			
Haveman and Nonnemaker (2000)	U.S. savings and loans in California, 1977-1991	Inverted U relationship between growth in current markets and entry to new markets and MMC	Positive for high levels of MMC
Fuentelsaz and Gomez (2002)	Spanish savings and loans, 1986-1999	Inverted U relationship between entry to new markets and MMC	Positive for high levels of MMC

[a] MMC: multimarket contact.

[79] Gelfand and Spiller (1987) analyse the effects of multimarket contact in product markets instead of geographic markets. They consider two product markets: loans in domestic and foreign currency, respectively. They find evidence of noncompetitive behaviour consistent with mutual forbearance, whereby firms avoid changing behaviour in one market fearing retaliation in another market.

Several limitations of previous works may account for these ambiguous results. Firstly, most studies focus on rivalry outcomes (using profitability, prices or changes in market shares as proxies for competition) rather than on the rivalry process itself. Secondly, many works use either market- or firm-level indexes of multimarket contact, while collusive agreements should not vary so much across firms or markets as from 'relationship to relationship' (Baum and Korn, 1999). Thirdly, many studies use cross-section data assuming that observations are in long-run equilibrium. Fourthly, some works do not include adequate controls for industry, market and firm characteristics and also for moderators of the relationship between multimarket contact and competition.

More recently, some studies in the banking industry analyse the impact of multimarket contact on rates of entry into new geographic markets, which may be considered a useful proxy for the intensity of rivalry among firms. Haveman and Nonnemaker (2000) analyse the impact of contact between saving banks in multiple markets in California focusing on two competitive behaviours i.e. growth in current markets and entry into new markets. They find that multimarket contact has an inverted-U-shaped effect on both growth into current markets and on entry into new markets for multimarket firms. Fuentelsaz and Gomez (2002a) examine the link between multimarket contact and entry into new markets in the Spanish savings bank industry following deregulation. They find that the influence of multimarket contact on entry is of an inverted U form and that entry is affected by the inclusion of moderators such as market dominance or strategic similarity among competitors. These studies use firm-market level measures of multimarket contact and incorporate controls for market and firm characteristics and some moderators of the relationship between contact and competition.

5.2.3 Entry Decisions

Several studies analyse entry behaviour more generally. Bresnahan and Reiss (1991), Berry (1992) and Scott-Morton (1999) use game theoretic models of discrete choice to develop econometric models of entry in oligopolistic markets. The predictions of these models are examined empirically in different markets using discrete choice techniques. Chevalier (1995) also uses discrete choice models to analyse de novo entry into the supermarket industry, but her model is not based on a game theoretic approach. Klepper and Simons (2000) use survival analysis techniques to analyse firm survival in the tire industry assuming that technical change drives entry and exit.

The game theoretic models of Bresnahan and Reiss (1991), Berry (1992) and Scott-Morton (1999) have several similarities. These studies assume that the number of market participants is the equilibrium outcome of a game in which firms choose whether or not to enter the market. A reduced-form profit function describes the resulting payoffs in terms of market conditions (and also firm characteristics in some of these models) and the number of operating firms. These works enforce a Nash equilibrium solution, so no profitable deviations from the observed equilibrium outcome are possible. All entrants earn positive profits while all non-entrants would not earned positive profits if they entered. Additional competitors reduce firms' profits in the postentry stage of the game. A probability is assigned to each outcome (number of operating firms) based on the equilibrium concept. Finally, these studies use maximum likelihood to select parameters of the payoff function that maximise the probability of the observed outcome.

These works, however, present several differences. Bresnahan and Reiss (1991) examine the effects of entry in five retail and professional markets. This study uses a profit function where the deterministic part of profits (composed of variable profits minus fixed costs) depends on market characteristics and the number of firms in the market. This work allows for unobserved profits through the error term but all firms within a market are assumed to have the same unobserved profit. These authors use an ordered probit model to measure entry thresholds ratios to analyse the effects of entry on competitive conduct in retail (tire dealers) and professional (doctors, dentists, druggists and plumbers) markets in the U.S.

Berry (1992) examines entry decisions in the airline industry. This study allows fixed costs to depend on observed and unobserved firm characteristics while variable profits, which are common to all firms, are function of (observed and unobserved) market characteristics and the number of firms in the market. This heterogeneity across firms introduces a substantial computational problem.[80] The author therefore uses simulation estimators that assume an order of entry (to solve this problem) to analyse airlines' entry decisions into city pair markets in the U.S.[81] Scott-Morton (1999) analyses entry into the generic pharmaceutical industry. This work also allows for firm heterogeneity in the profit function. Additionally, this study differentiates between existing firms in

[80] The probability of a given event has a complicated region of integration.
[81] He also uses probit and ordered probit models with and without unobserved heterogeneity.

the market and de novo entrants.[82] The author estimates a probit model to analyse entry decisions into the generic pharmaceutical industry.

Chevalier (1995) uses an econometric model, which is not based on a game-theoretic approach, to analyse de novo entry in the supermarket industry. This study analyses entry at the market level to explain the effects of capital structure (through the share of supermarkets that participated in leverage buyouts) on market structure. The author estimates a probit model to examine de novo entry by large supermarket chains into local markets in the U.S.

Klepper and Simons (2000) examine the effects of technological change on market structure and firm survival patterns in the tire industry. The driving force in their theoretical model is R&D. This study assumes that in each period new potential entrants composed by start-ups and firms with experience in related technologies arise. These potential entrants are heterogeneous since only a fraction of them are innovators while the remaining are imitators. In each period new R&D opportunities arise to lower costs, however, all innovations are costlessly imitated after one period. In each period potential entrants and incumbents choose their R&D and level of output to maximise current profits. Potential entrants enter if profits are non-negative while incumbent firms remain in the industry if profits are positive. Firms expand in each period until the marginal cost of growth equals their price-cost margin. Therefore, earlier entrants are larger than later entrants because they have lower average costs. Similarly, innovators are larger than imitators that enter in the same period.

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[82] As Toivanen and Waterson (2000) suggest the papers by Bresnahan and Reiss (1991) and Berry (1992) can be viewed as "explaining market structure rather than entry" (pg. 988).

This study also shows that the industry develops as follows. Initially, price is high enough to allow both innovators and imitators to enter profitably. Then price falls enough that only innovators can profitably enter. Eventually, price falls far enough that no firm can profitably enter and entry ceases. As price continues to fall, later entrants exit, contributing to a shakeout and evolution of an oligopolistic market structure. The authors use survival analysis techniques to examine the evolution of the U.S. tire industry concluding that technological change contributed to the changes in the structure of the industry as the theoretical model predicts.

These studies suggest that a potential entrant's decision to enter a market is a complex function of expected profits where expected profits depend not only on incumbent firm market structure, but also on potential competition as measured by ease of entry. Ease of entry also depends on factors such as market growth, barriers to entry and entrant capabilities. Empirical studies analysing entry and multimarket contact control for the effects of (some of) these factors on entry by including several firm and market-level control variables.

However, most of these studies (on entry and multimarket contact) do not give adequate attention to several factors that moderate the relationship between multimarket contact and competition (Jayachandran et al. 1999). Although some studies focus on some of these moderators (Baum and Korn, 1996, 1999; Haveman and Nonnemaker, 2000), there has been no attempt to examine integratively the impact of these moderators on the relationship between multimarket contact and the intensity of competition (Jayachandran et al. 1999). Fuentelsaz and Gomez (2002a) attempt to analyse the influence of more than one of these moderators, however, they only consider the impact of these variables on market entry rather than on multimarket contact. The objective of this study is to analyse the relationship between multimarket contact and entry into new geographic markets in the Argentine banking industry, taking into account the influence of these moderators, which are discussed in the next section.

5.3 Multimarket Contact and Market Entry Dynamics

The theoretical arguments presented above suggest that contact in multiple markets reduces the intensity of rivalry as a result of strategic deterrence and increased familiarity among multimarket competitors. However, empirical studies of the relationship between multimarket contact and competition in the banking industry does not provide clear support to those arguments. As mentioned above, these studies focus on prices, profitability or instability of market shares as proxies for the intensity of rivalry. However, there is a wide range of competitive actions available to firms that could be used as such proxies. Firm's market entry is key among strategic actions and represents an aggressive conduct that invite competitor reactions (Caves and Porter, 1977; Tirole, 1988; Scherer and Ross, 1990; Miller and Chen, 1994; Baum and Korn, 1996). Market entry provides then a useful proxy for the intensity of rivalry since the higher the entry rate, the more intense the rivalry (Porter, 1980, 1985; Caves, 1984).

Hence, if multimarket contact reduces the intensity of rivalry, multimarket firms will be unlikely to enter markets where their level of contact with market incumbents is high. Therefore, as the level of multimarket contact between a potential entrant to a market and the incumbent firms increases, the focal firm's likelihood of entry into that market will decline, ceteris paribus.[83] However, two opposing processes may also operate. First, when multimarket contact is low, firms have incentives to strengthen existing footholds in competitors' domains or establish new footholds to signal their ability to respond to an attack (Karnani and Wernerfelt, 1985). This expectation of strengthening or establishing a presence in competitors' domains may make multimarket firms inclined to enter markets as the level of multimarket contact with incumbents increases. Second, as the extent of multimarket contact increases, multimarket firms have more opportunities to observe each other's competitive behaviour increasing their abilities to interpret each other's intentions and actions (Boecker et al, 1997). This reduced uncertainty about rival's future behaviour may make multimarket firms inclined to enter markets as the number of contacts increases.

If all these processes associated with multimarket competition operate simultaneously, the result will be an inverted U-shaped relationship between multimarket contact and entry into new markets (Haveman and Nonnemaker, 2000). When multimarket contact between a potential entrant and the incumbents in the focal market is low, firms will be inclined to enter new markets to reinforce footholds in competitors' domains and to use the information benefits of additional contacts. In such circumstances, market entry will increase with multimarket contact. But when the level of multimarket contact between a potential entrant and the firms already operating in the focal market is high, firms will recognise that the risk of destabilising the competitive relationship will be more important than the incremental deterrent and information benefits of additional contacts. In such circumstances, market entry will decline with multimarket contact.

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[83] Focal market is the objective or target market for entry. The focal firm is the potential entrant in the focal market.

Therefore, *the relationship between multimarket contact and the rate of entry into new markets should have an inverted U-form.*

5.3.1 Moderator Variables

The relationship between multimarket contact and market entry is also affected by several moderators, which are typically characteristics of the competitive or market environment. Jayachandran et al. (1999) suggest three competitive and one market factors: (i) spheres of influence, (ii) resource similarity, (iii) organisation structure and (iv) market concentration as potential moderators of rivalry among multimarket competitors. Few previous studies analyse the moderating effects of these variables separately. Baum and Korn (1996) and Gimeno (1999) analyse the effects of spheres of influence, Gimeno and Woo (1996) and Young et al. (2000) consider the role of strategic similarity and Gimeno and Woo (1999) study the influence of organisational structure on multimarket competition. Fuentelsaz and Gomez (2002a) consider the effect of spheres of influence, resource similarity and market concentration *on firms' behaviour rather than the moderating effect on multimarket contact.* These moderating factors and their relationship to market entry behaviour and the interactive influences with multimarket contact are analysed below.

5.3.1.1 Spheres of Influence

Spheres of influence occur when firms engaged in multimarket competition have dominant market positions in different markets among those in which they meet (Edwards, 1955). The presence of spheres of influence may facilitate coordination among firms in a market, regardless of multimarket contact. Firms are more likely to retaliate in markets within their spheres of influence to protect important market positions (Haveman and Nonnemaker, 2000). Retaliation by dominant firms are likely to be harsher than retaliation by minor players because of their power to control prices or supply of material, financial and human resources. As a result, firms will be less likely to take aggressive actions in markets dominated by a large firm. This discussion suggests that *firms' entry rates into a new market should be lower when those markets are dominated by a single firm.*

Spheres of influence may also moderate the relationship between multimarket contact and the intensity of competition. Bernheim and Whinston (1990) suggest that the presence of spheres of influence leads to the reduction in the intensity of competition in a multimarket context rather than the simple aggregation of contacts. While the aggregation of contacts among firms may lead to reduced rivalry because of increased familiarity and deterrence among multimarket competitors, spheres of influence may enhance deterrence due to firms' interests in protecting important markets from rivals' actions. Hence, when firms are multimarket competitors, firms will be less inclined to take aggressive actions in markets dominated by a single firm (Baum and Korn, 1996). These arguments imply that *the impact of multimarket contact on the rate of entry into new markets should be amplified when those markets are dominated by a single firm.*

5.3.1.2 Strategic Similarity

Strategic similarity is the extent to which a firm's strategies in terms of advertising, cost structure, R&D, etc., are comparable to those of its competitors (Porter, 1979). Strategic similarity may influence the intensity of rivalry among firms in a market. Caves and Porter (1977) suggest that firms within a strategic group recognise their interdependence most closely while Newman (1978) argues that when firms have different strategies, such differences may lead to lack of consistency in their objectives, which may reduce their ability to tacitly collude. However, Porter (1976) points out that increased strategic similarity is often associated with increased product market interdependence, which could lead to more intense rivalry. In this context, Barney (1991) and Peteraf (1993) add that resource similarity among rival firms may increase rivalry. Consequently strategic similarity among firms in a market could be associated with more intense rivalry if the effect of lack of product differentiation or similar resource endowments outweighs the effect of increased coordination (Gimeno and Woo, 1996). These arguments imply that *the average strategic similarity of a firm to competitors in a market could be either positively, negatively or not related to the rate of entry into that market.*

But strategic similarity may also have an interactive influence with multimarket contact on firms' intensity of competition. Chen (1996) argues that firms' rivalrous behaviour depends on the consideration of both market and strategic profiles. Multimarket contact provides firms with additional information about rivals' behaviour across markets. For firms characterised by strategic similarity this additional information from multimarket contacts may increase the likelihood of coordination leading to tacit collusion. In addition, for firms characterised by strategic dissimilarities, this additional cross-market information provided by multimarket contact may provide a common basis with which to tacitly coordinate behaviour. Therefore, *the impact of multimarket contact on the rate of entry into new markets should be amplified, the higher the degree of strategic similarity among firms.*

5.3.1.3 Organisational Structure

Differences in organisational structure may influence firms' behaviour. Gimeno and Woo (1999) suggest that appropriate coordination among the different administrative units that manage operations in the different geographic markets is critical for the effectiveness of multimarket strategies. In the absence of such intrafirm coordination, competition converges to market-by-market competition, which may be less than optimal for overall firm performance (Jayachandran et al., 1999). An organisational unit within a firm, in its attempt to maximise performance within its geographic markets, may initiate actions that could lead to multimarket retaliation by better coordinated rivals. These actions may ultimately lead to losses in many markets. Therefore, firms with organisational units capable of coordinating actions across markets will be more likely to recognise the effects of interdependencies and respond to multimarket contact. Therefore, *the impact of multimarket contact on the rate of entry into new markets should be amplified when firms have organisational structures characterised by a greater degree of coordination of actions across the units that manage operations in the different markets than otherwise.*

5.3.1.4 Market Structure

Market concentration, an indicator of actual rivalry, represents another factor that may affect firms' actions.[84] Different lines of argument suggest different effects of concentration on firm's actions. On the one hand, oligopoly theory suggests that collusion is more likely to occur in concentrated markets because firms recognise their mutual interdependence (Scherer and Ross, 1990). On the other, the arguments offered

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[84] The literature has considered the effects of actual and potential rivalry when analysing entry decisions (Cotterill and Haller, 1992, for example). Following this literature, this section analyses the effects of actual rivalry on entry while the next section considers the influence of potential rivalry on rates of entry.

by the contestable markets theory suggest that under certain conditions, competitive outcomes can be observed even in concentrated markets (Baumol et. al., 1982).[85] Instead the theory of trigger price strategies suggests one means by which collusive behaviour may be sustained among arbitrarily many firms (Friedman, 1971). Consequently, the effect of market concentration on firms' actions cannot be determined. These arguments suggest that *firms' entry rates into a new market could be either positively, negatively or even unrelated to the degree of concentration in that market.*

Market concentration may also have an interactive influence with multimarket contact on firms' competitive behaviour. Linked oligopoly theory suggests that in oligopolistic markets, the degree of linkage among markets or among firms in different markets, represents an important determinant of performance. This view assumes that multimarket firms coordinate their operations across markets and that this coordination affects the intensity of rivalry. Bernheim and Whinston (1990) argue that multimarket contact is more likely to ensure coordination in concentrated markets. They maintain that it is easier for oligopolists who are also multimarket rivals to collude, even easier than it is for multimarket competitors in less concentrated markets. These arguments suggest *the impact of multimarket contact on the rate of entry into new markets should be amplified when those markets are highly concentrated.*

[85] However, these conditions are too extreme.

5.3.2 Firm and Market Control Variables

Several characteristics of the firms, focal and non-focal markets and the economic environment may also influence a firm's likelihood of entry into new markets. Previous studies include these factors in the analysis of market entry (Cotterill and Haller, 1992; Barnett, 1993; Baum and Korn, 1996; Haveman, 1993a,1993b, 2000; Fuentelsaz and Gomez, 2002a,b). These controls can be classified as: (i) firm-level characteristics including competence, size, experience and ownership structure; (iii) focal market controls such as market demand growth, demand intensity and potential rivalry; and (ii) non-focal market characteristics such as market concentration in markets where firms operate. These control variables and their potential influences on market entry are described below.

Several *firm* characteristics may influence rates of market entry. First, firms' competence may influence patterns of entry. More competent firms are characterised by superior management, costs control or strong market positions in established markets. These firms are more likely to enter new markets due to their ability to finance expansion either internally or externally (Cotterill and Haller, 1992). Second, firm's size may influence rates of market entry. Larger firms generally posses more slack resources, which may help them satisfy capital requirements associated with entry (Cyert and March, 1963; Haveman, 1993b). Moreover, larger firms also benefit from the existence of brand reputation or cost reductions associated with size that lower barriers to market entry (Caves and Porter, 1977; Haveman, 1993b). Third, firms with greater accumulated experience in managing operations across markets may exhibit higher rates of entry (Wilson, 1980). However, previous experience may also reduce the likelihood of entry for a highly diversified firm due to higher coordination and monitoring costs. Fourth, banks' ownership structure may also influence entry patterns. Banks with different ownership structure have different goals and authority structure, which affects their ability to monitor competitors or to devise adequate strategic responses.

Rates of market entry may also depend on the characteristics of *focal markets*. On the demand side, demand intensity and market growth may influence entry rates. A higher intensity of demand and/or market growth may lead to higher expected profits and a higher likelihood of entry.[86] On the supply side, potential rivalry may affect entry rates (Mitchell, 1989). A higher potential competition in the focal market will lead incumbents to discipline new entrants, making entry less attractive. Rates of entry may also depend on *non-focal market* characteristics. If rivalry in non-focal markets is high, firms will have incentives to diversify in order to relax the intensity of competition.

The preceding analysis suggests that a firm's likelihood of entry into a new (focal) market will be a function of: (i) the degree of multimarket contact with focal market incumbents; (ii) the competitive moderating factors: market share of the largest firm in the market; the degree of strategic similarity with the firms operating in the focal market and the firm's organisational structure; (iii) the level of concentration in the focal market; (iv) other firm and market characteristics. Hence, the basic estimating equation is along the following lines:

$$(5.1) \quad E_{int} = f\,(Mmc_{int}, Cmv_{int}, Mmv_{nt}, Fcv_{it}, Nfmcv_{mt}, Fmcv_{nt})$$

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[86] **A higher market growth rate can also reduce entry due to the larger queue of potential entrants (Cotterill and Haller, 1992). However, this effect is controlled for by including potential rivalry as a control variable.**

where E_{int} represents the hazard of firm i entering focal market n at time t, Mmc_{int} is the degree of multimarket contact between firm i and incumbent firms in market n (in markets different than n), Cmv_{int} are the competitive moderating factors of firm i in market n, Mmv_{nt} is the market moderating variable in focal market n; Fcv_{it}, are firm control variables and $Nfmcv_{mt}$ and $Fmcv_{nt}$ represent the market characteristics of non-focal market m and focal market n.

5.4 Methodology

Duration models are used to analyse the relationship between multimarket contact and entry into new geographic markets in the banking industry. Since the process of bank entry is intrinsically continuous but the observations are in discrete time (annual observations), the hazard that a bank enters a certain geographic market, given that, it does not already operate in that market is estimated using the Prentice and Gloeckler (1978) proportional hazards model for grouped data.[87] The parametric explanatory element includes the variables in (5.1) while the baseline hazard function is given a non-parametric specification for two reasons.[88] Firstly, because if a parametric baseline specification is incorrectly assumed the parameter estimates will be inconsistently estimated. Secondly, since even when the parametric baseline hazard specification is correct, a parametric approach will usually provide only a small increase in efficiency (Meyer, 1990).

Estimating market entry is subject to at least two problems. Firstly, the unit of analysis is the bank in a market in each year and the data on bank's operations across multiple

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[87] Survival times are grouped into discrete intervals of time.
[88] However, a parametric baseline hazard is also estimated in the empirical part for comparison purposes.

markets are pooled. As a result, the analysis of market entry is subject to non-independence bias from pooling multiple observations on each firm across multiple markets at each point in time.[89] To solve this problem, the model is estimated including random effects to account for the possible dependence between observations. Secondly, at each point in time, a bank is at risk of failure, by virtue of being alive, as well as of entering new markets. These risks are competing: if a bank fails it cannot simultaneously enter new markets, conversely if a bank enters new markets it cannot simultaneously fail. Therefore, in each year a bank can be treated as having simultaneous risks of entering new markets or failing. This can be modelled by means of an independent competing risk model where correlations between unobservable factors affecting each destination-specific hazard (entry or failure), are assumed away. Thus, single-destination models can be estimated separately, one for each destination. However, since the focus is on market entry dynamics the model of entry is the one estimated.

This section consists of two subsections. Section 5.4.1 introduces the proportional hazards model and discusses the grouped data model of Prentice and Gloeckler (1978) for the analysis of discrete time data. Section 5.4.2 discusses the extension of the grouped data model to include random effects to account for non-independence of observations.

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[89] Firms coordinate activities across multiple markets. This means that entry behaviour of each firm should be correlated across market leading to nonindependence across observations.

5.4.1 Proportional Hazards Models for Discrete Time Data

Proportional hazards models often assume that failure times (entry times), are expressed on a continuous time scale. In these models, the *continuous time hazard function* $\lambda(t)$ and explanatory variables x are associated through the expression:

$$(5.2) \quad \lambda\,(t;x_{it}) = \lambda_0(t) \cdot \exp\,(x_{it}'\beta)$$

where $\exp\,(x_{it}'\beta)$ represents a term specific to the individuals (banks) with covariates x_{it} (variables listed in (5.1)), β is a vector of regression coefficients and $\lambda_0(t)$ is the baseline hazard function corresponding to $\exp(\cdot)=1$. The hazard rate represents the conditional probability of having a spell length exactly t (bank entry into a new market in period t), conditional upon survival up to time t. In this specification the effect of explanatory variables is to multiply the hazard λ_0 by a factor $\exp(\cdot)$ which does not depend on duration t. Since $\partial \ln\lambda(t,x)/\partial x = \beta$ the coefficients can be interpreted as the constant proportional effect of x on the hazard rate. The associated *continuous time survivor function* is given by:

$$(5.3) \quad S(t;x_{it}) = \exp[-\Lambda_0(t)\cdot\exp(x_{it}'\beta)]$$

where $\Lambda_0(t)=\int_0^t \lambda_0(u)du$ is the integrated baseline hazard at t.

If $\lambda_0(\cdot)$ is completely arbitrary, expression (5.2) defines a semi-parametric regression model known as a Cox proportional hazard model (Cox, 1972). The Cox model is attractive since it permits the estimation of β without making any assumption about the form of $\lambda_0(\cdot)$. The procedure developed by Cox relies on the definition of a partial likelihood function, which is the part of the full likelihood function that does not depend on $\lambda_0(\cdot)$. The partial likelihood can be obtained as the marginal likelihood of the ranks of failure times since it contains all the information about the order in which failure occurred (Ducrocq, 1999). However, the ranking of failure times is not possible with a discrete measure of failure times, which generates a large amount of 'ties'.

When there are few ties between failure times (at least compared with the total number of observations), approximations of Cox's partial likelihood have been proposed. Cox (1972) suggested the use of logistic regression to approximate the true model. In addition, Breslow (1974) and Efron (1977) attempted to approximate the true partial likelihood when the information contained in the data does not allow an ideal construction. However, when there are many ties among failure times, these approximations are no longer valid and a different analysis must be performed.

Prentice and Gloeckler (1978) suggested an approach for discrete time data. In this method, if the underlying continuous durations are only observed in disjoint time intervals: $[0=\tau_0, \tau_1), [\tau_1, \tau_2),\ldots,[\tau_{k-1}, \tau_k),\ldots]$, all failures occurring during the interval $[\tau_{k-1}, \tau_k)$ are 'grouped' and the attached failure time is given by k. It is assumed that censoring only occurs at the end of each interval and that covariates are constant within each time interval. The *discrete time survivor function* in the kth interval has the same form as (5.3), which can be rewritten as follows:

(5.4) $S\,(t=\tau_k;x_{it}) = \exp\,[-\exp\,(x_{it}'\beta + \delta_k)]$ $\qquad k=1,\ldots,m$

where $\delta_k = \log [\Lambda_0(t)]$.

Assuming all intervals are of unit length, the *discrete time hazard function* in the kth interval is given by:

$$(5.5)\quad h(t=\tau_k;x_{it}) = 1 - \frac{S(\tau_k;x)}{S(\tau_{k-1};x)} = 1 - \exp[-\exp(x_{it}'\beta + \gamma_k)]$$

where $\gamma_k = \log \int_{\tau_{k-1}}^{\tau_k} \lambda_0(u)du$. The log likelihood function can be written as follows:

$$(5.6)\quad \log L = \sum_i \{c_i \cdot \log[S(t_{i-1};x_{it}) - S(t_i;x_{it})] + (1-c_i)\cdot \log[S(t_i;x_{it})]\}$$

where c_i is a censoring indicator. In contrast with the Cox model approach, the elements of the baseline survivor curve (the γ's in (5.4)) are estimated jointly with β.

5.4.2 Random Effects Models

In the presence of unobservable variables or non-independence from pooling observations, the model presented above can be extended by including a random error term along with the vector of individual characteristics x. The most commonly used correction model is based on the gamma distribution or an inverse Gaussian distribution since they give a closed form expression for the likelihood, avoiding numerical integration. However, other distributions could in principle be used (see Meyer, 1990). By incorporating the random error, the instantaneous hazard rate (5.2) is specified as follows:

$$(5.7) \quad \lambda\,(t;x_{it}) = \lambda_0(t)\cdot\varepsilon_i\cdot\exp\,(x_{it}'\beta) = \lambda_0(t)\cdot\exp\,[x_{it}'\beta + \log(\varepsilon_i)]$$

where ε_i is a random variable with a certain distribution. The discrete time hazard function is then given by:

$$(5.8) \quad h\,(t=\tau_k;x_{it}) = 1 - \exp\{-\exp\,[x_{it}'\beta + \gamma_k + \log(\varepsilon_i)]\}$$

This is the function used to analyse the effect of multimarket contact on market entry, where $h(\cdot)$ represents the hazard rate for bank i in the time interval k, x_{it} is the set of variables affecting market entry (multimarket contact, moderating and control variables) and γ_k is some functional form that represents the effect of duration of entry on the hazard rate, which is given a parametric specification by including the logarithm of time and also a non-parametric specification using dummy variables for each time interval (year). Finally, ε is assumed to have two alternative distributions: Gamma and Normal.

5.5 Data and Variables

5.5.1 Data Description

The relationship between multimarket contact and entry into new geographic markets is analysed using data of the retail-banking industry in Argentina over the period 1994-2000. The industry is composed of banks that operate in multiple provinces. The country is divided into 23 provinces and each province can be considered a geographic market, the exception being the Province of Buenos Aires.[90] This province consists of three main and clearly separated areas: Capital Federal, Greater Buenos Aires and the rest of the province. These areas account for 10%, 25% and 14% of the total country population, respectively. Geographically, the province of Buenos Aires is also important. Consequently, banks in Capital Federal do not compete with banks in the rest of the province or in the Greater Buenos Aires. Hence, Capital Federal, Greater Buenos Aires and the rest of the Province of Buenos Aires are treated as different geographic markets leading to a total of 25 markets.[91]

The sample period represents a critical window in the evolution of the Argentine banking sector. Over this period, a large number of mergers and acquisitions took place, which led to substantial changes in the size and geographic range of operations of most banks. Table 5.2 shows the evolution of the number of banks, the number of provinces served and the network size and geographic diversification of the average bank. The data reveal that in 1994 the average bank had 30 branches located in 4 provinces while in 2000 the average bank operated a network of 72 branches in 7 provinces. In addition, at the beginning of the sample period, 102 banks (out of 123) had branches in one to four provinces while the number of banks operating in less than five provinces fell to 36 (out of 62) by 2000.

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[90] Burdisso et al. (1998) analyses the validity of the SCP hypothesis in Argentina. They consider each province as a local market to estimate HHIs. They further suggest that banks' localisation decisions are mainly taken at provincial levels.
[91] The 23 provinces are subdivided into a total of 509 departments. The analysis is conducted at the provincial level due to data availability.

Table 5.2

Number of banks and geographic diversification

Argentine retail banking sector, 1993-2000

Year	Number of banks	Number of banks with operations in: Less than 5 Provinces	6 to 10 provinces	11 to 20 provinces	More than 20 Provinces	Average bank: Number of branches	Number of provinces
1994	123	102	10	7	4	30	4
1995	91	65	13	9	4	42	5
1996	87	61	11	11	4	45	5
1997	81	56	10	11	4	49	6
1998	72	45	12	9	6	61	7
1999	63	38	10	9	6	70	7
2000	62	36	10	10	6	72	7

The data were collected from different sources. The addresses of all branch offices from 1994 to 2000 were provided by the Banco Central de la República Argentina. Balance sheet data and information on mergers, acquisitions, conversion and failures were obtained from *Información de Entidades Financieras*, Banco Central de la República Argentina. Data on population density were gathered from the Instituto Nacional de Estadísticas y Censos (INDEC) and information on total loans and deposits per province were obtained from the *Boletín Estadístico*, Banco Central de la República Argentina. The data have a longitudinal dimension, as information on the dependent and explanatory variables was obtained for every year over the period 1994-2000. The data take the form of one observation per bank per market (province) per year in which the bank is not present at the beginning of the year.[92] This provides a total of 12,397 single bank-market-year observations from which 190 correspond to effective entries.

[92] Each pair potential entrant-focal market and their associated characteristics are followed year by year until either entry takes place or censoring occurs.

Sampling was affected by the mergers and acquisitions that took place during the sample period, which reduced the number of retail banks from 123 in 1994 to 62 in 2000. Three different cases were considered: (i) a bank was not involved in any merger or acquisition, (ii) a bank was acquired by another bank, and (iii) two banks were merged giving rise to a new entity. In the first case, the bank was followed throughout all the sample period. In the second case, the acquired institution was followed up until the year of the acquisition while the acquirer was traced through all the sample period. In the third case, the merging banks were followed up until the year of the merger while the new entity was traced from that point up until the end of the sample period. In all cases, a bank was included in the analysis either up to the time at which entry took place, or censoring occurred. Censoring occurs when a bank legally disappears as a result of a merger, acquisition or failure, or when entry has not taken place at the end of the follow up.

5.5.2 Variables

5.5.2.1 Dependent Variable

Market entry is measured through an indicator variable *(entry)* which equals one if a bank entered a new market between the beginning and end of the year and zero otherwise. *Entry* equals zero if the bank did not operate in the market in question in the focal year.[93] The set of markets (provinces) that a bank was at risk of entering each year

[93] Given the characteristics of the Argentine banking industry, the analysis of entry could be extended in at least two different ways. First, several banks have opened more than one branch in the same province in the same year. Since the market is defined at the provincial level and given the definition of the entry variable for survival analysis, these entries are recorded as a single entry. In an extended study, however, an ordered probit model could be used to analyse the factors that explain the number of branches a bank opens in a particular province. The dependent variable in such a study would be defined as the number of branches opened by a single bank in a province in each year. Second, banks have entered new markets by means of opening new branches but also via mergers and acquisitions. The variable entry does not differentiate among the different types of entry. Again, in an extended study, separate models could be estimated using different definition of entry as dependent variable to analyse the effects of these different

was the set of markets in which that firm did not have branches at the beginning of the year. It would be possible to limit the risk set to those provinces that are adjacent to the provinces in which a bank already operated, but more than half of the market entries observed occurred outside these adjacent provinces. The analysis included up to 22 provinces for each bank each year and excluded the one or more provinces in which banks already operated. As a result, a total of 190 effective entries were recorded. These entries correspond to 45 banks opening branches in different number of provincial markets over the sample period.[94]

5.5.2.2 Independent Variables

The main independent variable included in the analysis to test for the effects of multimarket contact on entry into new geographic markets is a multimarket contact variable, which is measured as a simple index. In addition, to further analyse the effect of other moderators of the relationship between contact and entry, the following variables are also considered in the analysis: (i) market dominance, (ii) strategic similarity and (iii) market concentration. The effects of organisational structure on market entry and multimarket contact are not analysed due to data limitations. However, the potential correlation due to omitted variables (other firm specific variables may also be omitted) is modelled through the random effect included in the hazard model. All variables are time-varying and measured at the start of each year.

modes of entry on the hazard of entry.[93] Additionally, an ordered probit model could also be estimated to analyse the determinants of these different entry mechanisms where the dependent variable assumes different values for the different types of entry.

[94] For example, 11 banks opened branches in 1 new market, 10 entities entered 2 new markets, 7 banks opened new branches in 3 markets, 3 entities entered 5 new provinces, 3 banks also entered 3 new markets while just 1 entity entered 11, 13, 15 and 17 new markets, respectively, over the sample period.

Multimarket contact. The relationship between multimarket contact and market entry is evaluated using a count measure of multimarket contact. Count measures simply add up the number of markets in which firms in the focal market compete outside that market, and represent the most common measure used in the literature (Heggestad and Rhoades, 1978; Evans and Kessides, 1994; Baum and Korn, 1996; Gimeno and Woo, 1996; Fuentelsaz and Gomez, 2002a). The average multimarket contact of that firm with each of its focal-market competitors is used when the potential entrant competes with multiple firms in the focal market. Hence, since a firm generally faces different competitors in different markets, the measures of multimarket contact differ across firms and markets.

Some researchers argue that count measures are too simplistic. This view considers that counts should be weighted by the strategic importance of the contacts, standardised by the number of markets in which the firm operates, or adjusted by the possibility of random contacts (Gimeno, 1999). Given the lack of consensus about which corrections to use, different studies use different measures making comparisons across works difficult to undertake. This study uses a simple count measure of multimarket contact, which is similar to the indexes used in previous studies. This approach allows comparisons with previous works (Gimeno and Woo, 1996, 1999; Fuentelsaz and Gomez, 2002a).

Thus, for each bank i and each focal market n, the average intensity of multimarket contact between bank i and multimarket rivals j that operate in market n at time t (Mmc_{int}) is calculated as:

$$(5.9) \quad Mmc_{int} = \frac{\sum_j D_{jnt} \cdot M_{ijm}}{\sum_j D_{jnt}}$$

where n represents the set of markets (the provinces plus Capital Federal, Greater Buenos Aires and rest of the Province of Buenos Aires) in which bank i does not have branch offices, m is a province from the set of markets in which bank i has branch offices, D_{jnt} is an indicator taking value 1 if bank j is established in market n and M_{ijm}= $D_{imt} \cdot D_{jmt}$, thus $\sum M_{ijm}$ counts the number of markets in which banks i and j simultaneously participate outside the focal market at time t. This measure averages the number of contacts that bank i has with incumbents in focal market n in markets different from n. Mmc_{int} ranges between zero, when bank i does not have any contact with incumbents in market n outside that market, and the number of markets in which bank i has branch offices. To allow a curvilinear effect, this variable is specified as a quadratic by including both linear and squared terms. *Mmc is expected to have an inverted U shaped effect on the hazard of entry into new markets.*

Table 5.3 presents a hypothetical example of multimarket contact, showing the contacts of three firms (i,j=A, B, C) in three markets (n,m=I, II, III), where a square indicates the presence of a firm in a given market. The multimarket contacts of firm A (i) with the incumbents in market I (n) is calculated as follows. First, the contacts of firm A with firms operating in market I outside that market ($D_{jnt} \cdot M_{ijm}$) is calculated as follows: $D_{B \cdot I} \cdot M_{A \cdot B \cdot II} = 1 \cdot (1 \cdot 1) = 1$, $D_{B \cdot I} \cdot M_{A \cdot B \cdot III} = 1 \cdot (1 \cdot 0) = 0$, $D_{C \cdot I} \cdot M_{A \cdot C \cdot II} = 1 \cdot (1 \cdot 1) = 1$, and $D_{C \cdot I} \cdot M_{A \cdot C \cdot III} = 1 \cdot (1 \cdot 1) = 1$, where $D_{B \cdot I} \cdot M_{A \cdot B \cdot II}=1$ simply indicates that firm A meets incumbent firm B in market II while $D_{B \cdot I} \cdot M_{A \cdot B \cdot III} = 0$ indicates that even when firm A meets B in I, B does not operates in III. Second, the contacts of firm A with incumbents in market I outside that market are averaged out by summing all the contacts outside the focal market and dividing by the number of firms in market I, that is, $Mmc_{A\,I}=(D_{B\,I}\cdot M_{A\,B\,II}+D_{B\,I}\cdot M_{A\,B\,III}+D_{C\,I}\cdot M_{A\,C\,II}+D_{C\,I}\cdot M_{A\,C\,III})/2=(1+0+1+1)/2=1.5$. This measure suggests that firm A (i) has 1.5 contacts on average in non-focal markets II and III (m) with B and C (incumbents in focal market I) (n). Table 5.3 shows that potential entrant A in market I meets B in one market outside the focal market (II) and competes with C in two markets outside I, A has on average 1.5 contacts with incumbents in I.

Table 5.3

Multimarket contacts of imaginary firms A, B and C in markets I, II and III

		Market	
Firm	I	II	III
A		■	■
B	■	■	
C	■	■	■

Market dominance. To evaluate the effects of spheres of influence on the likelihood of entry, market dominance (*$DShare_{nt}$*) is measured as the total market share of the bank with the largest branch-office network in the focal market (Baum and Korn, 1996; Fuentelsaz and Gomez, 2002a; Haveman and Nonnemaker, 2000). The interaction of this variable with multimarket contact is also included as an explanatory variable to analyse the effect of spheres of influence on the relationship between multimarket contact and market entry. ***DShare and its interaction with Mmc are expected to have a negative effect on the hazard of entry into new markets.***

Strategic similarity. The effect of strategic similarity among multimarket competitors on multimarket contact and entry is analysed by comparing some characteristics of firms' strategies. Following Mehra (1996), a multi-dimensional approach distinguishing between scope and resource commitments is used to select the variables describing banks' strategic characteristics. The *strategic scope* variables are: (1) retail loans/total loans and (2) corporate loans/total loans, which are used to represent the degree of involvement of the bank in the retail and wholesale markets, respectively, and (3) non-interest revenue/total revenues is employed to capture the product diversity in the banks' strategy. The *strategic resource* variables are: (4) net purchased funds/total assets which is intended to reflect the degree to which the bank relies on purchasing funds rather than on deposits to fund its assets; (5) equity/total assets is used to capture the riskiness of the banks' strategy; (6) provisions/total loans reflects the efficiency of a bank's process in recognising problem loans, and making the adequate provisions and (7) total loans/total assets captures the production mix of a bank's assets.

Following Gimeno and Woo (1996), these variables are used to measure strategic similarity for each pair of focal (i) and incumbent bank (j) as the Euclidean distances between the standardised points in the seven-dimensional space, normalised on the zero to one range:

$$(5.10)\quad Sim_{ijt} = \frac{\sqrt{\sum_{v=1}^{7}(z_{ivt} - z_{jvt})^2}}{\max_{k,l}\sqrt{\sum_{v=1}^{7}(z_{kvt} - z_{lvt})^2}}$$

where z_v represent each of the strategic scope or resource variables. This measure takes the value of one (minimum similarity) when the Euclidean distance in the strategic space between two banks is the largest for all pairs in the sample, and it equals zero (maximum similarity) when the Euclidean distance is zero.

Sim_{ijt} measures the strategic similarity between banks i and j, however, the intensity of rivalry experienced by bank i in a given market n is affected by the rivalry with all relevant competitors in that market. Thus, the effect of strategic similarity to those competitors is aggregated by calculating the average strategic similarity to all competitors j in focal market n. The bank-market measure of strategic similarity is then obtained by summing and dividing Sim_{ijt} by the number of incumbents j in every focal market n:

$$(5.11)\quad SSimil_{int} = \frac{\sum_j D_{jnt} \cdot Sim_{ijt}}{\sum_j D_{jnt}}$$

The interaction of this variable with *Mmc* is also included as an independent variable to analyse the moderating effect of strategic similarity on the relationship between multimarket contact and entry. *SSimil could have a positive, negative or no effect on the hazard of entry, while its interaction with multimarket contact is expected to have a negative effect on the hazard of entry into new markets.*

Market concentration. To analyse the influence of market structure, as an indicator of actual rivalry, on the relationship between multimarket contact and entry, market concentration (*FM Conc$_{nt}$*) for each focal market n is defined using the Herfindahl-Hirschman index at the start of each year:

$$(5.12)\quad FM\ Conc_{nt} = \sum_j S^2_{jnt}$$

where S_{jnt} is the market share of firm j in market n at time t defined in terms of number of branches. The interaction of this variable with multimarket contact is also included as explanatory variable to analyse the influence of market structure on the relationship multimarket contact-entry. *FM Conc could have a positive, negative or no effect on the hazard of entry, while its interaction with multimarket contact is expected to have a negative effect on the hazard of entry into new markets.*

5.5.2.3 Control Variables

The control variables are classified as firm-level and market-level controls. These variables are time-varying and measured at the start of each year.

Firm-level control variables. The effect of banks' competence on the likelihood of entry is proxied by the bank's profitability ($Prof_{it}$), which is measured using the return on assets calculated as profits before taxes to total assets. Size is also included as a control variable ($Size_{it}$), which is defined as the natural logarithm of total assets of bank i (in constant pesos).[95] The effects of a bank's previous experience in managing operations across markets on its current pattern of entry is controlled by including the variable Exp_{it}, which counts the number of provinces in which the bank was operating at the end of the previous year. To permit a curvilinear effect, this variable is specified as a quadratic by including both linear an quadratic terms. Banks' ownership structure is also included as a control variable. Banks are divided into three types: (i) public-owned banks, which are under the control of the national or provincial government; (ii) mutual banks, which are owned by all depositors, and (iii) stock banks owned by

[95] Size could be measured using the volume of loans instead of total assets, however, most studies in the banking industry measure size using total assets.

shareholders. This last category is further broken down in terms of domestic or foreign ownership. Binary dummy variables taking value one when the bank is public, mutual, stock or foreign (*DPub, DMut, DStock* and *DFor*), are used to distinguish among these different banks.

Market-level control variables. Several focal market characteristics are included as control variables. Two variables are used to measure intensity of demand in the objective market: (i) population density ($MPop_{nt}$) in the focal market n at the start of the year, which is a variable frequently used in the literature on bank branching to proxy for population concentration (Lilien and Yoon, 1990; Fuentelsaz and Gomez, 2002) and (ii) volume of loans per inhabitant ($Mdem_{nt}$). These two "intensity" variables are added to compare their ability to predict duration before entry.[96] Market growth ($MGrowth_{nt}$) is given by the average growth rate of total loans in province n in the three years previous to the focal year t.

Potential rivalry ($MRival_{nt}$) is measured by counting the number of banks operating in the markets adjacent to every potential focal market. The degree of concentration in markets in which banks operate is also controlled by including the variable $NFM\ Conc_{it}$, which is measured through a Herfindahl-Hirschman index weighted by the relative importance of each market for firm i (Fuentelsaz and Gomez, 2002a). A provincial HHI is calculated using the number of branches as a proxy for market share and then weighted by multiplying each provincial HHI by the relative importance of the

[96] In (i) intensity of demand arises from both market size (population) and geographic area. Population density is included to reflect the fact that the more densely populated the area the greater the likelihood of entry. Population density is used (instead of population and area separately) with the aim to compare its predicting ability with the other intensity of demand variable (ii). In an extended study, however, two different specifications could be estimated: one including population and area and another including population density and deposits per inhabitant.

province for bank i (the number of branches is used to measure the importance of the province for bank i).

Another control variable included in studies of entry is proximity to the objective market. These studies suggest that firms first enter closer locations, acquiring knowledge about local markets, and then enter further markets. Physical proximity arises then as a potential determinant of firms' entry. However, in this study more than half of the entries occurred outside the markets adjacent to that in which the bank already operates. For this reason, this variable is not included in the analysis. In addition, some studies limit the set of markets at risk to those adjacent markets. In this study, however, since this is not the case, all markets where the bank does not operate at the beginning of the year are considered at risk (not just adjacent markets).

5.5.3 Descriptive Statistics

Figure 5.1 shows the number of entries per year over the period 1994-2000. This figure reveals that the number of entries increased up until 1995, when entry started to decline possibly due to the effects of the Mexican crisis of 1994. But in 1996 the entry process started to escalate again with a peak in 1998 when around 50 new entries occurred, probably associated to the expansion process initiated by foreign- and large domestic-owned banks. However, from 1998 the number of entries fell until the end of the sample period. In 2000 the number of entries into new markets was as low as 10. This figure suggests that the entry process appear to have an (accentuated) S form

Figure 5.1

Number of entry events

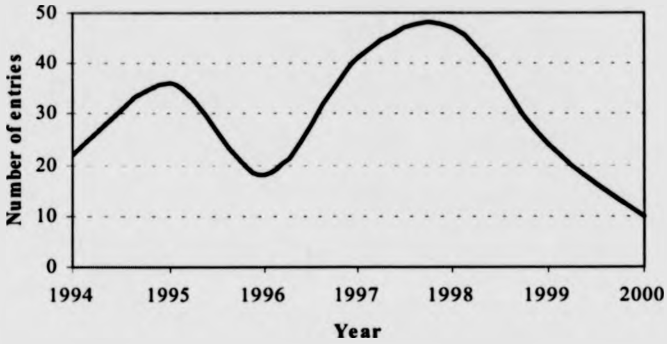

Table 5.4 presents the descriptive statistics for the independent variables. The mean value of multimarket contact is 2.63, which suggests that the average bank have contacts with market incumbents in 2.63 markets outside the focal market. The measure of skewness suggests the distribution of multimarket contact is skewed right with few banks greatly exposed to contact in outside markets. Figures in Table 5.4 also reveal that the average degree of strategic similarity among multimarket competitors is 0.20, ranging from 0.03 to 0.98. The mean dominant market share is 0.43, which suggests that a single bank with 43 percent of the market dominates the average market. The figures further suggest that the distribution of dominant shares is symmetric with many markets dominated by a single bank while many others shared among several banks with relatively small market shares. The data also show that the degree of concentration in the average market is 0.27, which varies from 0.04 to 0.62.

Table 5.4

Descriptive statistics

Argentine retail banking industry, 1993-2000

Variable	Mean	Median	St. Dev.	Min	Max	Skewness	Kurtosis
Multimarket contact							
Mmc (number of markets)	2.635	1.778	2.468	0.079	17.800	2.511	10.300
Moderating variables							
SSimil	0.200	0.122	0.155	0.029	0.984	1.147	4.472
DShare (%)	43.40	43.86	15.03	8.33	77.36	-0.016	2.411
FM Conc	0.268	0.258	0.124	0.036	0.617	0.579	2.880
Firm control variables							
Size (million $)	627.9	219.7	1,460.5	5.78	15,200	6.118	48.456
Prof (%)	0.546	0.766	3.399	-14.32	12.99	-1.088	6.448
Exp (number of markets)	3.361	2.0	3.453	0.00	24.00	2.954	13.645
Market control variables							
NFM Conc	0.144	0.123	0.091	0.036	0.554	1.609	5.970
FM Pop (inhabitants per km^2)	217.10	7.158	1,449.3	0.700	15,217	9.516	97.243
FM Dem (thousand $ per inhabitant)	1.528	0.615	2.623	0.086	16.158	2.902	10.725
FM Growth (%)	9.090	16.300	13.433	0.000	74.826	68.900	294.300
FM Rivalry (number of banks)	70.453	61.0	44.379	9.000	181.00	0.510	2.374

[a] Number of observations: 12,397

Table 5.4 also reports descriptive statistics for the firm- and market-level control variables. These figures reveal that the average bank has $628 million of assets, return on assets of 0.55 percent and operative branches in 3.36 markets. The data also show that the average degree of concentration in the markets where multimarket competitors operate is 0.14. The information further indicate that the average focal market has a population density of 217 inhabitants per square kilometre, that demand for loans is $1.5 thousand per inhabitant, that market growth is 9 percent per year and that the average number of competitors in adjacent markets is 70.4.

5.6 Results

The hazard function (5.3) was estimated using the Prentice and Gloeckler (1978) estimator. To correct for cross-dependence across observations, the hazard rate (5.7) was also estimated assuming a normal distribution for the random effects.[97] The null hypothesis that the variance of the random effects is zero was strongly rejected in all cases, hence, the results presented correspond to the model that includes random effects. Different models were estimated in order to analyse the relationship between multimarket contact and market entry into new markets using a parametric and a non-parametric baseline specification. Table 5.5 shows the results for the hazard rate estimates for these alternative models. Columns (1)-(3) report maximum likelihood estimates of the hazard of bank entry into new markets using a parametric baseline specification while columns (4)-(6) show the estimates obtained with a non-parametric baseline specification. All models provide similar estimates across specifications. However, the non-parametric baseline specification clearly dominates over the parametric specification from log-likelihood values.

Model 1 shows a baseline model, which contains only the firm- and market-level control variables. The coefficient on *Size* is positive and statistically significant at the 1% level in all cases. This suggests that banks with large asset bases are more likely to expand into new markets. The coefficients on *Exp* and Exp^2 present the wrong signs suggesting that as experience increases market entry decreases but it escalates for high levels of experience. However, after adding multimarket contact the linear term becomes insignificant while the quadratic term continues being positive and significant,

[97] Even though the Gamma and inverse Gaussian distributions are the most commonly used to capture unobserved heterogeneity, Meyer (1990) suggests that other distributions can also be used. In this study

which implies that entry increases at an increasing rate with experience. The coefficient on DPub is negative and highly significant suggesting that public-owned banks are less likely to enter new markets than private-owned banks. The coefficients on *FM Pop*, *FM Dem* and *FM Growth* (for the non-parametric specification) are positive and significant at the 1% confidence level, which suggests that banks tend to enter new markets when the level of demographic variables are favourable i.e. high population density, demand intensity and growth. None of the other control variables have any significant effect on the rates of entry.

Model 2 incorporates multimarket contact to analyse whether the relationship between multimarket contact and market entry is linear. Model 2 represents a significant improvement over Model 1. The Likelihood Ratio (LR) test of model 1 versus model 2 exceeds the chi-square critical value with 1 d.f. at the 1% level. The coefficient on *Mmc* is negative and statistically significant at the 1% level, suggesting that banks are more likely to enter markets where their level of contact with multimarket incumbents is low. Model 3 incorporates the quadratic term on multimarket contact to analyse whether the relationship is of an inverted U-form. The LR test of model 2 versus model 3 does not exceed the chi-square critical value with 1 d.f. at the 1% level and the quadratic term of multimarket contact is not statistically significant. These results suggest that the relationship between multimarket contact and market entry seems to be linear.[98]

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the Gamma distribution was used in a first instance, however, convergence problems for the estimation of most of the models led to the use of the normal distribution to represent heterogeneity.

[98] Another specification included a cubic term, which resulted negative (but insignificant). This result discards the U shape as an alternative.

Table 5.5

Hazard rate estimates using parametric and non-parametric baseline specifications

Variable [a]	Parametric baseline hazard			Non-parametric baseline hazard		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Control variables						
Size	0.645 ***	0.989 ***	1.451 ***	0.676 ***	1.006 ***	0.654 ***
	(5.99)	(7.85)	(10.07)	(5.71)	(8.09)	(5.6)
Prof	-0.018	-0.012	-0.009	-0.002	-0.011	-0.009
	(-0.85)	(-0.54)	(-0.35)	(-0.1)	(-0.5)	(-0.45)
Exp	-0.207 ***	-0.118 *	0.034	-0.187 ***	-0.092	0.125
	(-3.07)	(-1.66)	(0.35)	(-2.58)	(-1.18)	(1.18)
Exp^2	0.009 ***	0.008 ***	0.001	0.007 **	0.007 **	0.001
	(3.45)	(3.06)	(0.26)	(2.54)	(2.46)	(0.12)
NFM Conc	0.827	1.613	3.879 ***	3.217 **	1.569	3.229 **
	(0.56)	(1.07)	(2.63)	(2.07)	(1.1)	(2.01)
FM Pop	0.135 ***	0.133 ***	0.108 ***	0.135 ***	0.130 ***	0.105 ***
	(4.18)	(3.95)	(3.18)	(4.07)	(3.87)	(3.07)
FM Dem	0.139 ***	0.119 ***	0.109 ***	0.136 ***	0.118 ***	0.105 ***
	(5.32)	(4.55)	(4.07)	(5.23)	(4.5)	(3.99)
FM Growth	0.681	0.902	0.472	2.068 *	1.881 *	1.814 *
	(0.71)	(0.93)	(0.46)	(1.91)	(1.75)	(1.66)
FM Rivalry	0.003	0.003 *	0.003 *	0.003	0.003	0.003
	(1.56)	(1.86)	(1.89)	(1.54)	(1.63)	(1.61)
DPub	-2.140 ***	-2.511 ***	-3.635 ***	-2.315 ***	-2.361 ***	-2.548 ***
	(-4.11)	(-4.31)	(-6.39)	(-3.75)	(-4.22)	(-3.9)
DFor	-0.076	-0.008	-0.057	0.495 *	0.056	-0.428
	(-0.31)	(-0.03)	(-0.19)	(1.74)	(0.21)	(-1.35)
DMut	0.268	-0.581 **	-0.269	-0.489	-0.998 ***	-0.368
	(0.90)	(-1.98)	(-0.89)	(-1.59)	(3.15)	(-1.21)
Multimarket contact variable						
Mmc		-0.289 ***	-0.631 ***		-0.296 ***	-0.568 ***
		(-4.22)	(-4.15)		(-4.17)	(-3.52)
Mmc^2			0.018			0.018
			(1.52)			(1.25)
Time variables						
Log time	0.274	0.735 ***	0.758 ***			
	(1.37)	(3.36)	(2.87)			
Duration dummies [b]						
Constant	-14.332 ***	-18.696 ***	-23.223 ***	-15.375 ***	-19.660 ***	-14.986 ***
	(-10.19)	(-11.04)	(-12.85)	(-10.02)	(-11.5)	(-10.02)
Log likelihood	-775.57	-766.08	-764.83	-759.63	-750.06	-747.62
Likelihood Ratio test						
Versus Model 1		19.00 ***	21.48 ***		19.14 ***	24.03 ***
Versus Model 2			2.49			1.53 **
No random effects (ρ=0)	156.51 ***	127.46 ***	124.33 ***	101.81 ***	110.95 ***	113.04 ***

***, **, * indicates significance at the 1%, 5% and 10% level, respectively. [a] Dependent variable is entry into new geographical (provincial) markets, the number of entries is 190 and the number of observations is 12,397. [b] The coefficients of the dummy variables D1-D5 (D6-D7) are non-monotonically increasing (decreasing) from a larger (smaller) negative to a smaller (larger) negative number.

These results are similar to Baum and Korn's (1996) for the Californian airlines' industry. However, these findings differ from previous studies of multimarket contact and market entry in the banking industry. Haveman and Nonnemaker (2000) and Fuentelsaz and Gomez (2002a) find an inverted U-shaped relationship between contact and entry. Fuentelsaz and Gomez (2002a) analyse the period following elimination of branching restrictions in the Spanish banking industry. They find that the likelihood of entry increases for values of multimarket contact lower than 10.9 while it decreases for higher values of contact. They also recognise that while multimarket contact ranges between 0 and 24, the average level of contact in the Spanish savings industry is of 1.62 in 1999 (end of the sample period). In contrast, in the Argentine banking industry multimarket contact ranges between 0 and 17.8 and the average level of contact at the end of the sample period is 4.3. This may suggest that as a result of a higher degree of multimarket contact, the Argentine banking industry is on the decreasing portion of the inverted U-shaped curve. This may explain the linear relationship between contact and market entry encountered in this study.

Other variables may affect the relationship between multimarket contact and market entry, as discussed in section 5.3. Table 5.6 shows the results of estimating a set of models that consider the influence of market dominance, strategic similarity and market concentration on the relationship between multimarket contact and bank entry. These models incorporate the variables and their interactions with multimarket contact to analyse the effects of these moderators on the likelihood of entry and on the link between multimarket contact and entry. The results reported correspond to the estimation of proportional hazards models with non-parametric baseline specification. As mentioned above, the non-parametric specification imposes fewer restrictions on the shape of the baseline hazard avoiding any potential bias on the parameter estimates and provides a better representation of the data. The results show that the coefficients are similar across specifications and that all of models (but one) represent a significant improvement over Model 2.

Models 4 and 5 add the effect of dominant market share (*DShare*) to the analysis of multimarket contact and bank entry. Model 4 represents a significant improvement over Model 2, the LR test exceeds the chi-square critical value at the 1% level. The coefficient on market dominance is negative and statistically significant at the 1% level. This result suggests that banks are less likely to enter markets dominated by a large bank, since retaliation by a dominant bank is likely to be more damaging. In line with this finding, Baum and Korn (1996) also find that in the Californian airline industry *DShare* has a negative and significant influence on airlines' entry rates. Similarly, Haveman and Nonnemaker (2000) report that, in the S&Ls industry in California, market dominance reduces the likelihood of entry into new markets.

Model 5, which adds the interaction term, do not represent a significant improvement over Model 2 or Model 4. The estimate for the multimarket by dominant share interaction is statistically insignificant, suggesting that market dominance does not moderate the relationship between multipoint contact and market entry. Baum and Korn (1996) report that the interaction term between *DShare* and *Mmc* is negative and significant, however, the main effects of *Mmc* becomes insignificant in the analysis after adding this interaction. They suggest that the effects of multimarket contact become mediated by the share of the dominant airline on a route, however, they also mention multicollinearity as an alternative explanation. In contrast, Haveman and

Table 5.6

Hazard rate estimates of market entry including moderating variables

Explanatory Variables[a]	Market Dominance		Strategic Similarity		Market concentration	
	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Control variables [b]						
Size	0.813 ***	0.691 ***	0.796 ***	1.069 ***	1.134 ***	1.040 ***
	(6.79)	(5.64)	(6.67)	(8.3)	(7.56)	(7.93)
Prof	-0.003	-0.016	0.000	0.005	0.003	-0.004
	(-0.12)	(-0.77)	(-0.02)	(0.21)	(0.1)	(-0.16)
Exp	-0.100	-0.100	-0.093	-0.017	-0.116	-0.115
	(-1.24)	(-1.16)	(-1.1)	(-0.21)	(-1.37)	(-1.41)
Exp^2	0.010 ***	0.010 ***	0.011 ***	0.003	0.006 **	0.008 ***
	(3.47)	(3.26)	(3.67)	(1.08)	(2.06)	(2.77)
NFM Conc	1.854	1.598	2.754	3.457 **	3.918 **	2.377
	(1.28)	(1.03)	(1.59)	(2.27)	(2.17)	(1.61)
FM Pop	0.115 ***	0.096 ***	0.124 ***	0.122 ***	0.122 ***	0.104 ***
	(3.41)	(2.66)	(3.66)	(3.64)	(3.5)	(2.93)
FM Dem	0.084 ***	0.074 ***	0.118 ***	0.117 ***	0.063 **	0.050 *
	(2.99)	(2.58)	(4.52)	(4.47)	(2.2)	(1.74)
FM Growth	1.397	1.237	1.844 *	1.799	1.320	1.056
	(1.28)	(1.13)	(1.69)	(1.63)	(1.2)	(0.94)
FM Rivalry	0.006 ***	0.005 **	0.003 *	0.003 *	0.007 ***	0.007 ***
	(2.72)	(2.38)	(1.75)	(1.83)	(3.38)	(3.2)
DPub	-2.229 ***	-2.250 ***	-2.577 ***	-2.834 ***	-2.827 ***	-2.629 ***
	(-3.87)	(-4.09)	(-3.43)	(-4.7)	(-3.88)	(-4.38)
DFor	0.265	0.405	0.472	0.256	0.327	0.168
	(0.98)	(1.41)	(1.64)	(0.94)	(1.08)	(0.62)
DMut	0.619 **	0.611 *	-0.601 *	-0.077	0.194	-0.205
	(1.96)	(1.88)	(-1.87)	(-0.24)	(0.57)	(-0.66)
Moderator variables						
Mmc	-0.200 ***	-0.307 ***	-0.257 ***	-0.468 ***	-0.200 ***	-0.297 ***
	(-2.66)	(-2.92)	(-3.52)	(-5.05)	(-2.64)	(-3.05)
DShare	-1.813 ***	-3.319 ***				
	(-3.01)	(-3.35)				
SSimil			1.251	-0.924		
			(0.84)	(-0.54)		
FMConc					-3.654 ***	-5.463 ***
					(-4.55)	(-4.1)
Mmc·DShare		0.233				
		(1.52)				
Mmc·SSimil				-0.707 ***		
				(-3.37)		
Mmc·FMConc						0.259
						(1.6)
Constant	-16.446 ***	-14.506 ***	-16.852 ***	-20.066 ***	-20.268 ***	-18.397 ***
	(-9.87)	(-8.6)	(-10.49)	(-11.14)	(-9.82)	(-10.29)
Log likelihood	-745.37	-744.16	-749.70	-744.07	-739.75	-738.51
Likelihood Ratio test						
Vs Model 2	9.40 ***	11.82 ***	0.73	11.99 ***	20.62 ***	23.12 ***
Vs Model 4, 6, 8 or 10		2.43		11.26 ***		2.50
No random effects (ρ=0)	114.52 ***	116.09 ***	120.84 ***	122.44 ***	108.51 ***	110.43 ***

***, **, * indicates significance at the 1%, 5% and 10% level, respectively. [a] Dependent variable is entry into new geographical (provincial) markets, the number of entries is 190 and the number of observations is 12,397.

Table 5.7

Hazard rate estimates of market entry including all variables

Explanatory Variables[a]	All		Excluding DShare		Excluding FMConc	
	Model 10	Model 11	Model 12	Model 13	Model 14	Model 15
Control variables [b]						
Size	0.934 ***	0.960 ***	0.807 ***	0.548 ***	0.674 ***	0.741 ***
	(7.24)	(7.58)	(6.79)	(4.20)	(5.82)	(5.96)
Prof	0.005	0.002	-0.001	-0.003	-0.013	-0.001
	(0.24)	(0.07)	(-0.03)	(-0.12)	(-0.65)	(-0.02)
Exp	0.012	0.073	-0.108	0.007	-0.114	-0.043
	(0.14)	(0.85)	(-1.32)	(0.08)	(-1.38)	(-0.47)
Exp^2	0.007 **	0.006 **	0.010 ***	0.006 **	0.010 ***	0.009 ***
	(2.37)	(2.07)	(3.40)	(2.18)	(3.52)	(2.77)
NFM Conc	1.742	1.614	1.920	2.189	2.073	2.474
	(1.16)	(1.11)	(1.28)	(1.34)	(1.15)	(1.55)
FM Pop	0.182 ***	0.145 ***	0.119 ***	0.091 ***	0.115 ***	0.081 **
	(4.88)	(3.51)	(3.50)	(2.60)	(3.40)	(2.26)
FM Dem	0.056 *	0.045	0.064 **	0.046	0.085 ***	0.071 **
	(1.95)	(1.56)	(2.26)	(1.59)	(2.99)	(2.47)
FM Growth	1.067	0.570	1.159	0.849	1.494	1.125
	(0.97)	(0.5)	(1.06)	(0.75)	(1.38)	(1.01)
FM Rivalry	0.006 ***	0.006 ***	0.007 ***	0.006 ***	0.005 ***	0.005 **
	(3.02)	(2.73)	(3.23)	(2.99)	(2.61)	(2.42)
DPub	-2.584 ***	-2.659 ***	-2.234 ***	-2.320 ***	-2.306 ***	-2.444 ***
	(-4.15)	(-4.3)	(-3.85)	(-3.920	(-3.95)	(-3.88)
DFor	0.758 ***	0.688 **	0.273	-0.465	0.429	0.421
	(2.73)	(2.57)	(1.00)	(-1.44)	(1.47)	(1.51)
DMut	-0.173	-0.186	0.636 **	-0.475	0.631 *	-0.629 **
	(-0.57)	(-0.62)	(1.98)	(-1.48)	(1.90)	(-2.00)
Moderator variables						
Mmc	-0.135 *	-0.437 ***	-0.164 **	-0.396 ***	-0.174 **	-0.466 ***
	(-1.74)	(-3.25)	(-2.18)	(-3.31)	(-2.34)	(-3.71)
DShare	8.651 ***	6.092			-1.859 ***	-3.460 ***
	(3.98)	(1.63)			(-3.08)	(-3.52)
SSimil	1.658	0.214	0.662	-0.324	1.209	-0.199
	(1.14)	(0.13)	(0.43)	(-0.17)	(0.77)	(-0.12)
FMConc	-14.176 ***	-12.994 ***	-3.632 ***	-5.414 ***		
	(-5.12)	(-2.73)	(-4.53)	(-4.07)		
Mmc·DShare		0.423				0.284
		(0.94)				(1.25)
Mmc·SSimil		-0.434 **		-0.462 **		-0.412 **
		(-2.16)		(-2.24)		(-1.98)
Mmc·FMConc		-0.170		0.284		
		(-0.30)		(1.49)		
Constant	-18.647 ***	-17.710 ***	-16.312 ***	-11.963 ***	-15.145 ***	-14.345 ***
	(-10.52)	(-9.95)	(-9.91)	(-6.88)	(-9.43)	(-8.46)
Log likelihood	-738.76	-734.64	-738.85	-734.07	-744.99	-740.71
Likelihood Ratio test						
Vs Model 2	22.61 ***	30.85 ***	22.44 ***	32.00 ***	10.16 ***	18.71 ***
Vs Model 4, 6, 8 or 10		8.25 **		9.56 **		8.56 **
No random effects (ρ=0)	90.85 ***	90.94 ***	109.64 ***	112.93 ***	114.64 ***	113.46 ***

***, **, * indicates significance at the 1%, 5% and 10% level, respectively. [a] Dependent variable is entry into new geographical (provincial) markets, the number of entries is 190 and the number of observations is 12,397.

Nonnemaker (2000) report that market dominance has a moderating effect on multimarket contact.

Models 6 and 7 incorporate the effects of strategic similarity (*SSimil*) into the analysis of multimarket contact in Model 2. Model 6 does not improve over Model 2. The LR test does not exceed the chi-square critical value with 1 d.f. at usual levels of confidence and the coefficient on *SSimil* is statistically insignificant. This finding implies that the effects of increased coordination among similar firms, related to their recognition of mutual dependence, appears to compensate the effect of lack of product differentiation on the intensity of inter-firm rivalry. The final outcome is that strategic similarity has no significant influence on market entry. Gimeno and Woo (1996) report that high strategic similarity increases rivalry, as reflected by low average prices while Fuentelsaz and Gomez (2002a) find that more similar firms are inclined to have less aggressive behaviour towards rivals, as reflected by lower entry rates into new markets.

Model 7, which adds the interaction term with multimarket contact, represents a significant improvement over Model 6. The LR test of model 7 versus model 6 exceeds the chi-square critical value with 1 d.f. at the 1% level. The estimate for the multimarket contact by strategic similarity coefficient is negative and significant suggesting that higher similarity amplifies the negative effects of multimarket contact on market entry. This finding suggests that the deterrent and information benefits of multimarket contact outweigh the effects of lack product differentiation and reinforces firms' recognition of interdependence leading to higher coordination. In line with this result, Baum and Korn (1999) find that in the Californian airline industry size asymmetries across firms, an indicator of resource dissimilarity, interact with multimarket contact in reducing market entry rates.

Models 8 and 9 add the effect of market concentration to the relationship between contact and entry into new markets. Model 8 represents an improvement over Model 2. The coefficient on *FM Conc* is negative and statistically significant at the 1% level, suggesting that banks are less likely to enter highly concentrated markets. This results provides support to the predictions of oligopoly theory that collusion is more likely to occur in concentrated markets. Previous studies provide mixed results regarding the effect of market concentration. On the one hand, Fuentelsaz and Gomez (2002a) report that the degree of concentration has no significant effect on the rates of market entry. On the other, Baum and Korn (1996) find that market concentration has a positive effect on entry rates and argue that it creates opportunities for new specialised entrants.

Model 9, which adds the interaction term, does not provide any improvement over Model 8. The coefficient on the interaction term between *FM Conc* and *Mmc* is statistically insignificant. These results imply that market concentration does not appear to moderate the effect of multimarket contact on bank entry. Baum and Korn (1996) also find that market concentration has an insignificant effect when interacting with multimarket contact, but the effect of multimarket contact on entry also becomes insignificant. They suggest that this finding could be related to multicollinearity problems.

Model 10 and 11 incorporates all these moderating factors. The coefficient on *Mmc* is negative and statistically significant. Market dominance has now a positive effect on market entry, while its interaction with *Mmc* is insignificant. This result may be related to possible multicollinearity with market concentration. For this reason, Models 12 and 13 incorporate DShare and SSimil only while Models 14 and 15 include SSimil and FM Conc. These results show that market dominance has a negative and significant effect on market entry, while its interaction with *Mmc* is insignificant. Strategic similarity has no significant impact on the likelihood of entry, however, interacting with *Mmc* leads to lower entry rates. Finally, market concentration has a negative and statistically significant effect on the timing of entry into new markets while the interaction term with *Mmc* is insignificant.

The analysis of entry in the banking industry in Argentina could be further extended by analysing the factors that explain the number of branches banks open in a particular province or by estimating the determinants of the different types of entry i.e. de novo or via mergers and acquisitions. Additionally, alternative definition of control variables could also contribute to analyse the robustness of the results such as different definitions of size, inclusion of population and area instead of population density and deposits per inhabitant or inclusion of a proximity variable. However, this is left for an extended study.

5.7 Conclusions

This chapter adds new evidence to the debate regarding the link between multimarket contact and competition by examining the relationship between contact and market entry dynamics in the Argentine banking industry over the 1994-2000 period. Market entry is used as an indicator of firm's behaviour and multimarket contact is analysed at the firm-market level. The effects of firm- and market-level characteristics on banks' choices of entry and of other competitive and market factors such as spheres of influence, strategic similarity and market concentration on the relationship between multimarket contact and market entry are considered in the analysis. Survival analysis techniques are used to estimate the relationship between contact and bank entry into new geographic markets using a longitudinal dataset.

The results tentatively suggest that firms with large asset bases and greater experience are more likely to expand into new markets when the level of demographic variables such as population density, intensity of demand or market growth are favourable. The results further show that multimarket contact seems to reduce the likelihood of entry into new markets. This finding provides some support to the mutual forbearance hypothesis, which predicts that when firms meet in multiple markets they hesitate to contest a given market vigorously. Contact in multiple markets allow firms to observe each other's behaviour increasing firms' abilities to interpret each other's intentions and actions. It also provides greater scope for firms to respond to their competitors' actions. As a result, multimarket competitors avoid aggressive behaviour that could destabilise their competitive relationship.

The findings tentatively suggest that firms are less likely to enter markets dominated by a single firm, that is, these markets are not attractive for firms searching for new opportunities. However, the effects of multimarket contact on firms' rates of entry are not affected by the level of market dominance. The results also seem to suggest that strategic similarity among firms has no effect on rates of entry into new markets, which implies that the possibility of tacit coordination among strategically similar rivals is outweighed by the potential for disruption when rivals seek similar market positions, use similar resources or develop similar organisational capabilities. However, when similar firms are multimarket rivals, the additional information provided by the multiple contacts increases the likelihood of coordination, which thus reduces the rates of entry into new markets. The findings further imply tentatively that firms are less likely to enter highly concentrated markets, because they recognise their mutual interdependence, avoiding aggressive behaviour. The effects of multimarket contact on firms' entry rates are, however, not affected by market concentration.

The results have implications for the analysis of multimarket competition. First, it provides new evidence on the link between multimarket contact and competition in the banking industry, which is consistent with theoretical predictions and empirical findings for other industries. Second, the inclusion of moderating variables of the relationship between multimarket contact and competition contributes to a better understanding of the effects of market and firm-level characteristics. Third, the use of longitudinal data adds considerable value to the study of the dynamics of rivalry, going beyond traditional cross-sectional studies that examine interfirm interaction at a given point in time. Fourth, the introduction of random effects to control for the potential correlation across observations as well as for omitted variables represents a significant improvement over previous works.

The results lead to some tentative policy implications . The findings can be used by regulators to analyse the effects of deregulation in markets such as telephone communications, for example. Deregulation will have the effect of bringing into competition firms with different positioning and capabilities that have not experienced multimarket contact before due to local market regulations. The results of this study could be used to predict firms' competitive interactions given the effects of strategic similarity and multimarket contact, helping managers develop appropriate strategies. The findings of this chapter could also be used in antitrust policies when analysing the effects of horizontal mergers. Antitrust authorities in general ignore multimarket reactions, focusing only on horizontal dominance of markets. The results discussed in this study could be used to consider the effects of horizontal mergers on both market concentration and multimarket linkages.

Chapter 6

Conclusions

6.1 Summary of Findings

The banking industry has experienced extraordinary changes over the last decades. Banking markets have been deregulated and opened up to foreign competition in a number of countries around the world with the aim of achieving more efficiency. As banking markets were seen as partly characterised by collusive behaviour, liberalisation policies have been targeted at fostering innovation and efficiency, by making markets more competitive and reducing oligopoly rents. As a result, post-deregulation developments including mergers and consolidation, privatisation of public-owned banks and entry of foreign banks have led to deep changes in the structure of domestic banking markets.

This thesis has provided new evidence on post-deregulation developments in financial services industries by examining the banking industry in Argentina after its deregulation in the early 1990s. The analysis of the Argentine banking sector is relevant for other developing countries, as the banking reforms implemented throughout the 1990s made the country among the first developing economies transforming the ownership, structure and regulation of the industry. This thesis extends existing research by providing new evidence on the effects of consolidation on market power, cost economies and consumers' welfare; on the relative efficiency of different ownership types; and on the influence of banks' geographic expansion on multimarket contact and local market competition.

The construction of a rich and detailed dataset for the Argentine banking industry has allowed a fuller and richer understanding of the industry's cost structure, the effects of banks' ownership structure on efficiency and a more comprehensive assessment of the determinants of banks' expansion decisions. These issues have been examined using post-deregulation data over the 1993-2000 period. Such a period covers a decade of institutional order and economic stability. These conditions were, however, interrupted in December 2001 with the resignation of the Nation's President, the freezing of bank deposits and an asymmetric 'pesification' of banks' loans and deposits. The findings of this thesis are not only unaffected but, in practice, they also could assist policy makers in the development of future policies.

Chapter 2 provided the contextual industry framework that led to the questions addressed in the rest of the thesis. This chapter offered an institutional background to the empirical chapters, as it described the characteristics of the consolidation process in the banking industry, its effects on the structure of the sector and on the geographic range of banks' operations. It also examined the industry's privatisation process, the entry of foreign banks and discussed the changes in the ownership structure of the sector as a result of these developments. The three chapters that follow presented the empirical results.

Chapter 3 used a cost-function based model incorporating output- and input-market pricing equations to examine the market and cost structure of the banking industry in order to provide some useful insights on the effects of consolidation on market power, cost economies and economic welfare. This chapter makes two contributions to the banking literature. First, it is the first to examine market power both in the markets for loans (output) and deposits (inputs) using bank-level data and allowing for a flexible cost structure. Second, it is also novel in that it analyses the market power and cost economies effects of consolidation on economic welfare.

The findings provided evidence of market power exploitation in the market for loans but not in the market for deposits. On the contrary, in the latter banks appear to have been paying a margin above the marginal value for increases in deposits. The results also suggested differences across banks size classes since larger banks appear to have been exercising a higher degree of market power pricing in the market for loans and seem to have been paying a lower margin over the marginal value of deposits. The findings further suggested that banks operate under increasing returns to scale, which decrease with bank size, and that larger banks benefited to a larger extent from technical progress.

The evidence also indicated that market power and scale economies increased over the post-deregulation. However, the effects of cost economies appear to have outweighed the negative influence of market power on prices and service availability, as consumers and banks have benefited in terms of economic welfare. These findings could serve policy makers because they suggest that policies directed towards downsizing in industries characterised by high concentration levels could be misdirected if consolidation and resulting concentration are motivated by cost economies. Such an action could limit the potential to lower costs in the industry, and thus reduce the price for consumers.

Chapter 4 explored the relative efficiency of stock, mutual, public- and foreign-owned banks using a variety of techniques to allow for comparisons across measurement methods. This chapter makes two contributions to the empirical banking literature, as it is the first to consider efficiency differences across four different ownership types and since it analyses the relationship between ownership and efficiency in the context of a developing economy. The banking industry in Argentina presented an interesting setting to analyse the ownership-efficiency relationship as the sector is characterised by the coexistence of four ownership types: mutual, stock, public- and foreign-owned banks. Previous studies have mainly analysed differences between stock and mutual or domestic- and foreign-owned banks, most of them in the U.S. where the public ownership form is not present. Few studies have analysed efficiency differences in a developing economy and the results from these works have been mixed.

The findings suggested that the choice of methodology have an important impact on the estimated efficiency scores. However, the different methods provided similar efficiency rankings, especially at the top and bottom of the distribution, where managerial interest is concentrated. The evidence further indicated that among domestic-owned banks, stock banks have higher cost efficiency scores than mutual and public-owned banks. However, the differences between public-owned and private banks are much more relevant than differences within private banks, which point towards agency problems in public-owned banks as responsible for the lower efficiency levels.

The results also showed that stock domestic- and foreign-owned banks have similar cost and profit efficiency levels, suggesting that foreign-owned banks compensated the costs of operating abroad by importing capabilities from their parent organisations. The findings also provided evidence of widespread economies of scale across all ownership types but technical progress benefited only stock domestic- and foreign-owned banks. The empirical evidence further indicated that the efficiency of the banking industry increased over the post-deregulation period as a result of an improved performance of all ownership types, but especially that of mutual and public banks. This result suggested that the post-deregulation developments i.e. consolidation, privatisation and foreign entry, appear to have played a significant role in the banking industry in Argentina. These findings could serve regulators when performing regulatory analysis by suggesting that the use of multiple techniques could prove useful. Additionally, this evidence could also provide policy makers in developing countries with information regarding the benefits of privatising public banks or liberalising entry into their banking sectors, provided any adverse effects of such policies, are not too severe.

Chapter 5 examined the impact of multimarket contact on banks' entry rates into new geographic markets using survival analysis techniques and considering the effect of bank- and market-level characteristics on banks' choices of entry. The main contribution of this chapter to the multimarket contact literature lies in the analysis of the moderating effects of several variables, which were not considered, at least simultaneously, in previous studies. The results showed that, regardless of multimarket contact, banks with large assets bases and greater experience are more likely to expand into new markets when the level of demographic variables is favourable, such as high market population, intensity of demand and market growth.

The findings tentatively suggested that multimarket competitors are less likely to enter new markets when their level of contact with market incumbents is high, providing support for the mutual forbearance hypothesis. The results also showed that contact in multiple markets provide banks with greater information about competitors to predict future intentions and actions and also provide greater scope for banks to respond to their competitors' actions. However, the evidence further indicated that strategic similarity possibly moderate the relationship between multimarket contact and market entry. The results showed that when multimarket competitors are similar in terms of strategies, the likelihood of entry into new markets is reduced even more. These findings could serve regulators to analyse the effects of deregulation in markets characterised by barriers to geographic expansion or in antitrust policies to the analysis of horizontal mergers.

6.2 Further Research Avenues

This thesis has made several contributions to the banking literature. These contributions are in part a direct result of the utilisation of a particularly rich dataset for the banking industry in a developing country – given the industry standards – that contains bank level data for the period following deregulation in the 1990s. The findings presented in the thesis contributed to the literature by demonstrating how post-deregulation developments in the banking industry can be very important economic events with multiple implications. This thesis, furthermore, could also serve as the starting point for future research.

This thesis has analysed post-deregulation developments in the banking industry in Argentina, where deregulation policies were undertaken in the early 1990s with the aim of achieving more efficiency by making the industry more competitive. The evidence presented in the empirical chapters, however, has suggested that deregulation has not contributed to enhance competition during the decade. These chapters have analysed the behaviour of banks, though, other developments that have also emerged during this post-deregulation period have affected consumers behaviour. The unbundling of the pricing of services and electronic technology have contributed to increase consumers' switching costs in retail banking. These costs refer to "the information and transaction costs incurred by retail customers in switching from one supplier to another" (Rhoades, 2000, pg. 363). Switching costs could help explaining the effects of deregulation on market competition.

The unbundling in the pricing of retail banking services involved the implementation of explicit fees and charges to cover costs for specific services used by customers. This new pricing scheme replaced the previous one based on the implicit incorporation of fees and charges in the interest paid on deposits or charged on loans to customers. As a result of this new scheme, the pricing of banking services became more complex with the consequent difficulty for customers to compare the prices of products across banks. The increased use of electronic technology, such as direct deposit of paycheques or direct debit for payments of mortgages or bills, has also contributed to increase switching costs. To switch from one bank to another, customers need to make formal arrangements with each organisation making direct deposits or debits and also with the original and new banks.

As Rhoades (2000) mentions, the presence of switching costs constitutes a significant impediment to competition. In addition, Waterson (2003) notes that "resulting from the behaviour of customers in some important types of industry, traditional competition policy will not suffice to render the industry competitive and that, in such cases, quite different policy measures may well be more effective in enhancing competition" (pg. 130). Rhoades (2000) also argues that "the issue has received almost no attention from researchers or antitrust authorities" (pg. 364). As well as continuing with the line of research of this thesis, the analysis of post-deregulation developments in the banking industry could also be extended towards the study of switching costs and consumers' behaviour.

6.3 Concluding Remarks

This thesis has made several contributions to the banking literature in the following areas. Firstly, it has analysed market power in both the markets for loans (output) and deposits (input) using a structural model. In addition, this study has also examined the welfare consequences of market power and cost economies as a result of increased concentration, using a partial equilibrium model. Secondly, this thesis has explored the efficiency differences across public- and private-owned banks and, within the latter, it has further measured the relative efficiency of stock and mutual banks. Furthermore, it has compared domestic- and foreign-owned banks in terms of both cost and profit efficiency using a variety of techniques. Additionally, this study has analysed the evolution of the banking sector's efficiency after deregulation. Thirdly, this thesis has explored the effects of increased multimarket contact on market entry dynamics, considering the influence of firms' strategies or the structure of the markets on this relationship.

The findings of this thesis could be used by policy makers in developing countries when deciding about several issues. Firstly, the evidence presented could provide regulators with additional information to decide about the policies to adopt in highly concentrated industries, when consolidation is possibly driven by cost economies. Secondly, the findings could also provide policy makers with useful information regarding the benefits of privatisation or liberalising policies. Finally, the evidence could also serve regulators to analyse the effects of deregulation in markets characterised by barriers to geographic expansion or in antitrust policies to the analysis of horizontal mergers.

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