An empirical investigation of the effects of concentration on profitability among US banks

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Abstract

This paper analyses the effects of concentration on profitability in the US banking sector from 1994-2005, using bank-level panel data. A new index of concentration is proposed, which reflects the depth and intensity of concentration. The econometric specification facilitates the simultaneous testing of the four main hypotheses in the literature concerning the relationship between concentration and profitability. Strong support is found for the Structure-Conduct-Performance hypothesis, as well as some support for the Relative Market Power hypothesis. The results are robust to alternative econometric techniques and specifications, and to various measures of profitability and of concentration. Further analysis sheds light on the nature and possible channels of the concentration-profitability relationship. A positive relationship is found between concentration and profitability even when the largest banks are excluded from the sample, suggesting that the relationship between concentration and profitability may act in a generalised structural way. In addition to very large banks, large banks and small banks also appear to benefit from concentration, but with no clear advantages to lower-middle-sized banks. Analysis of the effects of concentration on the components of profitability suggests that concentration may raise both interest and non-interest revenue, and reduce both interest and non-interest costs. Furthermore, concentration appears to depress bank deposit interest rates and raise both lending rates and the interest rate spread. This suggests that bank concentration might have negative effects on savings, investment, and growth.

Keywords: banks, financial institutions, profitability, concentration, competition, market structure.

JEL codes: D4, G21, G34, L10, L11, O16.

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1. Introduction

This paper investigates how much and in what ways concentration affected profitability in the US banking sector[1] over the period 1994-2005. While some schools of thought in the industrial organisation (IO) literature would expect concentration to raise profitability, there is also an argument that any apparent relationship between concentration and profitability is spurious and that both concentration and profitability are likely to be the outcomes of other causal factors. To the extent that concentration does indeed affect profitability, this gives rise to further questions as to what channels this relationship works through. For example, is it just the biggest banks that benefit from concentration, or does concentration allow the banking sector as a whole to benefit vis-à-vis other sectors of the economy?

An understanding of the actual relationship between market structure and bank profitability (in a particular place and over a particular period) could have policy and regulatory implications. If the evidence suggests that it is a concentrated structure per se that raises bank profitability, as opposed to higher profitability being the result of efficiency or scale effects, then this might be interpreted as pointing to a greater focus on competition policy. Moreover, if the evidence suggests that the issue is the level of concentration in the sector rather than the relative market share of individual large banks, this might be taken as supportive of pre-emptive regulatory interventions based on structural conditions, as opposed to interventions requiring a behavioural trigger. Furthermore, how a finding of a relationship between concentration and profitability would be interpreted from a policy perspective might also be contingent on the source(s) of banks' 'superprofits'. Whether these arise primarily as a 'transfer' from depositors and lenders, or from borrowers, would have distinct economic implications for production and distribution. On the other hand, if the policy objective is to increase or maintain the profitability of the banking sector, especially of the larger banks, then evidence of such a relationship could point to tolerance or promotion of a highly concentrated market structure.

This study quarterly bank-level data to conduct panel regressions, using data for over 20 000 banks. Most other studies have relied on either or cross-sectional analysis or aggregated time series data. The specifications used to test hypotheses draw on but also extend the existing literature. Through the testing of regressors for endogeneity and the use of instrumentalisation

[1] Unless otherwise indicated, 'bank' refers to both commercial banks and savings institutions.

and GMM techniques, the paper provides a more rigorous treatment of potential problems of simultaneity, which is critical to drawing any firm conclusions from the econometric analysis. The paper also makes a contribution around understanding the channels of bank profitability. This is undertaken through an econometric investigation of the effects of concentration on the various components of profitability, as well as on key interest rate variables. The disaggregation of the banking sector into a stratum of the largest banks and the rest, and the further disaggregation of the rest by size, allows for an analysis of the relationship between the concentration at the top end of the banking sector and the profitability of the rest of the sector.

The next section reviews relevant developments in the US banking sector, both empirical and legislative/regulatory, as background to the investigation of the relationship between concentration and profitability. Section 3 is a literature review. Section 4 discusses the dataset and the variables that have been calculated for this study. The empirical analysis is presented in Section 5, including the conceptual approach, econometric techniques used, specifications, and results. Section 6 summarises the relevant hypotheses, the empirical predictions that would be associated with each hypothesis, and the implications of the results obtained in terms of the hypotheses. The final section concludes. The appendices contain all the regression results (as well as other tables such as summary statistics), more detail on the calculation of certain variables, and more detailed discussion of particular issues (such as the conditional relationship between size and profitability).

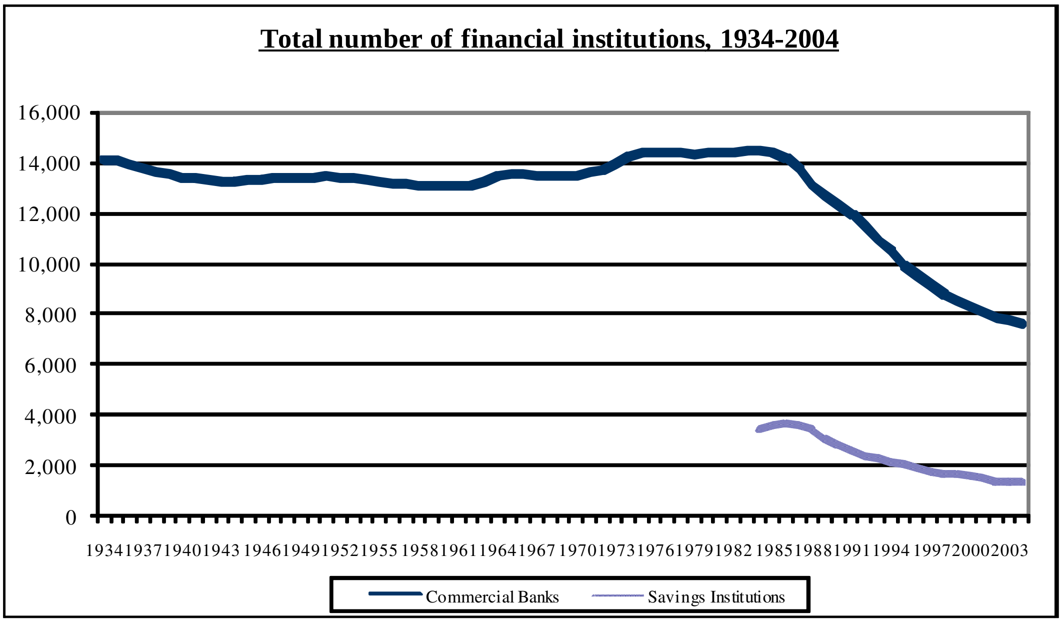
2. Overview of Developments in the US Banking Sector

This section will briefly review some developments in the US banking sector, including empirical trends and legislative and regulatory changes relevant to the issues at hand. Firstly, empirical data relevant to the issues of this paper is presented. These trends are presented at the aggregate level. Data is presented separately for commercial banks and savings institutions, given the differences apparent in the empirical trends for these two types of banks. Where historical data extends back beyond the period of focus of the paper, but is nevertheless relevant in contextualising current trends in historical perspective, this is also presented (data for commercial banks generally extends back to 1934, and for savings institutions back to 1984).

2.1 Number of institutions

Figure 1 simply shows the trend in the total number of commercial banks and savings institutions. The remarkable feature here is the precipitous and continuous drop in the number of institutions from the mid-1980s on. Whereas in the previous half century the number of commercial banks hovered within a fairly narrow band of between approximately 13 000 and 14 500, between 1985 and 2004 the number fell by an average of 357 per annum, bringing the total down to 7 630 commercial banks in 2004. The number of savings institutions also fell dramatically continuously, with the number of institutions in 2004 being just 37% of the number at the peak in 1986. The fall in the number of institutions can be attributed both to a rise in failures – particularly in the late 1980s and early 1990 – and to consolidation through mergers and acquisitions.

Figure 1



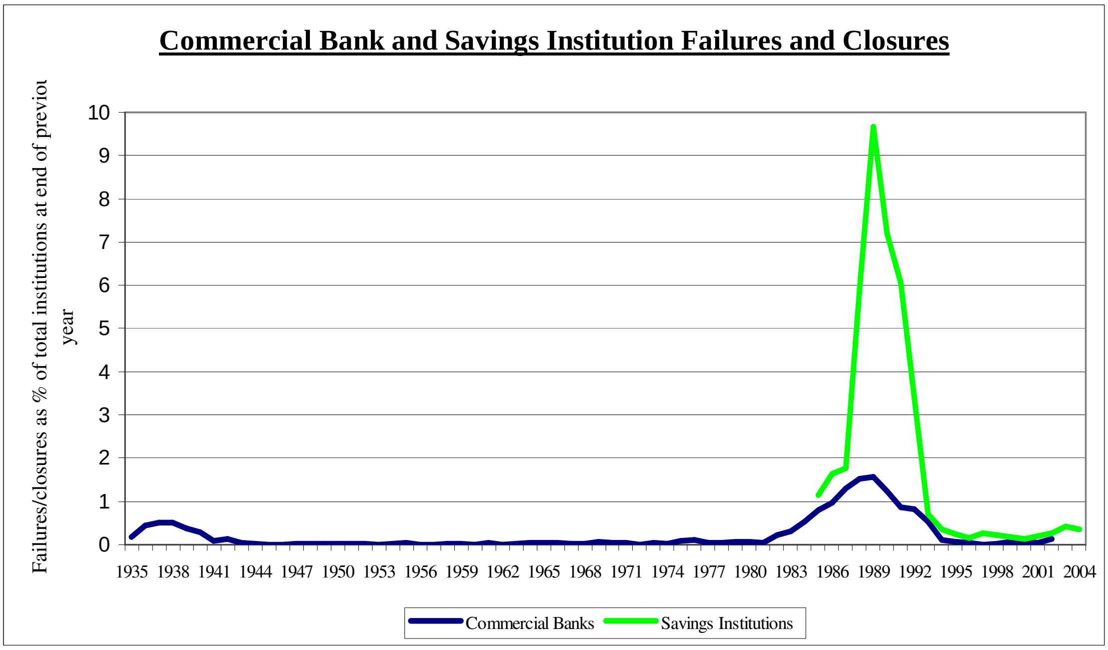
Note: The following institutional definitions apply to all data presented in this section: (1) Commercial banks includes the following groups of banks in the continental US operating under licenses issued by the Treasury or by state banking authorities: national banks, state-chartered commercial banks, loan and trust companies, stock savings banks, private banks under state supervision, and industrial banks. (2) FDIC-insured savings institutions includes all institutions insured by either the Bank Insurance Fund (BIF) or the Savings Association Insurance Fund (SAIF) that operate under state or federal banking codes applicable to thrift institutions.
Source: FDIC data

2.2 Failures and closures

These changes in the number of institutions are further elucidated by the trends in institutional failures and closures. Figure 2 depicts failures and closures of both commercial banks and savings institutions (the latter from 1985 onwards) as a percentage of institutions at the end of the previous year. On average less than five commercial banks failed per annum from the post-war period up until 1981. There is clearly a spike in failures and closures in the mid-late 1980s and early 1990s, peaking at almost 10% of savings institutions and 1.6% of commercial banks in 1989, before stabilising at an average rate of just 0.25% and 0.06% for savings institutions and commercial banks respectively for the period from 1994 onwards. Between 1980 and 1994 over 1600 FDIC-insured banks were either closed or received financial assistance, which was overwhelmingly more than at any previous time since federal deposit insurance was introduced in the early 1930s.

The proportion of failing or closing savings institutions was significantly higher than for commercial banks (although the rates are not quite comparable given the slightly different categories included, as explained in the notes below, due to data availability). The number of thrift failures/closures also peaked in 1989, with 332 failures/closures – representing almost 10% of the total number of thrifts at the end of the previous year – of which 317 were failures transferred to the Resolution Trust Corporation (RTC). By 1993 the percentage of thrifts failing had fallen to below 1%, but remained at a rate multiple times the commercial bank failure rate.

Figure 2



Commercial Bank failures include: (1) 'Failures - Mergers' meaning mergers, consolidations or absorptions entered into as a result of supervisory actions and (2) 'Failures - Paid off' meaning institutions that were declared insolvent, the insured deposits of which were paid by the FDIC.
Savings Institution failures include: (1) 'Assisted Mergers of Thrifts' meaning the absorption of a failing savings institution by another savings institution with assistance from either the BIF or SAIF. (Included are RTC Accelerated Resolution Program (ARP) assisted mergers. These institutions were not placed in RTC conservatorship.) (2) Assisted Mergers with Commercial Banks (3) 'Assisted Payouts' meaning all assisted payouts of FDIC-insured savings institutions that are not in RTC conservatorship (4) 'Voluntary Liquidations' – all instances where the owners of a thrift voluntarily surrender their charter with all liabilities including deposits paid down and all assets sold (5) Failures Transferred To RTC Conservatorship - representing institutions that were declared failed and placed under RTC conservatorship until a buyer(s) is(are) found or a payout to depositors occurs. Excludes unassisted mergers and charter transfers to commercial banks.
Source: Calculated from FDIC data

According to a detailed FDIC study (FDIC, 1997), the dramatic rise in the number of FDIC-insured banks that were either closed or received financial assistance between 1980 and 1994 had no single cause or even a shortlist of causes, but instead arose from a confluence of various forces, of which it identifies three categories. Firstly, 'broad national forces' including economic, financial, legislative, and regulatory factors, laid the grounds for the increased number of bank failures. Secondly, banks were affected by a series of sectoral and regional recessions. Thirdly, excessive risk-taking by some banks and inadequate regulation.

There is also an argument that attributes the high level of bank failures in the 1980s, at least in part, to geographical restrictions on bank ownership and regulations that proscribed acquisitions of banks by non-bank institutions, and that this allowed weak or failing banks to endure when they might otherwise have been taken over.

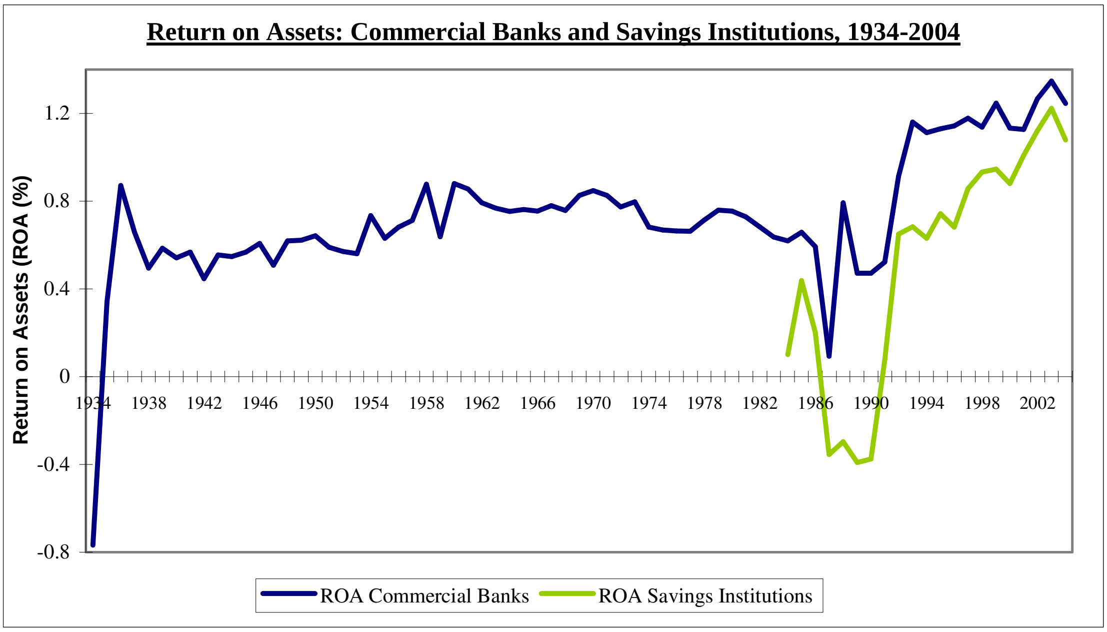
2.3 Profitability

Figures 3 and 4 show trends in the profitability of commercial banks (from 1934 onwards) and savings institutions (from 1984 onwards). This data is for the entire banking sector and shows aggregate figures (not averages across banks). Two measures of profitability are shown: return on assets (measured here as net income as a percentage of total assets) in the first chart, and return on equity (measured here as net income as a percentage of total equity capital) in the second.

A general upward trend in profitability over time is evident. The major exception in this regard is the plunge in profitability during the bank and thrift crisis of the second half of the 1980s and early 1990s: both measures of profitability for both types of institutions fell sharply after 1985, reaching the lowest point in 1987[2]. Both measures of thrift profitability were negative between 1987 and 1992, while commercial bank profitability approached zero in certain years. However, by the early 1990s profitability appears to have returned to what could be a long-term growth trend.

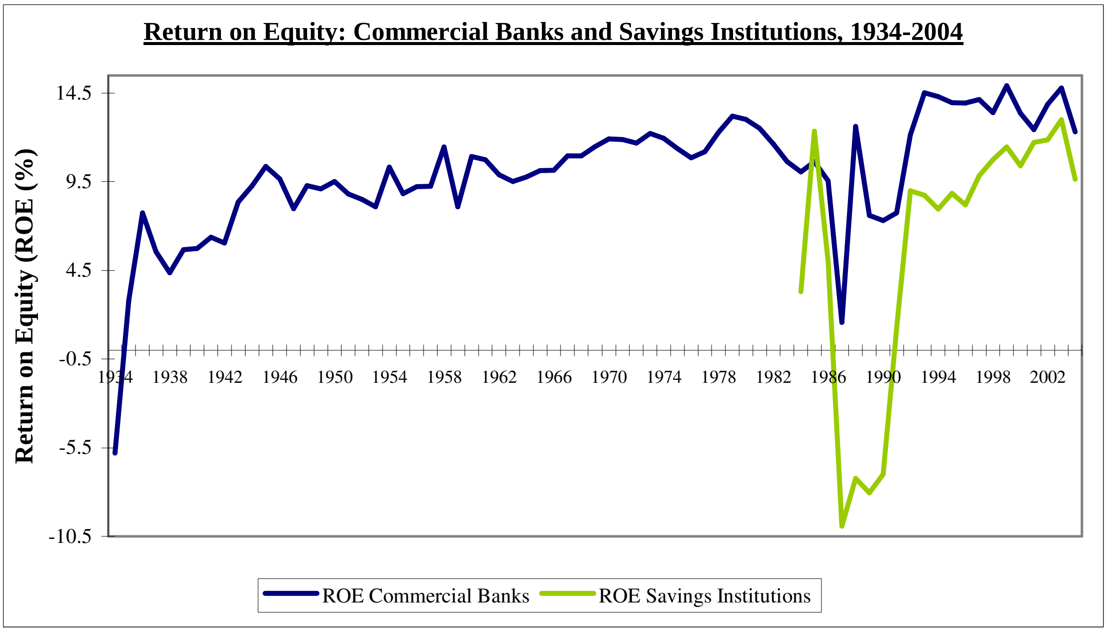
[2] Except for savings institutions' return on assets, which reached its nadir in 1989.

Figure 3



Source: calculated from FDIC data

Figure 4

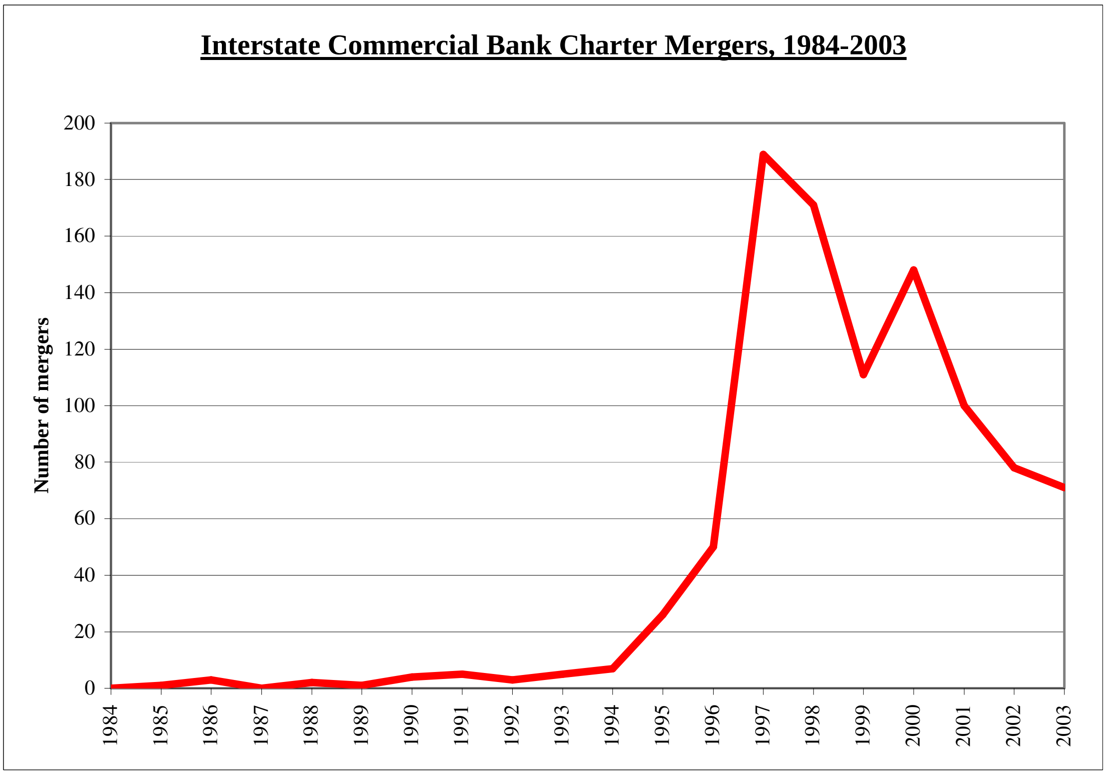


Source: calculated from FDIC data

2.4 Consolidation

Figure 5 shows the trend in interstate commercial bank mergers. The dramatic hike after the passage of the Riegle-Neal Interstate Banking and Branching Efficiency Act in 1994 (discussed in more detail below), illustrates the effects of this particular regulation on the industrial organisation of the banking sector.

Figure 5



Source: FDIC

Factors typically cited in the literature as causing or contributing to the trends towards consolidation and concentration include:

- Deregulation, in particular, the removal of geographic restrictions on banking and the weakening of restrictions on permissible banking activities. One demonstration of the impact of deregulation on concentration is to be found in the jump in mergers – specifically interstate mergers – with the implementation of the relevant provisions of the Riegle-Neal Act. Deregulation can be considered particularly important in facilitating rising concentration, in that other factors (such as those mentioned below) that could potentially have spurred concentration could not have actually triggered concentration in practice without the weakening or removal of previous legislative and regulatory barriers to this. In addition, a regulatory approach that (even implicitly) regards some institutions as ‘too-big-to-fail’ could incentivise growth above a threshold where economies of scale might otherwise be realized.

- Globalisation, which may have increased economies of scale, particularly among very large banks or niche banks that either compete internationally or whose domestic markets foreign banks were especially active in.
- Technological developments, which could have affected consolidation and concentration through the effects of technology on costs of entry, economies of scale, and transaction and screening costs.
- Macroeconomic conditions contributing to the bank and thrift crises that saw high rates of institutional failure and mergers and acquisitions of failed or failing institutions, intensifying concentration. This was in turn facilitated by the relaxation of the regulatory regime governing mergers and acquisitions, and even the public financing (through the FDIC) of acquisitions of weak or failing institutions. Further, the virtual explosion in financial sector stock prices from the mid-1990s on seems to have provided banks with the resources to fund takeovers (although the associated increase in new banks may have dampened the net effect of this on actual levels of concentration). Interest rate volatility at times such as the mid-1980s may also have favoured large and diversified financial institutions able to take advantage of economies of scope and scale (at least up to a point).
    - Incentivising of expansion and empire-building in the structure of managerial salaries and bonuses.

2.5 Legislative and regulatory developments

In terms of general trends in banking legislation and regulation over this period, an overall movement toward deregulation is apparent. However, this movement was not unilinear. Tightening and loosening of bank regulation occurred at different points in response to developments in the banking sector – notably where widespread failures occurred – as well as the legislative and regulatory environment significantly influencing the structure and performance of the banking sector. Nevertheless, there was a definite trend towards deregulation, which appears to have facilitated the rise in bank concentration. Of particular relevance in this regard were legislative and regulatory changes that, firstly, reduced or eliminated previous limitations on activities that could be undertaken by single institutions, facilitating conglomeration, convergence, and rising concentration; and secondly the removal of geographical restrictions particularly on interstate banking, which also contributed to increasing concentration.

The Depository Institutions Deregulation and Monetary Control Act (DIDMCA) of 1980 brought in uniform reserve requirements for all depository institutions and obligated the Fed to provide services, including access to the discount window, to all depository institutions at standard fees. Further, it phased out interest-rate ceilings for deposits, eliminated usury ceilings, increased the scope of thrift institutions' powers, and increased the deposit insurance limit.

The Garn-St Germain Depository Institutions Act of 1982, introduced in the context of a crisis among thrift institutions, brought three significant changes pertaining to thrifts. Firstly, money market deposit accounts were authorised for banks and thrifts, with the apparent purpose of reducing disintermediation. Secondly, net worth certificates were authorised in order to rescue thrifts in short-term peril of insolvency in order to implement capital forbearance. Thirdly, in order to bolster thrifts over the long-term, their ability to invest in commercial loans was increased. Thrift lending powers were thus significantly expanded. Banks were permitted to purchase failing banks and thrifts across state lines – potentially facilitating a rise in bank concentration. Further, the legislation abolished statutory restrictions on real estate lending by national banks and loosened the limits on loans to single borrowers.

By 1986, Regulation Q ceilings setting maximum rates on deposit accounts had been phased out, and regulations inhibiting competition between different types of depository institutions in different markets and products had been relaxed.

The Competitive Equality Banking Act (CEBA) of 1987 facilitated the recapitalisation of the Federal Savings and Loan Insurance Corporation (FSLIC) by allocating significant additional funding via the Financing Corporation (FICO), and put in place greater oversight over the thrift industry. The legislation also promoted the revival or acquisition of failed/failing institutions, implemented forbearance and assistance for (especially small-medium sized) agricultural banks, authorised bridge banks, and extended the ‘full-faith-and-credit’ protection of the government to federally insured deposits.

Also in 1987, the Board of Governors of the Federal Reserve authorised limited underwriting activities for specific giant institutions – J.P. Morgan, Citicorp, and Bankers Trust – with a 5% revenue limit on Section 20 ineligible securities activities.

The Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA) of 1989 completely overhauled the regulation of thrifts, including the introduction of stricter accounting and other standards and re-imposing restrictions on thrift lending. It allowed for $50 billion of public funding in order to resolve failed thrifts, as well as shifting thrift deposit insurance to the FDIC, and increasing the required insurance fund reserves of banks and thrifts as a proportion of their insured deposits. Some aspects also applied to commercial banks, and the enforcement authority of regulators was increased.

The Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991 sought to tighten up regulation in various ways following the thrift crisis and ongoing bank failures. It circumscribed the previous regulatory discretion regarding monitoring and intervention, instead setting out specific interventions and prompt corrective actions that would be triggered if the capital ratios of banks or thrifts dropped below specified thresholds, as well as restricting ‘too big to fail’. The law provided for compulsory regular on-site examinations and audits of all insured institutions, forbade undercapitalised institutions from using brokered deposits, circumscribed state bank activities, tightened least-cost standards for failure resolutions, introduced uniform standards for real estate lending by insured depository institutions, and brought in a risk-based deposit insurance assessment system introducing risk-based premiums and limiting deposit insurance coverage. Further, it sought to replenish the Bank Insurance Fund (BIF) in the wake of the thrift crisis and continuing bank failures.

The Omnibus Budget Reconciliation Act of 1993 gave the depositors of a failed bank priority over the claims of non-depositors. Also in 1993, a key court ruling (Independent Insurance Agents of America v. Ludwig) allowed national banks to sell insurance from small towns, aiding the trend towards conglomeration and diversification in the financial sector. This was further taken forward in subsequent court rulings in 1995 (Nations Bank v. Valic) and 1996 (Barnett

Bank v. Nelson) that allowed banks to sell annuities and repealed state restrictions on bank insurance sales.

In 1994 the Riegle Community Development and Regulatory Improvement (CDRI) Act overhauled regulatory structures and processes with an overall effect of reducing the regulatory burden on banks. The Riegle-Neal Interstate Banking and Branching Efficiency Act (IBBEA) of the same year authorised interstate banking and branching (for both US and foreign banks), to be phased in over a three-year period (although it can be noted that in practice state-wide banking was already existing in some form). Under the new legislation, from 29 September 1995 a bank holding company that met standards of capitalisation and management was allowed to acquire a bank in any state. This effectively repealed the Douglas Amendment. In order to limit deposit concentration, however, interstate acquisitions were only permitted if they would not result in the bank holding company controlling either over ten percent of US bank and thrift deposits or over thirty percent of deposits in the home state of the bank being acquired. These limitations were however subject to waiver or override by states. The legislation also opened the way for banks meeting required standards of capitalisation and management to merge across state lines from 1 June 1997 onwards, effectively repealing the McFadden Act. Foreign banks were also allowed to establish and operate both national branch banks and interstate banks. States however had considerable autonomy over interstate banking.

The Deposit Insurance Funds Act of 1996 was intended to recapitalise the Savings Association Insurance Fund (SAIF) by imposing a once-off levy on SAIF-assessable deposits. It also extended the FICO's assessment authority, brought in pro rata interest payments on FICO bonds for banks and thrifts, and mandated the merger of the bank and thrift insurance funds in 1999 and various other provisions. Also in 1996 the Federal Reserve eliminated a number of firewalls between bank and non-bank subsidiaries within bank holding companies, with many of the remaining ones eliminated the following year.

The Gramm-Leach-Bliley Act (GLBA) of 1999, also known as the Financial Services Modernization Act, repealed the earlier Glass-Steagall Act and allowed different types of financial institutions to affiliate/merge with one another as well as compete in each other's markets, thus removing key restrictions on conglomeration in the financial services industry. Specific provisions included the authorisation of bank holding companies to act as financial holding companies; ending regulations barring the merger of banks, insurance companies, and securities firms; lifting some restrictions governing non-bank banks; allowing a national bank to engage in new financial activities in a financial subsidiary (with some circumscriptions); and allowing national banks to underwrite municipal revenue bonds. Overall, these provisions facilitated greater diversification as well as concentration within the financial sector.

In 2001 the Federal Reserve revised Regulation K, broadening the scope of activities permitted for US banks in the rest of the world and weakening the regulations in this regard. Banks were permitted to invest up to 20 percent of capital and surplus in Edge Corporations (specialised banks chartered by the Federal Reserve permitted to engage in international banking business and exempt from restrictions on interstate banking). Provisions of the Riegle-Neal legislation affecting foreign banks were implemented.

2.7 Conclusions

The key developments in the US banking sector since the 1980s have thus included:

- consolidation (referring to the merging of firms in the same sector) and rising concentration;
- conglomeration (merging of firms in different segments of the financial sector);
- convergence (in the roles of financial institutions and in the products and services that they provide);
- globalisation, both in terms of the participation of foreign banks in the domestic market (especially in terms of lending to US corporations) and of US banks abroad;
- a general trend towards deregulation;
- a high rate of failures and closures (at least up to the mid-1990s);
- a net decline in the number of institutions;
- an increase in off-balance sheet activities;
- the financial sector accounting for an increasing share of the aggregate US economy – one aspect of the financialisation of the US economy that occurred during this period;
- the opening up of interstate banking;
- rapid technological progress;
- increasingly complex and opaque financial instruments;
- increasing profitability.

3. Literature review

This review begins by contextualising the relevant literature within the broader Industrial Organisation (IO) literature. Secondly, the different schools of thought regarding the relationship between concentration and profitability among banks will be discussed. Thirdly, selected empirical studies, particularly those focussed on the US banking sector, will be reviewed. Thereafter, the literature on the broader economic effects of concentration in the banking sector will be briefly considered. Lastly, some limitations of the existing literature will be discussed and the objectives of this study thus situated within the literature.

The two main traditions within the general IO literature are the 'classical' and 'revisionist' traditions. The classical tradition tends to treat the industry as the unit of analysis, with little attention paid to firm-specific issues or differences. The main determinants of industry profitability are considered to be the degrees of concentration and competition in the industry, specifically among established firms. The higher the degree of concentration, the greater is considered to be the ease (and the lower the costs) of collusion, and hence the higher would be industry profits. Further, barriers to entry of the industry would also raise profits in the industry. The work of Joe Bain (notably the seminal paper of 1951) provides the basis for this tradition. Bain's argument has been formalised in the Differential Collusion Hypothesis, that collusion is likely to be more effective and profitability above competitive levels, in industries with higher degrees of seller concentration.

The revisionist, or anticlassical, view which emerged later instead treats all markets as more or less competitive and regards economies of scale as absent or unimportant. The key issue is considered to be firm differences, specifically in efficiency. More efficient firms are more profitable and also gain larger market shares. This may show up in an apparent relationship between concentration and profitability, although there is no causal relationship. Between industries, the greater are differences in efficiency between firms, the greater will be the variation in market shares between firms, hence the higher is the degree of concentration in the industry; and also the higher will be the level of industry profitability (given the enhanced profitability of the leading firms); yet the level of industry concentration does not itself raise industry profitability. The work of Demsetz is considered central to this tradition. The Differential Efficiency Hypothesis thus provides an alternative explanation to an apparent positive correlation between concentration and profitability to that posited in the Differential Collusion Hypothesis discussed above. The Differential Collusion Hypothesis disputes the prevalence of effective collusion. Instead, it is argued that certain industries have similar levels of efficiency among firms, and relatively low levels of both concentration and profitability; while other industries have significant variation in efficiency among firms and relatively high levels of both concentration and profitability.

Specifications in empirical work in the broader IO literature, for example on the determinants of profitability, would tend to include both firm-specific and industry-specific variables. A key question of interest would be whether individual firm profitability is affected by sectoral or firm-specific characteristics: for example, the explanatory variables could include the level of advertising or of R&D expenditure at the sectoral and industry levels, in order to analyse how industry and firm spending each benefit individual firm profitability.

The literature within which this study is located, on the other hand, focuses in on one particular industry – in this case the banking sector. While such literature loses the inter-sectoral dimension of the broader IO literature that tends to focus on inter-industry studies, it does allow for a more detailed and specific study of the particular sector of interest. The dynamics in the banking sector are also likely to differ significantly from those found in the rest of the economy.

Turning to the more specific literature to which this paper is related, the 'structural' literature on the relationship between concentration and profitability can be characterised as falling into two very different broad approaches: the Market Power (MP) and Efficiency Structure (ES) paradigms. Although both are broadly 'structural', they are sharply differentiated by different understandings of the direction of causality between concentration and profitability (and this leads to quite disparate distinct policy implications). Broadly, in a MP paradigm the direction of causality runs from the market structure of an industry to its behaviour, which affects its performance. A concentrated structure is conducive to the use of market power in ways that may enhance banks' profitability. An ES paradigm, by contrast, would see the causality as running from individual firms' efficiency to their market share and profitability.

Two distinct approaches can be distinguished within the MP paradigm: the traditional Structure-Conduct Performance (SCP) hypothesis, and the Relative Market Power (RMP) hypothesis.

According to the SCP approach, the level of concentration in a banking market gives rise to potential market power by banks, which may raise their profitability. The higher the levels of concentration, the lower the costs of collusion (whether explicit or tacit), which gives rise to monopoly rents. Concentration thus affects profitability through firms' pricing behaviour, with concentrated market structures being more conducive to allowing banks to make 'abnormal' profits through higher mark-ups.

Whereas the SCP hypothesis would predict generic benefits to banks arising from higher concentration, the RMP hypothesis sees any benefits as accruing to individual banks based on their own market share. This approach proposes that only large banks, which enjoy brand recognition, can influence prices and increase profits.

There are also two distinct approaches within the ES paradigm: the X-efficiency and scale-efficiency hypotheses. According to the X-efficiency approach, more efficient firms – through better management or more efficient production technology – are more profitable because of their lower costs. Such firms would tend to gain larger market shares, which may manifest in higher levels of market concentration, but without any causal relationship from concentration to profitability: both profitability and market structure are functions of efficiency.

The scale efficiency approach within the ES paradigm emphasises the economies of scale rather than differences in management or production technology. Larger firms are able to enjoy lower unit costs and higher unit profits through economies of scale. As these firms have higher market shares, which may manifest in higher concentration, there may be an apparent – yet spurious – relationship between concentration and profitability.

According to the ES approaches, a positive correlation between concentration and profitability thus need not be indicative of a causal economic relationship, especially not through market power. In fact, a finding of a positive relationship between concentration and profitability is not inconsistent with any of the above four approaches. Distinguishing between the validity of these hypotheses requires careful specification in any empirical testing (as will be discussed further in the empirical section).

In their overview of the literature, Berger et al (2004) note that many studies found that US banks in more concentrated local markets tend to have pricing structures consistent with the exercise of market power under the SCP hypothesis, but that when banks' market shares were included in the regression equation, there were no longer strong relationships between concentration and profitability. Studies since the early 1990s have attempted to control for X-efficiency and scale efficiency, and have found some – generally weak – support for the effects of both market power and efficiency on profitability.

We briefly discuss a couple of the studies that have empirically investigated the relationship between concentration and profitability in the US in particular, focussing on two particular issues: their specifications of the equation to be tested, and their empirical results. However, given that few of these studies overlap with the recent time period which is the focus of this study, and in the light of the significant changes in the banking sector, there is probably limited direct comparability of actual results.

Smirlock's seminal paper (1985) argues that there is no relationship between concentration and profitability, but rather between bank market share and profitability. Any concentration evident is just an outcome of more profitable firms obtaining a larger market share, and any apparent relationship between concentration and profitability would be spurious if market share is not properly considered. Critiquing the SCP literature, he notes that few studies within that paradigm have found a consistently strong and positive relationship between concentration and profitability. Smirlock also refers to another paradigm in the literature that he refers to as the product differentiation hypothesis: that banks with a higher market share may have higher quality products, which allows them to charge higher prices and earn higher profits.

In order to test all three paradigms simultaneously, he proposes a specification that uses price to measure performance and includes both market share and concentration as explanatory variables. He suggests that the SCP hypothesis would predict a zero coefficient on market share and a positive coefficient on concentration; the ES hypothesis a zero coefficient on both market share and concentration; and the product differentiation hypothesis a positive coefficient on market share and a zero coefficient on concentration. Using data from 2 700 unit state banks operating in the area under the jurisdiction of the Federal Reserve Bank of Kansas City over the period 1973-1978, Smirlock finds that once market share is controlled for, concentration does not contribute to explaining bank profit rates. There is a positive and statistically significant relationship between market share and profit rates, which he interprets as supportive of the ES paradigm.

Berger (1995) conducts tests using 30 separate cross-sectional datasets: one for each year of the 1980s and for each of three different competitive environments: unit banking, limited branching, and state-wide branching states. In an important contribution to this literature, he includes measures of concentration, market share, X-efficiency, as well as scale-efficiency in a single specification in order to test all four hypotheses. Berger finds some support for the RMP hypothesis, in that market share is positively related to profitability for most of his cross-sectional datasets, once the effects of concentration and of efficiency are controlled for. He also finds partial support for the X-efficiency approach within the ES paradigm, as there seems to be a positive relationship between X-efficiency and profitability once the effects of the other three hypotheses are controlled for, but there is much weaker support for the other necessary condition of this hypothesis, that X-efficiency should be able to explain the positive relationship between profitability and market structure, which would be evidenced through a positive relationship between X-efficiency and concentration or market share. However, Berger notes that neither of these hypotheses are very important in explaining bank profitability, as the respective variables explain little of the variance of profitability (with median R^2 below 10%).

Nier (2000) uses risk-adjusted measures of profitability in comparing the profitability of European and UK banks. Using a panel data set of 63 banks from 13 countries, he estimates risk-adjusted profitability as the dependent variable. He uses two measures of excess profitability: firstly, a risk-adjusted after tax return on equity; and secondly, Tobin's q. Two measures of bank inefficiency using balance sheet data are proposed: the ratio of overheads to net income for a given bank and year; and the ratio of other funding to deposits (the logic being that other funding tends to be more costly than funding through deposits, hence firms relying more on deposits to fund their lending will have lower average funding costs and can thus be considered more efficient). He includes both bank-specific and country-specific variables in his specification.

Relating profitability to the level of concentration, Nier argues that according to the RMP theory, size may give rise to market power through the channel of product differentiation. Dominant firms, with a large market share, may be able to differentiate their product to a greater extent. On the basis of this differentiation in a firm's product, the firm's own demand function is downward sloping, and this endows the firm with market power. The use of this market power can in turn raise a firm's profitability. This theory could be tested by including market share as a determinant of profitability, and would predict a positive coefficient on market share (over and above the effect of concentration). He argues that product differentiation at a national level can be measured as the number of branches per inhabitant, the logic being that the fewer branches there are per inhabitant, the greater the market power enjoyed by each bank. Nier finds some evidence in support of the effects of concentration on profitability, as well as some support for the product differentiation hypothesis, and for measures of efficiency and factor costs.

Jeon and Miller (2002) study the relationship between banking concentration on a state-by-state basis and average bank profitability within a state. They find strong support for a positive relationship between concentration and profitability. Further, through temporal causality tests they find that bank concentration leads bank profitability. They conclude that their evidence supports the market-power hypothesis.

Overall, the evidence in the existing literature on the relationship between concentration and profitability is mixed.

Apart from the 'structural' approaches to the issue of the relationship between concentration and profitability, 'cost/price' approaches on the other hand, study in various ways the responsiveness of prices to costs in order to derive conclusions about the degree of competitiveness in a sector, and hence the degree to which the sector can be characterised as monopolistic or competitive. The studies fitting broadly within the 'cost/price' approach tend to draw on the idea advanced in Panzar and Rosse's seminal paper (1987) that monopoly profit maximisation places testable restrictions on the estimated parameters of firms' reduced form revenue equations. Other non-structural models of competitive behaviour employed in the literature include the Bresnahan model and the Iwata model. These types of analyses neither use information about nor attempt to model the market structure.

For example, Gischer and Stiele employ Panzar and Rosse's approach to test for the degree of competition among German savings banks over the period 1993-2002. They find that all the factor prices included have a positive and statistically significant relationship with the dependent variable. The Panzar-Rosse (PR) statistic in their results is driven primarily by the price of deposits, with labour price having a weak effect and the price of fixed capital close to zero. The results support the hypothesis of monopolistic competition, not monopoly or perfect competition. The authors also retest separately for small, medium, and large banks, finding that small banks have a PR statistic 0.16 lower than that of medium-sized banks – suggesting that they have greater market power - although this difference is barely significant in the robust regression, while large banks do not differ from medium-sized banks in their PR statistic. They conclude that the economic problems experienced by large German banks are not the result of overall fierce competition in the banking market, but rather derive from their focus on financing large enterprises and international corporate groups that have significant outside options for financing.

Bikker and Haaf (2001) also apply the non-structural Panzar-Rosse model to measure competition in terms of the elasticities of interest revenues with respect to changes in banks' input prices. They study banks in 3 separate categories (small or local banks, medium-sized banks, and large or international banks) in 23 countries over the period 1988-1998. The H-statistic calculated supports a hypothesis of monopolistic competition, although the authors note that perfect competition cannot be ruled out in some cases. In addition, their results show that a few large banks can limit overall competition, and that even the presence of a very large number of small competitors does not bring about competition.

In other studies using the Panzar-Rosse method to analyse the degree of banking competition, Coccorese (1998) finds monopolistic competition in Italian banks over the period 1988-1996; Bikker and Groenewald (2000) also find monopolistic competition in their study of 15 EU countries between 1989 and 1996; and De Bandt and Davis's (2000) study of banking in Germany, Italy, and France from 1992-1996 finds monopolistic competition among large banks in all three countries, and monopolistic competition among small banks in Italy, but monopoly in Germany and France.

One limitation of these types of non-structural approaches is that the analysis must be based on observations that are in long-run equilibrium (which is arguably unlikely to ever actually be the case). In addition, these approaches rely on are implicit assumptions about the nature of markets and perfect competition in the absence of a particular type of 'distortions'.

A couple of important studies on the effects of the degree of competition or concentration in banking on the 'real economy' will now be briefly reviewed.

Caminal and Matutes (2002) argue that the net effects of competition in banking may ultimately depend on the net balance of two effects: on the one hand, improved 'efficiency' of the industry associated with more competition; yet on the other hand, 'excessive' competition may jeopardise bank solvency and increase the risk of financial crises. The authors examine the extent to which market power affects banks' incentives to monitor borrowers (moral hazard problems) and the welfare implications of this. They distinguish between 'transaction-based credit' for which banks ration the loan size in order to incentivise efficient decisions by entrepreneur borrowers and for which the decision on granting the loan depends only on publicly available information, and 'information-based credit' for which banks can monitor the transaction thereby mitigating information asymmetries and facilitating higher levels of investment for which the bank is required to make a firm-specific investment in order to decide whether or not to grant the loan. The authors argue that the degree of monopoly power in the banking sector affects the equilibrium mix of transaction-based and information-based credit. When the higher monitoring effort associated with higher bank market power dominates the higher lending rates (also associated with higher market power), it is optimal for banks to have some degree of market power.

General equilibrium models have found that less competitive banking systems may have negative effects for the economy, for example on income and the business cycle (Smith 1998). Cetorelli (2004) finds that monopoly banking affects the financing of credit-constrained firms by facilitating the adoption of new and superior technologies as well reducing the costs of the screening process for new loans, yet these gains are offset by the redistribution of productive resources towards higher profit margins of banks.

Guzman employs a simple general equilibrium model to examine how banking market structure – specifically comparing a monopolistic and competitive banking structure – affects long-run capital accumulation and economic growth. He finds firstly that monopoly banking tends to depress capital stock and thus reduce the level of long-run real activity, either because under credit-rationing a monopoly bank rations credit more severely than is the case under competitive banking, or in the absence of credit rationing monopoly banking results in excessive monitoring of credit-financed investment, both of which depress capital accumulation. Guzman's second key result is that monopoly banking is less likely to lead to credit rationing than is competitive banking. Thirdly, under credit rationing a monopolistic banking system leads to lower interest rates on deposits, but in the absence of credit rationing the interest rate charged on loans is higher under monopoly banking. Fourthly, the resources consumed by the banking sector due to monitoring of investment projects will be highest under monopoly banking. Finally, development trap phenomena are less likely to arise under competitive banking, and are likely to be less severe if they do arise.

Corvoisier and Gropp (2001) examine the effects of concentration on retail interest rates among European banks in the period 1993-1999. They estimate a simple Cournot model of bank pricing, with country- and product-specific measures of bank concentration. The authors find that higher levels of concentration may have resulted in less competitive pricing (higher interest margins) associated with collusion, in the case of loans and demand deposits. The highly information-intensive character of the loans may be conducive to concentration-induced collusion in this market, allowing banks to use their information advantage to extract rents from borrowers. For demand deposits, the importance of geographical proximity and the costs involved for firms or households in shopping around for demand deposits beyond their local market may be relevant to the relationship between higher concentration and less competitive pricing in this market. However, they do not find higher margins in more concentrated markets for savings and time deposits, and suggest that this could be attributed to an increase in contestability that occurred concurrently with the increase in concentration. The authors also argue that the lower importance of geographical proximity with respect to savings and time deposits (relative to demand deposits) and likely greater willingness of savers to go beyond their local area in pursuit of higher interest rates, may reduce the effects of concentration on pricing.

In conclusion, we can note that most econometric analysis of the relationship between concentration and profitability use either cross-sectional or aggregated time series methods. There is surprisingly little analysis using panel data (as in this study), given the advantages of these methods.

Further, there appears to be limited econometric analysis employing formal tests of endogeneity and appropriate instrumentalisation of key variables. As discussed elsewhere, this could be considered particularly important given the nature of the relationships being studied and possible issues of simultaneity.

In terms of results, there are no decisive and generalisable empirical results that seem to emerge from the literature on the relationship between concentration and profitability among US banks (and certainly not for the recent period which this paper studies). This makes direct comparability of empirical results difficult. Much seems to hinge on issues of specification and sample.

Most of the literature focuses on the overall relationship between concentration and profitability. This neglects to analyse intermediate variables and channels of profitability, as well as the effects of concentration on various interest rates. The literature on the effects of banking structure on real variables tends to be rather disconnected from the literature on the concentration-profitability relationship. This paper looks holistically at the relationships between concentration and both the components of profitability and key interest rates as well as profitability itself.

4. Data

4.1 Dataset

The dataset used in the empirical analysis is Standard and Poor's Bank Compustat Dataset. Results reported here are all from the Bank Compustat Quarterly Dataset. The findings are supported when the Annual Dataset is used. Bank Compustat provides detailed balance sheet and income statement by bank and by quarter. This allows for more sophisticated analysis and consideration of heterogeneity amongst institutions than would be possible with aggregated time series data.

The following categories of financial institutions are included in the sample: Commercial Banks; National Commercial Banks; Savings Institutions that are not Federally Chartered, Savings Institutions that are Federally Chartered, and State Commercial Banks. Life Assurers were excluded from the sample, as were banks that were classified as American Depository Shares (ADSs) and American Depository Receipts (ADRs), in order to focus the analysis as much as possible on the U.S. domestic banking market.

Banks that did not have a minimum of six consecutive quarters of full data were excluded from the sample. This was done both in order to avoid banks with excessively patchy data, and in particular to minimise any unintended changes to the sample when lag structures are introduced. The small number of banks that did not have positive mean profitability over the sample period were also excluded.

4.2 Description of variables

This section briefly describes each of the variables used in the regressions. Further detail on the construction of variables is provided in Appendix 3 where pertinent.

Variable	**Meaning**	**Comments**
Dependent variables:		
$\pi^{m}_{i,t}$	profitability of bank i in quarter t using measure m	profitability is measured using two different measures: $\pi^{ROA}_{i,t}$ is return on assets (ROA) and $\pi^{ROE}_{i,t}$ is return on equity (ROE).
(total gross interest income /TA)$_{i,t}$	ratio of total gross interest income to total assets of bank i in quarter t	
(total gross interest income /equity)$_{i,t}$	ratio of total gross interest income to total equity capital of bank i in quarter t	
(interest expense /TA)$_{i,t}$	ratio of interest expenses to total assets of bank i in quarter t	
(interest expense /equity)$_{i,t}$	ratio of interest expenses to total equity capital of bank i in quarter t	
(other income /TA)$_{i,t}$	ratio of other income to total assets of bank i in quarter t	
(other income /equity)$_{i,t}$	ratio of other income to total equity capital of bank i in quarter t	
(other expenses /TA)$_{i,t}$	ratio of other expenses to total assets of bank i in quarter t	
(other expenses /equity)$_{i,t}$	ratio of other expenses to total equity capital of bank i in quarter t	
deposit interest rate$_{i,t}$	ratio of interest on deposits to total deposits of bank i in quarter t	
lending interest rate$_{i,t}$	ratio of interest and fees on loans to the sum of gross loans, valuation portion of reserves for loan losses, and unearned discount/income, for bank i in quarter t	
interest rate spread$_{i,t}$	difference between the lending and deposit interest rates for bank i in quarter t	

Explanatory variables:		
$conc^{x}_{I,t}$	index of market concentration in sector I in quarter t using measure x	$conc^{1}_{I,t}$ represents an index of the weighted share of the largest 2% of institutions in sector I in each quarter in the total assets of that sector in that quarter, where sector I is either commercial banks or savings institutions. $conc^{2}_{I,t}$ is similarly constructed by represents the largest 5% of each type of institutions in each quarter.
CR^{a}	standard concentration measure	CR^{10} for the commercial banks and CR^{3} for savings institutions (given the differential number of banks in these sectors). This is included for comparison purposes.
$MS_{,t}$	market share of bank i in quarter t	the share of the aggregate net income of banks for quarter t accounted for by bank i.
$lnTA_{i,t}$	size of bank i in quarter t	natural log of the (real) total assets of bank i in quarter t
$(lnTA_{i,t})^2$	size of bank i in quarter t, squared	natural log of the total assets of bank i in quarter t, squared
$OPEFF_{i,t}$	measure of the operational inefficiency of bank i in quarter t	ratio of its total other expenses to net income.
Control variables:		
$CA_{i,t}$	capital asset ratio of bank i in quarter t	
$CDTA_{i,t}$	cash and dues from banks as a percentage of total assets, for bank in quarter t	
$TIATA_{i,t}$	total invested assets as a percentage of total assets, for bank in quarter t	
$PE_{i,t}$	price earnings ratio of bank I in quarter t	

5. Empirical analysis

5.1 Conceptual approach

Concentration at the top end of the banking sector can facilitate (and may or may not actually lead to) collusion among these banks. Collusion may allow them to charge higher lending rates and/or to pay lower interest rates on deposits and borrowings. Either or both of these effects would increase the profitability of the colluding banks, through a transfer from borrowers or lenders respectively. Further, concentration may be conducive to a high degree of political and economic power of the banking sector, or at least of the largest banks. This could have positive effects on bank profitability in broader ways, such as a more favourable regulatory environment.

One interesting issue that arises, to be discussed empirically later, is the extent to which concentration among the top banks is favourable for these banks alone, or for the banking sector more broadly. This question calls for an investigation of whether any apparent relationship between concentration and profitability in the banking sector is a reflection of an actual causal relationship of the entire sector – and if so through which channels such a relationship operates – or whether it is just a manifestation of higher profits obtained by the top banks as a product of their collusion.

On the one hand, under a concentrated market structure, where the top banks have a relatively high share of the market, these banks may be better able to increase their own profits. There are several possible channels through which such a relationship might operate. Given the definition of concentration in terms of market share, a higher degree of concentration among the top banks means that there may be intra-sectoral (within the banking sector) effects on profitability. Such effects could be realized through both compositional and causal channels. These mechanisms would be contingent on the reasons for higher concentration among the top ten banks. If the rising concentration is primarily as a result of mergers and acquisitions, then the effects of this on profitability would depend on the one hand on the relative profitability of the merged/acquired banks being 'brought into' the stratum of banks included in the concentration indices; as well as on the other hand on dynamic effects of the mergers and acquisitions on the profitability of both banks, for example through possible economies of scale. While the gaining of a larger market share by the top banks would naturally lead to a higher profit share of the top banks, the effect on the profit rate (the dependent variable in the econometric analysis that follows) is less clear, although it is hypothesised to be positive.

In terms of the impact of higher levels of concentration on the relationships between banks and other sectors, a greater market share of the top banks may increase their 'power' relative to consumers and non-financial corporations (both borrowers and depositors). This power may operate in various ways, such as collusion, political power to secure a favourable regulatory environment, etc. Under these circumstances banks may gain superprofits in various ways. They may be able to charge 'abnormally' high interest rate charges (or fees) on loans, and/or they may be able to pay 'abnormally' low interest rates on deposits and borrowings. Profits might also be raised in banks' non-interest activities.[3]

Note that these may not necessarily lead to profit rates of the top banks actually exceeding those of other banks. There could potentially be aspects of size – such as diseconomies of scale after a certain point – that would mitigate against the giant banks necessarily having the highest profit rates. The point is that high levels of concentration at the top may allow the top banks to enjoy higher profit rates than would otherwise be the case.

The relationship between concentration at the top, and the profitability of the rest of the banking sector, is more complex. There may be distinct and potentially opposing effects of concentration on the profitability of the rest of the sector. On the one hand, insofar as the market share of the rest of the sector is declining relative to the top banks, notably through mergers and acquisitions, this could have an indeterminate effect on their profit rate as discussed above (through the compositional and causal mechanisms).

On the other hand, insofar as concentration of the top banks increases their overall power vis-à-vis the non-financial sectors (households, industry, and government; both depositors and borrowers) and this allows the top banks to extract higher profits (notably through a higher interest rate spread), and insofar as the top banks act as 'price-leaders' for the rest of the banking sector or at least for the next layer of banks, then one might expect a positive effect of the concentration of the top banks on the profitability on the rest through a 'trickle-down' effect.

In other words, a high market share concentrated among the top banks could be conducive to collusive behaviour among them which could facilitate higher levels of profitability for the colluding banks. If such behaviour includes, for example, a pricing structure that facilitates

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[3] Types of non-interest revenue include service charges on deposit accounts' other service charges, collection and exchange charges, commissions and fees; and profit on securities sold or redeemed.

higher interest rate spreads and hence higher profitability, it might as a by-product allow non-colluding banks to also maintain higher interest rate spreads and hence higher profitability than would otherwise be the case.

In addition, a highly concentrated top end of the banking market may render the sector more economically and politically powerful, for example through a more favourable legislative and regulatory environment, although whether such effects would be limited to the top banks, to particular categories of large banks, or generic to the banking sector as a whole, would be conjuncturally contingent.

The net relationship between concentration at the top and the profitability of the rest of the banking sector is thus a priori indeterminate.

In order to empirically test the relationships discussed above, the following lines of investigation were pursued:

- Firstly, testing the relationship between bank concentration and profitability at the 'aggregate' level (i.e. the entire dataset). To this end a baseline equation is specified that is intended to isolate the effects of concentration in its own right on profitability.
- This relationship is then re-estimated excluding those banks whose asset shares are included in the computation of the concentration indices. That is, the key explanatory variables of interest (the two concentration indices) are constructed using data for a subset of the largest banks, while the dependent variable (and other variables in the regression) is for the rest of the banking sector excluding those large banks. The object of this step is to establish whether the effects of concentration on profitability are merely through raised profitability of the large banks whose asset shares are raising the concentration index, or whether there are more generalised structural effects on the sector as a whole.
- The baseline specification is also re-estimated for sub-samples of the dataset disaggregated by size (into quintiles, quartiles, and thirds respectively) in order to attempt to distinguish differences in the concentration-profitability relationship by bank size.
- The final part of the analysis tests for some of the mechanisms through which the concentration-profitability relationship may operate. Two methods of analysis are used in this

regard. Firstly, profitability is disaggregated into its component parts (gross interest income; interest expense; other income; and other expense; each as a ratio of total assets and total equity capital respectively) in order to investigate which component(s) of profitability are affected by concentration. Secondly, banks' deposit interest rate, lending interest rate, and interest rate spread are specified as dependent variables in order to ascertain the effects of concentration on each of these.

5.2 Econometric Methods

Equations were estimated using four econometric techniques: OLS (both static and dynamic); 2-step efficient GMM; dynamic Arellano-Bond GMM; and 2-step dynamic Arellano-Bover/Blundell-Bond GMM. The econometric methods used, particularly the GMM methods, will now be briefly reviewed.

Firstly, OLS regressions were all run with two-way fixed effects, between banks and between quarters. Both static and dynamic specifications were used, as discussed later.

Three GMM methods were also used. The employment of GMM techniques could be considered appropriate in obtaining efficient and consistent estimation in the presence of heteroskedasticity of unknown form, through the exploitation of orthogonality conditions. GMM specifications may also be more appropriate for dynamic models than simply including a lagged term of the dependent variable in an OLS specification.

Instrumental variables were also used in the GMM specifications in order to deal with possible endogeneity of the regressors. Whilst endogeneity of regressors is of course a problem in general, this issue is of particular pertinence in this study given the economic relationships being investigated. As discussed elsewhere in this paper, the issue of the direction of causality between concentration and profitability is a critical and contentious question in the literature. The ES schools of thought would posit a relationship from bank profitability to size, market share, and concentration. The issue of possible simultaneity in regression specifications thus presents a challenge for deriving strong conclusions from regressions that appear to find a causal relationship from concentration to profitability, yet do not take account of possible issues of endogeneity and simultaneity.

In order to deal with this issue, regressors were instrumentalised and tested for endogeneity. Variables were instrumentalised in the first instance with lags of their own levels. It is important in selecting instruments that they be appropriate: both relevant – in terms of their correlation with the regressors to be instrumentalised - and valid – in terms of orthogonality with the errors. Proposed instruments were thus assessed for their relevance by considering the (individual and joint) significance of the excluded instruments in the first-stage regressions (which are reduced form regressions of the potentially endogenous variables on the full set of proposed instruments, i.e. testing the explanatory power of the exclude instruments over each potentially endogenous regressor). The Bound F-statistics, t-statistics, and Shea 'partial R^2' were examined for each of the potentially endogenous regressors in this manner.

The validity of subsets of the proposed instruments was tested using the J-statistic from the Hansen test (which is the value of the GMM objective function evaluated at the current GMM estimator). The 'difference-in-Sargan' statistic[4] test was also employed in order to test a subset of orthogonality conditions (for a subset of instruments whose validity needs to be tested).

Once appropriate instruments were found for potentially endogenous regressors (which were various lagged values of the suspect regressors), the endogeneity of these regressors were tested for. This was implemented through the Durbin-Wu-Hausman (DWH) test, which involves a comparison of the coefficient vectors obtained through OLS and IV estimation[5]. The OLS estimate of the error variance is used to form the Hausman statistic.[6] Suspect regressors were tested for possible endogeneity both individually and as a subset of regressors.

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[4] Also known as the C-statistic or the distance difference statistic.

[5] Note that both the DWH endogeneity tests as well as the Sargan-type tests discussed earlier are essentially all tests of linear combinations of orthogonality conditions. In fact, under certain conditions the C and Hausman statistics would be equivalent.

[6] There are variations in the precise method of forming the Hausman statistic, contingent on the estimates of the asymptotic variances that are used. The Hausman statistic is sometimes formed using the IV statistic of the error variance. However, the form employed here (what can be termed the Durbin version) appears to be preferred as it is more efficient, and also performs better when the instruments are weak. (Baum et al 2003).

None of the regressors were found to be endogenous through the testing process discussed above. This was an important finding for two reasons. Firstly, it suggests that (at least on this count) the results from the OLS regressions are not necessarily inconsistent. These results are thus reported in this paper, along with the GMM results. Secondly, it may suggest that if market share and concentration are not endogenous to profitability – at least on a quarterly basis as tested for here – then a finding that concentration does appear to raise profitability may actually be robust and economically significant, and not just a manifestation of spurious correlation or reverse causality.

The finding of no endogeneity was actually to be expected for the concentration variable in particular, given that it is defined for the entire commercial banking and savings institution sectors for any given quarter. The way in which this variable was defined makes it virtually exogenous to the profitability of any single institution in any given quarter.[7] The question of possible endogeneity was thus more relevant to the other regressors.

Despite the finding of no endogeneity of regressors, they were still treated as either endogenous or predetermined and instrumentalised accordingly. Although the DWH test showed them not to be endogenous, they may still be predetermined (and economic theory would suggest that at least some regressors, such as market share and size, could be predetermined). Further, the DWH test may not be entirely conclusive, particularly as it appears to be somewhat sensitive to the choice of instrumental variables. In addition, as discussed above, possible simultaneity is a particularly important issue for this study. Instrumentalisation is also integral to the GMM techniques which are preferred for other reasons (such as the appropriate treatment of a dynamic structure). For all these reasons, regressors were still instrumentalised, and both the OLS and GMM results are discussed in this paper.[8]

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[7] In fact, to the extent that there could be a causal relationship from profitability to concentration, this might be a *negative* relationship, insofar as high levels of aggregate profitability could encourage entry, leading to rising competition and lower levels of concentration. If this type of simultaneity were present, then the positive relationship between concentration and profitability could even be understated.

[8] It should be noted that the consistency obtained through IV estimation (if the use of instruments is indeed warranted) does come at a cost of a loss of efficiency relative to OLS, particularly if the instruments used are only weakly relevant to the regressors being instrumentalised, since the asymptotic variance of the IV estimator is inevitably larger than that of the OLS estimator.

In addition to OLS, relationships were thus estimated using three different GMM methods. Firstly, a standard two-step efficient GMM estimator was implemented which minimises the GMM criterion function $J = N * g' * W * g$ where N is the sample size, g are the orthogonality or moment conditions(which specify that all exogenous variables or instruments in the equation are uncorrelated with the error term) and W is a weighting matrix. The GMM estimator with the optimal weighting matrix that minimises the asymptotic variance of the estimator, is the efficient GMM estimator. In the case of two-step efficient GMM, the optimal weighting matrix is the inverse of an estimate of the covariance matrix of orthogonality conditions.

If the model is exactly identified, and if the assumptions of conditional homoskedasticity and independence hold, there would be no difference between the efficient GMM estimator and the traditional IV/2SLS estimators. However, the efficient GMM estimator is more efficient through the use of the optimal weighting matrix and insofar as the model is overidentified and where the i.i.d. assumption needs to be relaxed.

The two-step efficient GMM estimator was implemented in both static and dynamic specifications. Robust estimates were obtained through the Eicker-Huber-White ‘sandwich’ robust variance-covariance matrix for the IV estimator.

Secondly, the Arellano-Bond (1991) estimator was used in implementing ‘difference GMM’. This approach treats the model as a system of equations differing only in their moment condition sets, with one equation for each quarter. Strictly exogenous regressors and other instruments enter the instrument matrix in first differences, with one column per instrument, as usual with instrumental variables. Variables that are specified as either predetermined or endogenous enter the model in first differences and are instrumented with appropriate lags of their own levels. The Arellano-Bond dynamic panel-data estimator is thus derived using lagged levels of the dependent variable as well as the predetermined and (originally) endogenous variables and differences of the strictly exogenous variables.

This method was implemented with both the one- and two-step estimator, and the results were generally very similar. However, it should be noted that although the two-step estimates are asymptotically more efficient, the estimates of the standard errors have been found to be downward biased. Arellano and Bond thus recommend the use of the one-step estimators for inference. The results reported here for the Arellano-Bond estimations are from the one-step procedures.

The third method used was the Arellano-Bover/Blundell-Bond method of ‘system GMM’, the basis of which was laid by Arellano and Bover (1995) and which was fully developed in Blundell and Bond (1998). This method improves on the original Arellano-Bond method, a limitation of which is that the lagged levels used in the construction of the difference GMM estimator may be poor instruments for the first difference form in which the variables enter the system of equations. The improvement introduced by Arellano and Bover (1995) was thus to bring in additional moment conditions by also including the original equations in the system, thus increasing efficiency. The levels of predetermined and endogenous variables are thus instrumented with appropriate lags of their own first differences, in addition to the lagged levels being used as instruments for the first differences – hence the characterisation of ‘system GMM’.

Both the one- and two-step estimators were implemented in system GMM. Further, a finite-sample correction was made to the two-step covariance matrix derived by Windmeijer (2005). This correction has been shown to significantly improve accuracy, and can make the two-step estimator more efficient that the one-step when the robust estimator of the covariance matrix of the parameter estimates is calculated. This can thus yield estimates robust to both heteroskedasticity and serial correlation as well as with the appropriate finite sample correction.

As part of the post-estimation testing, various methods of outlier identification were used[9] and the baseline regressions rerun excluding the outliers identified through each method. This step was important, particularly given the heterogeneity of the dataset, in order to verify that the results were not simply outlier driven. The baseline results were found to be consistently robust (with minor variations) with all outlier identification methods used. Having confirmed this, the regressions were then run with the full dataset.

[9] The outlier identification methods used were the Cook, leverage, covratio, dfbeta, dfits, Rstandard, and Rstudent methods.

5.3 Specification and Results

5.3.1 Baseline and dynamic specifications

The baseline specification is as follows:

$$\pi^{m}_{i,t} = \beta_0 + \beta_1 \mathrm{conc}^{x}_{I,t} + \beta_2 \mathrm{MS}_{i,t} + \beta_3 \ln \mathrm{TA}_{i,t} + \beta_4 \ln \mathrm{TA}^{2}_{i,t} + \beta_5 \mathrm{OPEFF}_{i,t} + \beta_6 \mathrm{CA}_{i,t} + \beta_7 \mathrm{CDTA}_{i,t}$$
$$+ \beta_8 \mathrm{TIATA}_{i,t} + \beta_9 \mathrm{PE}_{i,t} + \alpha_i + \gamma_t + \varepsilon_{i,t}$$

This regresses profitability (measured as either ROA or ROE) on five explanatory variables: the concentration index (‘conc1’ or ‘conc2’), market share, log of total assets, the quadratic of the log of total assets, and the measure of operational inefficiency; and four additional ‘control’ variables: the capital-asset ratio, ratio of cash and due from banks to total assets, the ratio of total invested assets to total assets, and the price-earnings ratio; as well as 2-way fixed effects by bank and by time (quarter).[10]

The primary purpose of this specification is to test the relationship between concentration and profitability. The specification is designed to simultaneously test the four competing hypotheses in the literature – the structure-conduct-performance, relative market power, scale-efficiency and X-efficiency – by nesting all four hypothesis in the specification. Further, this specification allows stronger conclusions to be drawn from a finding concerning concentration (which is the main variable of interest in this paper) as it suggests that any apparent relationship between concentration and profitability may indeed be a genuine causal one, as opposed to a spurious correlation arising from a causal relationship associated with one of the other three hypotheses. A positive and statistically significant coefficient on concentration (‘conc1’ or ‘conc2’), even when market share, size, and operational efficiency are controlled for, would thus suggest that concentration has an effect in its own right on profitability, and that an apparent positive relationship is not spurious; this could be interpreted as supportive of the Structure-Conduct-Performance (SCP) hypothesis.

A positive and significant coefficient on market share (‘MS’) could be associated with the Relative Market Power (RMP) hypothesis, and would suggest that a bank’s market share has a positive effect on its profitability, and that (if no independent effect of concentration is found)

[10] Note that each variable is discussed more fully in section 4.2 as well as in Appendix 1.

any apparent relationship between concentration and profitability is actually just a reflection of the association between high market shares of the large individual banks and concentrated market structure. Further, a positive and statistically significant coefficient on market share even with the measure of operational efficiency in the specification, would suggest that – in addition to the generic structural effects of concentration on profitability – a bank's individual market share is significant even when its operational efficiency is controlled for.

A positive and statistically significant coefficient on the size variable 'lnTA' could be interpreted as supportive of the scale efficiency hypothesis, suggesting that large banks enjoy important economies of scale and it is this dynamic that may produce an apparent yet spurious relationship between market structure and profitability. The measure of size ('lnTA') is included in both the linear and quadratic form. The reason for this specification is a hypothesis, derived from the existing literature and empirical evidence, that banks realize economies of scale only up to a certain point, after which there may even actually be diseconomies of scale. A negative and significant estimated coefficient on '$lnTA^2$', especially if the turning point of the regression were found to be at a relatively low size threshold, would however go against the scale efficiency hypothesis.

Finally, a negative and significant coefficient on 'OPEFF' would be supportive of the X-efficiency hypothesis: if operational efficiency were a significant determinant of bank profitability, one would expect a negative coefficient on this variable. (Note that the way that this variable is constructed thus actually measures operational <u>in</u>efficiency.)

The SCP hypothesis would thus predict a positive and significant coefficient on 'conc', but would not be associated with explicit predictions concerning the other explanatory variables. The RMP hypothesis would predict a positive and significant coefficient on the 'MS' variable, and does not require any particular results in terms of the other variables. The scale efficiency hypothesis would predict a positive and significant coefficient on 'lnTA', would not predict a negative (and significant) coefficient on '$lnTA^2$' (at least not at a low turning point), and would predict that positive and significant coefficients would not be found on 'conc' or on 'MS'. The X-efficiency hypothesis would predict a negative and significant coefficient on 'OPEFF' and would predict that that the coefficients on 'conc' and 'MS' would not be positive and significant. Note that the latter two hypotheses predict that including the relevant variables in the specification (size in the case of the scale efficiency hypothesis and operational efficiency in the case of the X-efficiency hypothesis) would collapse any apparent relationship between concentration and either profitability or bank market shares.

The regressions were run with two different measures of the dependent variable profitability – return on assets (ROA) and return on equity (ROE). Some studies in the literature use one or the other of these measures, as they measure slightly different concepts, and both sets of results are presented here.

Further, two different measures of concentration are used as the explanatory variable of primary interest. A detailed explanation of the construction of these indices is given elsewhere in this paper, but essentially 'conc1' measures concentration among the top (i.e. largest) 2% of commercial banks and savings institutions respectively that are in the sample, while 'conc2' is a somewhat broader measure of the degree of concentration among the top 5%. The concentration indices were constructed in a new and arguably superior way to the measures usually used in such studies. One advantage of the new proposed measures is that they give a better sense of the depth and intensity of concentration than the CR^x measures typically used in the literature.[11] The concentration indices incorporate the asset shares of *each* of the banks within the top 2% or 5% respectively, weighted so that the largest banks within the top 2% or 5%, rather than simply the cumulative asset share of the top x banks as typically used in the CR^x measures.

Tables 2-8 show the results for the baseline specification, using OLS estimation, dynamic OLS (with one or four LDVs), with 2-step efficient GMM, with 1-step dynamic Arellano-Bond GMM, and with two-step dynamic Arellano-Bond/Blundell-Bover GMM.

Both measures of concentration have positive and highly statistically significant estimated coefficients in all OLS specifications – with both measures of profitability (ROA and ROE) as the dependent variable, and in the static as well as both dynamic specifications. The coefficients on 'conc2' (the 5% measure of concentration) tend to be slightly higher than on 'conc1' (the

[11] Note that, as discussed further below, the baseline OLS specification was rerun with the type of CR^x measures typically used, and the results are very similar to those obtained with the conc1 and conc2 measures, demonstrating the robustness of the results and also that the results are not specific to the new concentration indices proposed.

narrower 2% measure). The estimated coefficients on market share ('MS') are also all positive and statistically significantly, possibly pointing to some market power effects.

The estimated coefficients on 'lnTA' are consistently positive and statistically significant, while those on '$lnTA^2$' are consistently negative and statistically significant. This is an interesting result which is consistent with our theoretical priors, that banks do enjoy economies of scale but only up to a certain point. This issue is discussed in much more detail in Appendix 3, which also discusses the distribution of the actual sample in terms of the apparent parabolic relationship between size and profitability.

The estimated coefficients on operational efficiency (expected to be negative) are marginally negative but close to zero (sometimes appearing as zero in the results due to rounding of decimal points), and statistically insignificant in the estimations with ROA but statistically significant with ROE (although the level of significance is diminished in the dynamic specifications).[12]

The baseline specification in OLS was also rerun with the CR^x measures typically used in the literature. A CR^{10} measure was used for commercial banks, and a CR^3 measure for savings institutions (given the far smaller number of the latter both in the sample and in the entire population). The results are reported in table 2. Both the estimated coefficients and levels of significance are very close (in some cases even identical) to those for the baseline OLS specifications using 'conc1' and 'conc2', as reported in table 2.

Considering the results of the baseline specification with both static and dynamic 2-step efficient GMM, the estimated coefficients on both concentration measures and for both profitability variables remain positive and significant, with a roughly similar order of magnitude as with the OLS estimation. Market share remains positive but is no longer statistically significant, and while the signs of the size variables are the same as with OLS, their statistical significance is dampened. Operational efficiency is now marginally negative (as would be expected) and statistically significant, especially with ROA.

[12] Further consideration could be given to whether an improved measure of operational efficiency could be developed in future research.

The results from the one-step Arellano-Bond and the Arellano-Bover/Blundell-Bond dynamic GMM methods are consistent in signs and statistical significance with the other estimation methods (but note that all variable are in their first-differenced form in the former). Note that the estimated coefficients on both the first difference of concentration and on the level remain positive and highly statistically significant for both measures of concentration and of profitability.

Summing up the results from all four methods using the baseline specification, the finding of a positive and highly significant coefficient on concentration, and the robustness of this finding, suggests that what is important is the market structure of the sector and that this relationship is not just a manifestation of higher market shares of large banks, through economies of scale, or through superior efficiency of large banks. With reference to the existing literature, this result provides strong support for the SCP hypothesis over the RMP, X-efficiency and scale-efficiency hypotheses. It suggests that the market structure of the banking sector – specifically, the degree of concentration at the top end of the banking market – has effects in its own right on profitability, not merely through channels such as economies of scale, nor as a common outcome of an underlying determinant such as market share.

The R^2 statistics are generally rather low.[13] Although this is somewhat disappointing, it is worth noting that the related literature typically finds rather low R^2 statistics in these sorts of tests. Further, the specification focuses on the market structure and industrial organisation determinants of profitability, and could potentially be underspecified with respect to other determinants of profitability. The inclusion of additional control variables (results not reported here) did raise the R^2 somewhat, but this had the disadvantage of reducing the sample due to poorer coverage of these variables, and would probably have biased the sample as well.

Interpreting the economic significance of the results is critical to understanding the strength of the relationship between concentration and profitability and the degree of importance of any implications for the real economy. Given the way in which the concentration indices are

[13] Note that not all the methods used report a R^2 statistic.

constructed, were each bank included in the concentration indices (that is, the largest 2% of banks in each quarter for 'conc1' and the largest 5% for 'conc2') to increase their asset share by x% of their current share, the concentration index would rise by x%. (For example, a 5% rise in asset shares would mean, for the first quarter of 1994, the largest bank's asset share increasing from 6.272% to 6.585%, or that of the 20^{th} largest bank rising from 0.324% to 0.340%, and the concentration indices rising by 5%.) The effects of a change in the asset shares of the largest banks on the concentration indices and hence, based on the estimated coefficients on the concentration indices, on profitability, can thus be calculated.

The results of this exercise are summarised in table 9, for two estimation methods (OLS and two-step Arellano-Bover/Blundell-Bond dynamic GMM, for which the estimated coefficients differ in size) using the baseline specification, for both ROA and ROE as the dependent variable, and with each of 'conc1' and 'conc2' as the explanatory variable of interest. Based on the estimated coefficients on 'conc1' and 'conc2', the increase in profitability (ROA or ROE) that would be associated with a 5% or 10% increase in the asset share of each institution included in the concentration indices, are shown. The increases in profitability are also shown as a percentage of mean ROA or ROE respectively, to give a sense of their relative magnitude. For example, a 10% increase in the asset share of the largest 2% of institutions (as a percentage of their actual asset share in each quarter) would mean a 10% rise in 'conc1', which would be associated with (using the GMM estimated coefficients) increases in ROA and ROE respectively equal to 1.184% and 1.12% of mean profitability.

In economic terms, these effects are not particularly high. However, they do seem to be credible: given the range of determinants of an individual bank's profitability, a macro variable such as the level of concentration would probably not be expected to have a very high absolute effect. Note that the increases in profitability associated with increases in concentration are broadly similar for ROA and ROE as a percentage of mean ROA or ROE, (although mostly slightly higher for ROE). Further, the effects are slightly higher for 'conc2' (the broader concentration index) than for 'conc1'.

5.3.2 Re-estimation excluding banks included in the concentration indices

Next, the above specifications are re-estimated for a sample excluding those banks whose asset shares are included in the construction of the concentration indices – that is, the largest 2% of each type of institution in each quarter in the case of 'conc1' and the largest 5% for 'conc2'. One objective of this exercise is to further verify that the apparent relationship running from concentration to profitability does not derive simply from a correlation between large banks being more profitable and having a large market share, showing up in a higher concentration index, without any necessary structural relationship between concentration and overall profitability.

The second object of this step is to begin to investigate the channels of the concentration-profitability relationship, by considering whether the positive overall relationship between concentration and profitability is just operating through increased profitability of the top banks, which shows up when the relationship is tested for the entire sector, or alternatively whether concentration has positive effects on profitability of the sector as a whole. That is, to what extent is the enhanced profitability of the top banks, arising from their greater share of the overall banking market, at the expense of the rest of the banking sector, and/or to what extent does it also enhance the profitability of the rest of the sector?

The results from these regressions (using all four econometric techniques) are shown in tables 10-13. The coefficient on concentration is again positive and highly statistically significant in all sixteen estimations reported in the tables below excluding the large banks whose market shares are included in the respective concentration indices (i.e. for both profitability measures, both concentration indices, and all four estimation techniques). This result suggests that the overall positive relationship between concentration and profitability is not just a reflection of the positive effects of concentration at the top on the profitability of the top banks, but that concentration is actually affecting the profitability of the sector as a whole.

This is a particularly striking result given the indeterminate and possibly contradictory effects of higher concentration at the top on the rest of the sector. It might be interpreted as suggesting that any 'trickle-down' effects of the benefits to the top banks from higher concentration outweigh any negative effects on the profitability of the other banks, for example through the loss of market share to the largest banks. Even though rising concentration would mean lower market share for the rest of the sector and potentially lower absolute profits, the profit rate is higher.

This result also provides strong support for the SCP hypothesis over the RMP hypothesis. If the concentration-profitability relationship were operating through the advantages accruing directly to large banks through their own individual market shares, one would expect the apparent relationship between concentration and profitability to fall away when the large banks from whose asset shares the concentration indices are calculated, are excluded from the sample. The result of a robust positive relationship between concentration and profitability even when these banks are excluded points strongly towards a generic structural relationship between concentration and profitability.

5.3.3 Disaggregation by bank size

Next, the sample is disaggregated by bank size (measured as an institution's total assets) in order to investigate the differential effects of concentration on profitability. The sample is broken down into quintiles, quartiles, and thirds for each quarter, with institutions being classified according to their assets in that particular quarter (such that the particular sample of institutions in each category may change over time as their relative size changes). The specification is re-estimated by quintile, quartile, and third, for both concentration indices and for both measures of profitability. In each case quintile1/quartile1/third1 is the group of the smallest banks and quintile5/quartile4/third3 the largest. At this point these regressions have only been run with OLS.

The results of these regressions are reported in tables 14-15 (quintiles), tables 16-17 (quartiles) and 18-19 (thirds), in each case with each of 'conc1' and 'conc2' as regressors. The estimated coefficients on both concentration measures are consistently positive, and the estimates are mostly but not always statistically significant. In most regressions one (or two in the quintiles disaggregations) of the middle-lower size categories are not statistically significant[14]. Comparing the size of the estimated coefficients on the concentration regressors across size categories, these are always highest for the category of the largest banks (quintile/quartile/third 1 respectively).

[14] The estimated coefficients on concentration are not statistically significant even at the 10% level in the regressions with quintiles 2 and/or 3, in one case with quartile 2, and in some cases with the middle third.

For some size disaggregations (such as by thirds) the next highest estimated coefficients are for the smallest group and the lowest are for the middle group. For other size disaggregations (such as by quintiles) the estimated coefficient for the second largest group of banks is the second largest.

Summarising the results in terms of statistical significance and size of estimated coefficients on concentration across these 45 regressions across disaggregations of banks by size, a general picture seems to emerge of a strong positive relationship for the largest banks and large banks in the next tier or so, as well as for the smallest banks. The results are generally weak for a section of banks in the small-medium range of the size spectrum. These findings do make some economic sense. To the extent that high levels of concentration may facilitate collusive-type behaviour among the largest banks and allow them to extract higher profits (through interest and or non-interest channels, as discussed further below), the benefits of this may 'trickle down' to banks in the next tier(s) who are concomitantly able, for example, to pay lower rates on deposits or charge higher rates on loans. Furthermore, the industrial organisation literature often suggests that the smallest firms benefit significantly from concentrated markets, as they are pulled along by the price-setting behaviour or larger firms. However, the mixed results for middle-sized banks could perhaps arise from the combination of some benefits from being 'pulled along' on the one hand, while on the other hand the negative effects of being outside the direct benefits of collusive-type behaviour at the top. The smallest firms, on the other hand, are less likely to be direct competitors of the largest banks, and this could explain the positive results observed for them. For instance, these might be small local banks or niche banks that are in less direct competition with the large national banks than would be the case for medium-sized national banks.

5.3.4 Investigation of components and channels of profitability

The next line of investigation regards the 'channels' through which the apparent relationship between concentration and profitability operates. This can potentially shed light on some of the more qualitative and causal issues that the baseline regressions do not completely answer. Such an analysis is also germane to potential effects of bank concentration on the broader economy, and to any policy implications of this research, for which it would be important to understand the mechanisms through which the relationship operates and where the 'additional' profits realized through higher levels of concentration can in some sense be understood to have derived from.

However, such analysis does not appear to be extensively developed in the literature, and hence this research can potentially make a contribution in this regard.

Two lines of investigation were pursued in this part of the investigation. Firstly, the two measures of profitability were disaggregated into their four basic components as follows, and each of the components specified as the dependent variable. The object is to establish through which component(s) of profitability the concentration-profitability relationship operates. The components of ROA and ROE – these components being specified as the dependent variables in the next sets of regressions – are as follows:

$$\text{ROA} = \frac{\text{total gross interest income}}{\text{total assets}} + \frac{\text{interest expense}}{\text{total assets}} + \frac{\text{other income}}{\text{total assets}} + \frac{\text{other expense}}{\text{total assets}}$$

and

$$\text{ROE} = \frac{\text{total gross interest income}}{\text{total equity capital}} + \frac{\text{interest expense}}{\text{total equity capital}} + \frac{\text{other income}}{\text{total equity capital}} + \frac{\text{other expense}}{\text{total equity capital}}$$

Tables 20-23 show the results of estimation – using the same four econometric techniques of OLS, two-step efficient GMM, one-step Arellano-Bond dynamic GMM, and two-step Arellano-Bover/Blundell-Bond dynamic GMM – for the first two components of each of the two profitability ratios above, that is,

$$\frac{\text{total gross interest income}}{\text{total assets}}, \frac{\text{interest expense}}{\text{total assets}}, \frac{\text{total gross interest income}}{\text{total equity capital}}, \text{ and } \frac{\text{interest expense}}{\text{total equity capital}}.$$

Tables 24-27 show the results with the other two components of the two profitability ratios as above, that is,

$$\frac{\text{other income}}{\text{total assets}}, \frac{\text{other expense}}{\text{total assets}}, \frac{\text{other income}}{\text{total equity capital}}, \text{ and } \frac{\text{other expense}}{\text{total equity capital}}.$$

The results for these regressions are not entirely conclusive, and further investigation in this area is required. However, particularly when the estimated coefficients on the concentration variables are statistically significant, they are indeed of the expected signs: positive estimated coefficients on the concentration indices when the dependent variables are total gross interest income or other income over either total assets or total equity capital, and negative estimated coefficients on the concentration indices when the dependent variables are interest expense or other expense over either total assets or total equity capital. These results suggest that the effects of concentration on bank profitability may operate through all four components of profitability. This further bolsters a conclusion of a causal relationship from concentration to profitability. However, the unevenness of the results when the results using the various econometric techniques used are compared – mostly in terms of differing levels of statistical significance, and in a few cases even of sign – suggests that further investigation is required in this regard.

The second line of analysis in terms of the intermediate variables and channels of profitability is on the effects of concentration on interest rates paid by the bank, received by the bank, and the difference between these (the interest rate spread). Note that the deposit and lending interest rates calculated here are 'effective' rates, in that they are not the nominal rates actually charged/paid by the banks, but are based on the interest actually received or paid (such that defaults on loans are also taken account of).

Each of these three variables was specified as the dependent variable and estimated with the same four econometric techniques. These three variables are defined as follows:

$$\text{deposit interest rate} = \frac{\text{interest on deposits}}{\text{total deposits}}$$

$$\text{lending interest rate} = \frac{\text{interest and fees on loans}}{\text{gross loans} + \text{unearned discount/income} + \text{valuation portion of reserves for loan losses}}$$

$$\text{interest rate spread} = \text{lending interest rate} - \text{deposit interest rate}$$

Tables 28-31 show the results from regressions in which the dependent variables are the deposit interest rate, lending interest rate, and interest rate spread, respectively.

Both concentration indices have a negative (except in the case of the Arellano-Bond results, which is in first differences) and generally statistically significant coefficient in explaining the deposit interest rate, and positive and statistically significant coefficients in explaining both the lending interest rate and the interest rate spread. These results suggest that relatively high levels of concentration may allow banks to increase their interest rate spread both at the expense of depositors and of borrowers, a potentially very significant result.

However, it must be noted that the sample size for these regressions is restricted – and probably in a biased fashion – owing to the poor coverage of certain data items needed in the calculation of these ratios (although still yielding over 2 500 valid observations for each regression[15]), and this unfortunately diminishes the weight that can be attached to these results.

Overall, the results of the estimation on the various intermediate variables are supportive of the overall results discussed above concerning the relationship between concentration and profitability. Moreover, it appears that the relationship operates through interest rates on both lending and borrowings, as well as through both interest and non-interest channels.

This analysis is important in understanding the effects of concentration in the banking sector on the real economy, notably in terms of accumulation as well as distribution. The interest rate spread can be thought of as a wedge between deposit and lending rates, transferring resources to banks rather than productive investment. The effects of concentration-depressed interest rates on deposits on savings would depend on the interest elasticity of savings. If savings were completely interest inelastic, the lower interest rates on deposits associated with higher rates of competition would mean a transfer from depositors to banks. The more interest elastic were savings, in addition to these distributional effects there would also be lower rates of savings and/or financial disintermediation. On the other side, the higher interest rates on lending associated with higher levels of concentration could likely have more direct negative effects on investment and growth.

6. Conclusion

This paper has investigated the effects of concentration on profitability in the US banking sector between 1994 and 2005. A strongly significant positive relationship is found – even with the inclusion of regressors associated with an individual bank's market share, size, and operational efficiency – which supports for the Structure-Conduct-Performance hypothesis of a structural

[15] Fewer observations for the GMM regressions due to the lag structures.

relationship between overall concentration and profitability. This is an important finding, and suggests that concentration in the banking sector does have a positive effect on profitability in the entire banking sector, even when controlling for individual bank market share, size, and operational efficiency. The implication is that bank concentration raises profitability in a generalised, structural way – rather than simply as an outcome of banks' individual market power associated with their own market shares, or with economies of scale or the benefits associated with higher operational efficiency simply manifesting in higher concentration.

Some support is also found for the RMP hypothesis, as the estimated coefficients on 'MS' are also consistently positive and statistically significant. Economies of scale are found up to a certain point, but the evidence suggests that the scale-efficiency hypothesis is not valid for the sample. The analysis does not show support for the X-efficiency hypothesis.

The relationship found between concentration and profitability is robust to various econometric techniques used: OLS (both static and dynamic); two-step efficient GMM; dynamic Arellano-Bond GMM; and two-step dynamic Arellano-Bover/Blundell-Bond GMM. Further, it is robust to two alternative measures of concentration used (one including the asset share of the largest 2% of commercial banks and savings institutions respectively in each quarter, and the other including the largest 5%), as well as to both measures of profitability specified as the dependent variable (ROA and ROE).

This conclusion that the relationship between concentration and profitability operates in a generalised structural way is bolstered by the persistence of a robust positive relationship between concentration and profitability even when those banks whose asset shares are included in the construction of the concentration indices were excluded. This is a new test, which contributes to our understanding of the relationship between concentration and profitability. The results support the hypothesis that the concentration-profitability relationship operates not simply through inflated profits of those dominant banks, but that the payoffs of concentration are felt in the banking sector more broadly. These results thus provide strong support for a generalised structural and causal relationship between bank concentration and profitability, and for the SCP over the RMP hypothesis. They could also suggest that the enhanced bank profits associated with higher bank concentration come primarily at the expense of non-banking sectors rather than a 'redistribution' within the banking sector.[16]

The baseline specification was also re-estimated for various subsamples of banks disaggregated by size. The object of this exercise is simply to test differences in the relationships for different sizes of banks, and the results are helpful in understanding how the relationships operate for different sizes of banks, and shedding further light on the relationship between concentration amongst the largest banks and the profitability of the rest of the sector. The benefits of concentration are highest for the largest banks and those in the next largest tier, as well as for the smallest banks, but with no clear results for lower-middle-sized banks. We suggest that this might be because while some of the benefits of concentration at the top trickle down to middle-sized banks, they could also be negatively affected by concentration at the top which places them at a competitive disadvantage. The smallest banks, on the other hand, are less likely to be direct competitors to the largest banks (as they may rely primarily on local or niche advantages) but might still gain some of the benefits of concentration in terms of overall profitability of the banking sector.

The final aspect of the empirical analysis was to investigate the effects of concentration on separate components of profitability, in order to shed light on the channels through which the relationship between concentration and profitability operates. Firstly whether concentration affects profitability through the interest and/or non-interest items of banks' balance sheets; secondly whether concentration affects profitability through the income and/or expense items of banks' balance sheets; and thirdly whether concentration affects the interest rates paid by banks on deposits, those charged by banks on loans, and/or banks' interest rate spreads. Although the findings in this regard are not entirely conclusive, several interesting results emerge. Firstly, concentration appears to raise profitability through both the interest and non-interest sides of banks' balance sheets. Secondly, concentration appears to affect profitability through both the income and expense sides of banks' balance sheets, that is, raising bank income and lowering bank expenses. Thirdly, concentration appears to lower the (effective) deposit interest rate and raise both the (effective) lending interest rate and the (effective) interest rate spread.

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[16] Furthermore, in reference to the broader IO and game theoretic literature, it may tentatively suggest that a group of the largest banks are colluding (or in game theoretic terms, playing the colluding game), while others are free-riding on this.

The finding that bank concentration is associated with higher bank profitability, as well as the results that concentration is associated with higher lending rates and lower rates on deposits, could have significant implications for the real economy. Firstly, there are distributional implications in terms of a transfer of resources from depositors and/or borrowers to banks. Secondly, lower interest rates on deposits could reduce the rate of savings, with the extent of this depending on the interest elasticity of deposits. Thirdly, in a related effect, higher interest rates on loans could depress investment and growth. These results thus suggest that concentration in the banking sector could potentially exacerbate credit rationing and constrain accumulation and growth.

These results suggest the need for stronger regulation of concentration in the banking sector. The typical arguments advanced as to the benefits of concentration in the industrial sector – such as enhanced competitiveness, facilitation of innovation, and economies of scale – do not necessarily apply to the banking sector, particular as it appears that economies of scale in banking only prevail up to a certain size (which is below that of the large banks in the sample).

Appendix 1: More information on selected variables

This section provides greater detail on the construction of the variables than that provided in the main text, where necessary.

Concentration ($\mathrm{conc}^{x}_{I,t}$)

$\mathrm{conc}^{1}_{I,t}$ is an index of the weighted share of the largest 2% of institutions in sector I (by quarter) of aggregate total assets of sector I, and $\mathrm{conc}^{2}_{I,t}$ similarly for the largest 5% of each type of institutions in each quarter. These are new indices developed in this paper. The specific institutions included in each measure thus vary by quarter. The two sectors are commercial banks and savings institutions. This division was necessary in order to avoid collinearity problems arising from a variable being uniform across banks for every period, in models with time fixed effects.[17] The measures of aggregate total assets are derived from the FDIC statistics of the entire sectors, rather than the sample of the Bank Compustat database.

The indices were calculated as follows:

$$\mathrm{conc}^{x}_{I,t} = \frac{\sum_{j=1}^{N}\sum_{i=1}^{j} AS_{i,t}}{N} = \frac{\sum_{i=1}^{N}\left\{(N-i+1)AS_{i,t}\right\}}{N}$$

where $AS_{i,t}$ is the assets of institution i in quarter t as a share of the aggregate (FDIC-reported) assets for the relevant sector (commercial banks or savings institutions) in that quarter; and

N is the number of institutions in the largest two percentiles of institutions of sector i in the case of $\mathrm{conc}^{1}_{I,t}$, or the largest five percentiles in the case of $\mathrm{conc}^{2}_{I,t}$.

The weighting in the concentration indices is thus that the asset share of the largest institution in each quarter is counted N times, the second largest institution counted (N-1) times, and so on, such that the asset share of the Nth institution is counted once.

[17] An alternative that was considered was to construct separate concentration indices for different geographical regions. However, in addition to the problem that banks do compete interregionally (particularly since the full implementation of the Riegle-Neal Interstate Banking and Branching Efficiency Act, this approach would have meant the loss of close to half the banks in the sample, no doubt with a selection bias in this as well, as many banks did not have a valid geographical code in the dataset.

The difference between $\text{conc}^1_{I,t}$ and $\text{conc}^2_{I,t}$ is thus that the latter is a somewhat broader measure, as it includes the asset shares of the largest 5% of institutions as opposed to the largest 2% in the case of $\text{conc}^1_{I,t}$.

This measure improves on measures of concentration typically used in the literature, such as CR1, CR3, CR5, C7, or CR10. These measures do not give a sense of the 'depth' or intensity of concentration among the n banks. Such measures are also unduly sensitive to changes such as mergers and acquisitions at the threshold of n banks.

Market share ($MS_{,t}$)

Note that this denoted the share of institution i in the aggregate net income as reported by the FDIC for quarter t, rather than the total net income of institutions in the Bank Compustat dataset.

Size ($\ln TA_{i,t}$ and $(\ln TA_{i,t})^2$)

Total assets were deflated (using a quarterly GDP deflator) and then the natural log taken, and the measure squared in the case of $(\ln TA_{i,t})^2$.

Operational inefficiency ($OPEFF_{i,t}$)

This is the ratio of an institution's total other expenses (including salaries and wages of officers and employees, pension and employment benefits, (net) occupancy expense of bank premises, total costs of furniture and equipment, and other current operating expenses) to net income in quarter t.

Appendix 2: Tables of Results

Table 1: Summary statistics

Variable		Mean	Std. Dev.	Min	Max	Obs
Dependent variables:						
ROA	overall	0.4087	0.2970	-3.6067	7.7170	N = 20796
	between		0.1686	0.0090	1.4154	n = 644
	within		0.2452	-4.0596	6.7103	T = 32.29
ROE	overall	4.5303	3.2568	-48.0378	60.7970	N = 20781
	between		1.8587	0.0254	14.4487	n = 644
	within		2.6989	-45.2800	57.8542	T = 32.27
TGIITA	overall	0.0094	0.0078	-0.0092	0.5867	N = 20775
	between		0.0034	0.0016	0.0345	n = 644
	within		0.0069	-0.0220	0.5617	T = 32.26
TGIIE	overall	0.1097	0.0786	-2.0938	1.2708	N = 20760
	between		0.0487	0.0146	0.3633	n = 644
	within		0.0598	-2.2019	1.1204	T = 32.24
interest expense/total assets	overall	0.0077	0.0064	0.0000	0.5229	N = 20790
	between		0.0020	0.0009	0.0306	n = 644
	within		0.0060	-0.0195	0.5000	T = 32.28
interest expense/equity	overall	0.0892	0.0628	-2.0938	1.2423	N = 20775
	between		0.0341	0.0137	0.3794	n = 644
	within		0.0528	-2.2029	0.9578	T = 32.26
Other income/total assets	overall	0.0033	0.0054	-0.0177	0.2955	N = 20781
	between		0.0035	0.0000	0.0403	n = 644
	within		0.0039	-0.0442	0.2588	T = 32.27
other income/total equity	overall	0.0383	0.0662	-2.2027	2.8547	N = 20766
	between		0.0402	0.0003	0.4833	n = 644
	within		0.0504	-2.6477	2.5972	T = 32.25
other expenses/total assets	overall	-0.0081	0.0064	-0.4332	0.0188	N = 20780
	between		0.0031	-0.0347	-0.0012	n = 644
	within		0.0055	-0.4067	0.0454	T = 32.27
other expenses/equity	overall	-0.0938	0.0734	-2.7806	0.4130	N = 20765
	between		0.0450	-0.5569	-0.0091	n = 644
	within		0.0573	-2.5702	0.8761	T = 32.24
deposit interest rate	overall	0.0070	0.0038	0.0009	0.0612	N = 2535
	between		0.0018	0.0036	0.0132	n = 58
	within		0.0034	-0.0010	0.0586	T = 43.71
lending interest rate	overall	0.0209	0.0073	0.0032	0.1666	N = 2529
	between		0.0033	0.0133	0.0324	n = 58
	within		0.0065	0.0063	0.1572	T = 43.60
interest rate spread	overall	0.0139	0.0047	-0.0141	0.1054	N = 2526
	between		0.0028	0.0063	0.0214	n = 58
	within		0.0038	-0.0114	0.0986	T = 43.55

Variable		Mean	Std. Dev.	Min	Max	Obs
Explanatory variables:						
conc1	overall	2.5587	1.1568	1.0000	7.4609	N = 20796
	between		0.9803	1.9270	5.3679	n = 644
	within		0.7543	-0.7167	5.5715	T = 32.29
conc2	overall	2.4446	1.0973	1.0000	5.3652	N = 20796
	between		0.9417	1.8437	5.1321	n = 644
	within		0.7007	-0.6024	4.5976	T = 32.29
CR[a]	overall	2.5223	1.1953	1.0000	5.7813	N = 20796
	between		1.0361	1.8724	5.4800	n = 644
	within		0.7532	-0.7891	4.9269	T = 32.29
MS	overall	0.0686	0.4353	-5.5359	13.7505	N = 20794
	between		0.2960	-0.0001	4.4559	n = 644
	within		0.2664	-7.0409	9.6962	T = 32.29
lnTA	overall	6.9398	1.6143	2.6614	13.9045	N = 20796
	between		1.4721	4.0027	13.5855	n = 644
	within		0.3910	4.1364	9.4230	T = 32.29
lnTA2	overall	50.7668	25.8206	7.0830	193.3345	N = 20796
	between		23.1272	16.0234	184.6028	n = 644
	within		5.9213	11.4214	85.3308	T = 32.29
OPEFF	overall	372.0091	2340.2640	-68158.82	142438.50	N = 20773
	between		519.1217	-4401.145	4021.2810	n = 644
	within		2292.5700	-66714.57	139277.90	T = 32.26
Control variables:						
CA	overall	9.6050	3.8524	-1.3291	97.7792	N = 20781
	between		3.1814	3.3409	31.2604	n = 644
	within		2.3754	-18.2690	95.6610	T = 32.27
CDTA	overall	4.1871	3.0869	-0.1259	36.2589	N = 20777
	between		2.5098	0.4800	30.2728	n = 644
	within		1.8485	-6.4522	28.0357	T = 32.26
TIATA	overall	89.6251	7.4875	0.0000	98.7520	N = 20796
	between		6.0563	19.7485	97.9560	n = 644
	within		4.3991	-1.5057	137.1648	T = 32.29
PE	overall	60.6667	105.5963	-2951.00	3031.000	N = 20148
	between		53.0205	-625.00	874.4778	n = 644
	within		100.3362	-2874.046	2757.8650	T = 31.29

Table 2: Baseline specification with OLS

Depvar	**ROA**	**ROE**	**ROA**	**ROE**
conc1	0.0253	0.3678		
	[0.000]	[0.000]		
conc2			0.0263	0.3825
			[0.000]	[0.000]
MS	0.1039	1.3414	0.1039	1.3417
	[0.000]	[0.000]	[0.000]	[0.000]
lnTA	0.1031	1.5066	0.1027	1.5009
	[0.003]	[0.000]	[0.004]	[0.000]
lnTA2	-0.0111	-0.1235	-0.0111	-0.1232
	[0.000]	[0.000]	[0.000]	[0.000]
OPEFF	0	0.0002	0	0.0002
	[0.658]	[0.002]	[0.657]	[0.002]
CA	0.0152	-0.1602	0.0151	-0.1607
	[0.000]	[0.000]	[0.000]	[0.000]
CDTA	-0.0008	0.0603	-0.0007	0.0612
	[0.721]	[0.002]	[0.742]	[0.002]
TIATA	-0.0009	0.0614	-0.0009	0.0613
	[0.529]	[0.000]	[0.528]	[0.000]
PE	0	-0.002	0	-0.002
	[0.531]	[0.000]	[0.532]	[0.000]
Constant	0.0846	-5.093	0.0855	-5.0795
	[0.633]	[0.005]	[0.630]	[0.006]
Obs	20112	20112	20112	20112
# banks	644	644	644	644
R-sq	0.07	0.08	0.07	0.08

Robust p values in brackets

Table 3: Baseline specification with OLS, using standard CR10/CR3 measures of concentration

	ROA	**ROE**
CR^a	0.0239	0.3491
	[0.000]	[0.000]
MS_i	0.1039	1.3417
	[0.000]	[0.000]
lnTA	0.1029	1.5044
	[0.003]	[0.000]
lnTA2	-0.0111	-0.1234
	[0.000]	[0.000]
OPEFF	0	0.0002
	[0.658]	[0.002]
CA	0.0152	-0.1604
	[0.000]	[0.000]
CDTA	-0.0007	0.061
	[0.739]	[0.002]
TIATA	-0.0009	0.0614
	[0.529]	[0.000]
PE	0	-0.002
	[0.532]	[0.000]
Constant	0.0868	-5.067
	[0.624]	[0.006]
Obs	20112	20112
# banks	644	644
R-sq	0.07	0.08

Robust p values in brackets

Note: the CR^a measure of concentration combines the CR^{10} measure in the case of commercial banks, and the CR^3 measure in the case of savings institutions (given the different number of banks in these two sectors).

Table 4: Dynamic baseline specification with OLS

Depvar	**ROA**	**ROE**	**ROA**	**ROE**	**ROA**	**ROE**	**ROA**	**ROE**
L.depvar	0.2078	0.2582	0.2079	0.2583				
	[0.000]	[0.000]	[0.000]	[0.000]				
L4.depvar					0.0873	0.1291	0.0873	0.1292
					[0.000]	[0.000]	[0.000]	[0.000]
conc1	0.0228	0.2571			0.0359	0.3751		
	[0.000]	[0.000]			[0.000]	[0.000]		
conc2			0.0241	0.27			0.0378	0.3911
			[0.000]	[0.000]			[0.000]	[0.000]
MS	0.0899	1.2006	0.0899	1.2009	0.0952	1.2818	0.0952	1.2822
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
lnTA	0.1123	1.6365	0.1121	1.6334	0.0875	1.8513	0.0873	1.8476
	[0.000]	[0.000]	[0.000]	[0.000]	[0.017]	[0.000]	[0.017]	[0.000]
lnTA2	-0.0112	-0.1284	-0.0112	-0.1282	-0.0113	-0.1591	-0.0113	-0.1589
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
OPEFF	0	0.0002	0	0.0002	0	0.0002	0	0.0002
	[0.449]	[0.022]	[0.448]	[0.022]	[0.564]	[0.021]	[0.563]	[0.021]
CA	0.0152	-0.1336	0.0151	-0.1339	0.0211	-0.1763	0.021	-0.1767
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
CDTA	-0.0031	0.0306	-0.003	0.0311	-0.0018	0.0463	-0.0018	0.0474
	[0.105]	[0.060]	[0.111]	[0.055]	[0.410]	[0.024]	[0.433]	[0.021]
TIATA	-0.0013	0.0449	-0.0013	0.0449	-0.0016	0.0496	-0.0016	0.0496
	[0.360]	[0.000]	[0.360]	[0.000]	[0.299]	[0.000]	[0.300]	[0.000]
PE	0	-0.0013	0	-0.0013	0	-0.0017	0	-0.0017
	[0.960]	[0.008]	[0.959]	[0.008]	[0.639]	[0.005]	[0.640]	[0.005]
Constant	0.0122	-5.1949	0.0119	-5.1942	0.225	-5.0317	0.2258	-5.0347
	[0.943]	[0.001]	[0.944]	[0.001]	[0.261]	[0.014]	[0.260]	[0.014]
Obs	19518	19510	19518	19510	17895	17882	17895	17882
# banks	644	644	644	644	644	644	644	644
R-sq	0.13	0.16	0.13	0.16	0.1	0.11	0.1	0.11

Robust p values in brackets

Table 5: Baseline specification with 2-step efficient GMM

Depvar	**ROA**	**ROE**	**ROA**	**ROE**
conc1	0.0374	0.3002		
	[0.000]	[0.000]		
conc2			0.0405	0.3242
			[0.000]	[0.000]
MS	0.0051	0.1312	0.0051	0.1315
	[0.66]	[0.27]	[0.66]	[0.27]
lnTA	0.0509	1.0071	0.0519	1.0105
	[0.22]	[0.034]	[0.21]	[0.033]
lnTA2	-0.0046	-0.078	-0.0046	-0.0781
	[0.087]	[0.010]	[0.082]	[0.010]
OPEFF	-0.0003	-0.0012	-0.0003	-0.0012
	[0.000]	[0.031]	[0.000]	[0.032]
CA	0.0067	-0.2518	0.0069	-0.2517
	[0.075]	[0]	[0.069]	[0]
CDTA	-0.005	-0.0306	-0.005	-0.0297
	[0.14]	[0.37]	[0.14]	[0.39]
TIATA	-0.0066	-0.0206	-0.0067	-0.0205
	[0.000]	[0.32]	[0.000]	[0.32]
PE	0.0025	0.0141	0.0025	0.0141
	[0.000]	[0.002]	[0.000]	[0.002]
Obs	17118	17118	17118	17118
# banks[18]	627	627	627	627

Robust p values in brackets

[18] Where the number of banks varies between specifications, this is due to lag structures. The sample is however standard across specifications.

Table 6: Dynamic baseline specification with two-step efficient GMM

Depvar	**ROA**	**ROE**	**ROA**	**ROE**	**ROA**	**ROE**	**ROA**	**ROE**
L.depvar	0.2026	0.24	0.2026	0.2401				
	[0.000]	[0.000]	[0.000]	[0.000]				
L4.depvar					0.0453	0.0718	0.0456	0.0714
					[0.010]	[0.001]	[0.010]	[0.0001]
conc1	0.0302	0.2293			0.0363	0.2935		
	[0.000]	[0.000]			[0.000]	[0.000]		
conc2			0.0324	0.2487			0.0394	0.3169
			[0.000]	[0.000]			[0.000]	[0.000]
MS	0.015	0.2435	0.015	0.244	0.0024	0.0756	0.0024	0.0762
	[0.13]	[0.024]	[0.13]	[0.024]	[0.83]	[0.53]	[0.83]	[0.52]
lnTA	0.0477	0.7003	0.0483	0.7026	0.0542	0.8929	0.0552	0.8969
	[0.16]	[0.070]	[0.16]	[0.069]	[0.18]	[0.059]	[0.17]	[0.058]
lnTA2	-0.0043	-0.0591	-0.0044	-0.0591	-0.0051	-0.0733	-0.0052	-0.0734
	[0.054]	[0.018]	[0.052]	[0.018]	[0.054]	[0.016]	[0.051]	[0.016]
OPEFF	-0.0001	-0.0004	-0.0001	-0.0004	-0.0003	-0.0004	-0.0003	-0.0004
	[0.000]	[0.24]	[0.000]	[0.25]	[0.000]	[0.34]	[0.000]	[0.33]
CA	0.0062	-0.2004	0.0063	-0.2002	0.0092	-0.2173	0.0094	-0.2173
	[0.047]	[0]	[0.045]	[0]	[0.018]	[0]	[0.016]	[0]
CDTA	-0.0048	-0.0237	-0.0048	-0.0235	-0.0058	-0.03	-0.0058	-0.0292
	[0.063]	[0.35]	[0.065]	[0.36]	[0.079]	[0.36]	[0.080]	[0.37]
TIATA	-0.0048	0.002	-0.0048	0.002	-0.0071	-0.0194	-0.0072	-0.0193
	[0.002]	[0.89]	[0.002]	[0.90]	[0.000]	[0.31]	[0.000]	[0.32]
PE	0.0017	0.0088	0.0017	0.0089	0.0022	0.0077	0.0022	0.0078
	[0.000]	[0.008]	[0.000]	[0.008]	[0.000]	[0.039]	[0.000]	[0.037]
Obs	17118	17118	17118	17118	17118	17118	17118	17118
# banks	627	627	627	627	627	627	627	627

Robust p values in brackets

Table 7: Baseline specification with one-step Arellano-Bond dynamic GMM

Depvar	**ROA**	**ROE**	**ROA**	**ROE**
LD.depvar	0.0693	0.0642	0.0692	0.0644
	[0.000]	[0.008]	[0.000]	[0.0080]
D.conc1	0.0749	0.6375		
	[0.000]	[0.000]		
D.conc2			0.0839	0.7002
			[0.000]	[0.000]
D.MS	0.0694	1.0114	0.0694	1.0117
	[0.000]	[0.000]	[0.000]	[0.000]
D.lnTA	0.2297	3.5096	0.2245	3.489
	[0.001]	[0.000]	[0.001]	[0.000]
D.lnTA2	-0.0281	-0.3357	-0.0281	-0.3357
	[0.000]	[0.000]	[0.000]	[0.000]
D.OPEFF	0	0	0	0
	[0.85]	[0.74]	[0.88]	[0.76]
D.CA	0.0251	-0.0334	0.0252	-0.0328
	[0.000]	[0.24]	[0.000]	[0.25]
D.CDTA	-0.0064	0.0005	-0.0063	0.0008
	[0.13]	[0.99]	[0.14]	[0.98]
D.TIATA	-0.0052	0.0108	-0.0051	0.0112
	[0.14]	[0.76]	[0.14]	[0.75]
D.PE	0	-0.0003	0	-0.0002
	[0.83]	[0.62]	[0.87]	[0.64]
Obs	18763	18756	18763	18756
# banks	640	640	640	640

Robust p values in brackets

Table 8: Baseline specification with two-step Arellano-Bover/Blundell-Bond dynamic GMM

Depvar	**ROA**	**ROE**	**ROA**	**ROE**
L.depvar	0.1407	0.1375	0.1409	0.1377
	[0.000]	[0.000]	[0.000]	[0.000]
conc1	0.0484	0.5076		
	[0.013]	[0.005]		
conc2			0.0511	0.5144
			[0.016]	[0.007]
MS	0.0679	1.0281	0.068	1.0303
	[0.000]	[0.000]	[0.000]	[0.000]
lnTA	0.3729	4.4489	0.3759	4.4949
	[0.000]	[0.000]	[0.000]	[0.000]
lnTA2	-0.0229	-0.27	-0.023	-0.2731
	[0.000]	[0.000]	[0.000]	[0.000]
OPEFF	0	0.0002	0	0.0002
	[0.071]	[0.036]	[0.072]	[0.037]
CA	0.0189	-0.0377	0.0189	-0.0363
	[0.001]	[0.20]	[0.001]	[0.21]
CDTA	-0.0121	-0.0275	-0.0119	-0.0247
	[0.005]	[0.49]	[0.005]	[0.53]
TIATA	-0.0091	-0.0171	-0.0091	-0.0163
	[0.011]	[0.60]	[0.012]	[0.61]
PE	-0.0001	-0.0015	-0.0001	-0.0014
	[0.080]	[0.050]	[0.084]	[0.054]
Constant	-0.5835	-13.2241	-0.5986	-13.4113
	[0.094]	[0.000]	[0.089]	[0.000]
Obs	19518	19510	19518	19510
# banks	644	644	644	644

Robust p values in brackets

Table 9: Economic significance of baseline results

Estimation method	Depvar	Conc index	Estimated coefficient on concentration	Effect of 5% increase in concentration on profitability	Increase in profitability as % mean profitability	Effect of 10% increase in concentration on profitability	Increase in profitability as % mean profitability
OLS	ROA	conc1	0.0253	0.00127	0.310	0.00253	0.619
	ROA	conc2	0.0263	0.00132	0.322	0.00263	0.644
	ROE	conc1	0.3678	0.01839	0.406	0.03678	0.812
	ROE	conc2	0.3825	0.01913	0.422	0.03825	0.844
2-step Arellano-Bover/Blundell-Bond	ROA	conc1	0.0484	0.00242	0.592	0.00484	1.184
	ROA	conc2	0.0511	0.00256	0.625	0.00511	1.250
	ROE	conc1	0.5076	0.02538	0.560	0.05076	1.120
	ROE	conc2	0.5144	0.02572	0.568	0.05144	1.135

Table 10: Baseline specification excluding banks included in the concentration indices, with OLS

Depvar	**ROA**	**ROE**	**ROA**	**ROE**
conc1	0.0245	0.3764		
	[0.000]	[0.000]		
conc2			0.0182	0.3142
			[0.016]	[0.000]
MS	0.8138	8.0721	3.3911	34.0396
	[0.000]	[0.000]	[0.000]	[0.000]
lnTA	0.1877	1.8087	0.3386	2.7027
	[0.000]	[0.000]	[0.000]	[0.000]
lnTA2	-0.018	-0.151	-0.0306	-0.2282
	[0.000]	[0.000]	[0.000]	[0.000]
OPEFF	0	0.0002	0	0.0002
	[0.593]	[0.003]	[0.793]	[0.001]
CA	0.0151	-0.1621	0.015	-0.1597
	[0.000]	[0.000]	[0.000]	[0.000]
CDTA	-0.0007	0.0635	-0.0008	0.0701
	[0.769]	[0.001]	[0.751]	[0.001]
TIATA	-0.0009	0.063	-0.0013	0.0612
	[0.573]	[0.000]	[0.433]	[0.000]
PE	0	-0.0019	0	-0.0019
	[0.665]	[0.000]	[0.692]	[0.000]
Constant	-0.2045	-6.3201	-0.6556	-9.1508
	[0.345]	[0.003]	[0.008]	[0.000]
Obs	19516	19516	18543	18543
# banks	635	635	615	615
R-sq	0.08	0.09	0.13	0.13

Robust p values in brackets

Table 11: Baseline specification excluding banks included in the concentration indices, with 2-step efficient GMM

Depvar	ROA	ROE	ROA	ROE
conc1	0.036	0.2636		
	[0.000]	[0.001]		
conc2			0.0397	0.2274
			[0.000]	[0.004]
MS	0.0113	0.095	0.5897	5.0591
	[0.87]	[0.85]	[0.013]	[0.003]
lnTA	0.022	0.6721	0.0801	1.1517
	[0.61]	[0.16]	[0.12]	[0.037]
lnTA2	-0.0022	-0.0543	-0.0068	-0.0888
	[0.43]	[0.071]	[0.050]	[0.015]
OPEFF	-0.0004	-0.0016	-0.0003	-0.0013
	[0.000]	[0.0021]	[0.000]	[0.001]
CA	0.0034	-0.2689	0.0035	-0.2675
	[0.37]	[0.000]	[0.33]	[0.000]
CDTA	-0.0034	-0.0211	-0.0033	0.0131
	[0.33]	[0.57]	[0.38]	[0.73]
TIATA	-0.0064	-0.0176	-0.0054	0.0067
	[0.0015]	[0.43]	[0.010]	[0.77]
PE	0.0031	0.0153	0.0027	0.0101
	[0.000]	[0.000]	[0.000]	[0.002]
Obs	16595	16595	15730	15730
# banks	617	617	597	597

Robust p values in brackets

Table 12: Baseline specification excluding banks included in the concentration indices, with one-step Arellano-Bond dynamic GMM

Depvar	**ROA**	**ROE**	**ROA**	**ROE**
LD.ROA	0.0537	0.0503	0.0323	0.0202
	[0.0042]	[0.046]	[0.16]	[0.45]
D.conc1	0.0848	0.7095		
	[0.000]	[0.000]		
D.conc2			0.0967	0.8173
			[0.000]	[0.000]
D.MS	0.4747	5.2581	1.96	20.6324
	[0.000]	[0.000]	[0.000]	[0.000]
D.lnTA	0.195	1.6675	0.5902	4.7055
	[0.079]	[0.12]	[0.000]	[0.001]
D.lnTA2	-0.0275	-0.219	-0.059	-0.4669
	[0.000]	[0.008]	[0.000]	[0.000]
D.OPEFF	0	0	0	0
	[0.80]	[0.78]	[0.77]	[0.73]
D.CA	0.0245	-0.0577	0.026	-0.0494
	[0.000]	[0.056]	[0.000]	[0.17]
D.CDTA	-0.007	-0.0067	-0.0045	0.0111
	[0.098]	[0.87]	[0.27]	[0.82]
D.TIATA	-0.0051	0.0139	-0.0051	0.0098
	[0.18]	[0.71]	[0.17]	[0.82]
D.PE	0	-0.0002	0	-0.0001
	[0.80]	[0.68]	[0.95]	[0.78]
Obs	18205	18198	17282	17275
# banks	631	631	610	610

Robust p values in brackets

Table 13: Baseline specification excluding banks included in the concentration indices, with two-step Arellano-Bover/Blundell-Bond dynamic GMM

Depvar	**ROA**	**ROE**	**ROA**	**ROE**
L.ROA	0.1235	0.1192	0.1095	0.1125
	[0.000]	[0.000]	[0.000]	[0.000]
conc1	0.0501	0.4513		
	[0.018]	[0.013]		
conc2			0.0585	0.4766
			[0.011]	[0.010]
MS	0.3883	4.5576	2.3461	25.0322
	[0.009]	[0.001]	[0.000]	[0.000]
lnTA	0.3646	3.216	0.8376	6.9331
	[0.002]	[0.060]	[0.000]	[0.002]
lnTA2	-0.0228	-0.1855	-0.0608	-0.4906
	[0.008]	[0.13]	[0.000]	[0.004]
OPEFF	0	0.0002	0	0.0002
	[0.12]	[0.061]	[0.14]	[0.063]
CA	0.0201	-0.0418	0.024	-0.035
	[0.001]	[0.25]	[0.000]	[0.51]
CDTA	-0.0135	-0.0401	-0.0092	-0.0124
	[0.011]	[0.25]	[0.029]	[0.73]
TIATA	-0.0095	-0.0127	-0.0084	-0.0194
	[0.026]	[0.68]	[0.014]	[0.50]
PE	-0.0001	-0.0013	-0.0001	-0.0013
	[0.14]	[0.081]	[0.26]	[0.10]
Constant	-0.5145	-9.1089	-2.1187	-19.7064
	[0.37]	[0.11]	[0.000]	[0.005]
Obs	18942	18934	17992	17984
# banks	635	635	614	614

Robust p values in brackets

Table 14: Disaggregation by size into quintiles with baseline OLS regression (with conc1)

Depvar	**ROA**	**ROA**	**ROA**	**ROA**	**ROA**	**ROE**	**ROE**	**ROE**	**ROE**	**ROE**
quintile	**quintile1**	**quintile2**	**quintile3**	**quintile4**	**quintile5**	**quintile1**	**quintile2**	**quintile3**	**quintile4**	**quintile5**
conc1	0.0328	0.014	0.0126	0.0456	0.0699	0.3568	0.1915	-0.0832	0.624	0.916
	[0.052]	[0.146]	[0.202]	[0.046]	[0.000]	[0.000]	[0.085]	[0.490]	[0.004]	[0.000]
MS	102.5646	112.4099	58.8018	16.5578	0.0995	832.7901	1,367.12	693.08	157.9667	1.383
	[0.021]	[0.000]	[0.000]	[0.000]	[0.000]	[0.007]	[0.000]	[0.000]	[0.000]	[0.000]
lnTA	3.904	0.0662	-0.1477	1.9685	0.246	8.3006	-0.2967	-1.3334	31.9361	3.8569
	[0.000]	[0.944]	[0.846]	[0.000]	[0.018]	[0.014]	[0.978]	[0.888]	[0.000]	[0.003]
lnTA2	-0.3742	-0.0279	-0.0112	-0.1446	-0.019	-0.7269	-0.2325	-0.1576	-2.2617	-0.2869
	[0.000]	[0.725]	[0.846]	[0.000]	[0.000]	[0.028]	[0.802]	[0.825]	[0.000]	[0.000]
OPEFF	0	0	0	0	0	0.0001	0.0003	0.0001	-0.0001	0.0006
	[0.418]	[0.001]	[0.277]	[0.494]	[0.810]	[0.146]	[0.003]	[0.417]	[0.612]	[0.026]
CA	0.0184	0.0082	0.007	0.0095	0.02	-0.0065	-0.1985	-0.2251	-0.1657	-0.3239
	[0.026]	[0.002]	[0.086]	[0.004]	[0.000]	[0.776]	[0.000]	[0.000]	[0.000]	[0.000]
CDTA	0.0071	-0.0029	0.006	0.0043	0.0018	0.0028	-0.0423	0.0686	-0.0315	0.0418
	[0.031]	[0.239]	[0.092]	[0.226]	[0.735]	[0.887]	[0.200]	[0.095]	[0.396]	[0.353]
TIATA	0.0067	-0.0018	0.0028	0.0035	0.0027	0.0093	-0.0276	0.0452	0.0014	0.0488
	[0.007]	[0.264]	[0.123]	[0.020]	[0.162]	[0.550]	[0.264]	[0.118]	[0.928]	[0.036]
PE	-0.0001	-0.0003	-0.0001	0	-0.0001	-0.0009	-0.0023	-0.0007	0.0002	-0.0046
	[0.539]	[0.000]	[0.183]	[0.392]	[0.269]	[0.092]	[0.007]	[0.312]	[0.722]	[0.013]
Constant	-10.9576	0.2726	0.6666	-7.2874	-0.7954	-23.7747	9.1039	8.0309	-112.293	-9.8233
	[0.000]	[0.923]	[0.792]	[0.000]	[0.078]	[0.009]	[0.779]	[0.796]	[0.000]	[0.092]
Obs	3573	4038	4085	4175	4241	3573	4038	4085	4175	4241
# banks	230	292	285	226	148	230	292	285	226	148
R-sq	0.21	0.51	0.49	0.42	0.11	0.26	0.46	0.43	0.35	0.15

Robust p values in brackets

Table 15: Disaggregation by size into quintiles with baseline OLS regression (with conc2)

Depvar	**ROA**	**ROA**	**ROA**	**ROA**	**ROA**	**ROE**	**ROE**	**ROE**	**ROE**	**ROE**
Quintile	**quintile1**	**quintile2**	**quintile3**	**quintile4**	**quintile5**	**quintile1**	**quintile2**	**quintile3**	**quintile4**	**quintile5**
conc2	0.0358	0.0139	0.014	0.0491	0.0731	0.375	0.1997	-0.098	0.6729	0.9719
	[0.060]	[0.186]	[0.173]	[0.038]	[0.000]	[0.000]	[0.102]	[0.441]	[0.003]	[0.000]
MS	102.59	112.4273	58.7999	16.556	0.0995	833.065	1,367.28	693.102	157.9447	1.3839
	[0.021]	[0.000]	[0.000]	[0.000]	[0.000]	[0.007]	[0.000]	[0.000]	[0.000]	[0.000]
lnTA	3.8978	0.0654	-0.1542	1.9714	0.2457	8.2722	-0.2746	-1.2805	31.9799	3.8469
	[0.000]	[0.945]	[0.839]	[0.000]	[0.018]	[0.015]	[0.980]	[0.892]	[0.000]	[0.003]
lnTA2	-0.3735	-0.0278	-0.0106	-0.1448	-0.019	-0.7245	-0.2345	-0.162	-2.2647	-0.2865
	[0.000]	[0.726]	[0.853]	[0.000]	[0.000]	[0.028]	[0.800]	[0.820]	[0.000]	[0.000]
OPEFF	0	0	0	0	0	0.0001	0.0003	0.0001	-0.0001	0.0006
	[0.418]	[0.001]	[0.279]	[0.490]	[0.804]	[0.146]	[0.003]	[0.416]	[0.609]	[0.026]
CA	0.0184	0.0082	0.007	0.0095	0.0199	-0.007	-0.1987	-0.2256	-0.1659	-0.3244
	[0.026]	[0.002]	[0.084]	[0.004]	[0.000]	[0.761]	[0.000]	[0.000]	[0.000]	[0.000]
CDTA	0.0072	-0.0029	0.0061	0.0044	0.0019	0.0034	-0.0421	0.0684	-0.0312	0.0423
	[0.030]	[0.241]	[0.089]	[0.226]	[0.725]	[0.862]	[0.202]	[0.095]	[0.403]	[0.348]
TIATA	0.0067	-0.0018	0.0028	0.0034	0.0028	0.0093	-0.0277	0.045	0.0012	0.0493
	[0.007]	[0.258]	[0.121]	[0.021]	[0.156]	[0.553]	[0.260]	[0.120]	[0.937]	[0.035]
PE	-0.0001	-0.0003	-0.0001	0	-0.0001	-0.0009	-0.0023	-0.0007	0.0003	-0.0046
	[0.539]	[0.000]	[0.184]	[0.389]	[0.268]	[0.091]	[0.007]	[0.311]	[0.719]	[0.013]
Constant	-10.9468	0.2774	0.684	-7.3004	-0.8015	-23.7074	9.0515	7.9026	-112.488	-9.8754
	[0.000]	[0.922]	[0.786]	[0.000]	[0.076]	[0.009]	[0.781]	[0.799]	[0.000]	[0.090]
Obs.	3573	4038	4085	4175	4241	3573	4038	4085	4175	4241
No. banks	230	292	285	226	148	230	292	285	226	148
R-sq	0.21	0.51	0.49	0.42	0.11	0.26	0.46	0.43	0.35	0.15

Robust p values in brackets

Table 16: Disaggregation by size into quartiles with baseline OLS regression (with conc1)

Depvar	ROA	ROA	ROA	ROA	ROE	ROE	ROE	ROE
Quartile	**quartile1**	**quartile2**	**quartile3**	**quartile4**	**quartile1**	**quartile2**	**quartile3**	**quartile4**
conc1	0.0295	0.0052	0.0377	0.055	0.2929	0.0784	0.3349	0.7835
	[0.025]	[0.580]	[0.080]	[0.000]	[0.000]	[0.519]	[0.099]	[0.000]
MS	112.9414	82.3941	24.2258	0.0998	984.9516	985.8871	241.6762	1.3818
	[0.002]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
lnTA	3.0315	-0.8109	-0.605	0.1352	6.3875	-11.6252	-8.6081	2.7231
	[0.000]	[0.216]	[0.151]	[0.095]	[0.023]	[0.180]	[0.084]	[0.008]
lnTA2	-0.2878	0.0456	0.028	-0.0134	-0.576	0.7316	0.4961	-0.2312
	[0.000]	[0.387]	[0.369]	[0.002]	[0.031]	[0.290]	[0.170]	[0.000]
OPEFF	0	0	0	0	0.0001	0.0002	0	0.0004
	[0.348]	[0.055]	[0.109]	[0.878]	[0.044]	[0.065]	[0.545]	[0.052]
CA	0.0146	0.0065	0.0074	0.017	-0.035	-0.2059	-0.2084	-0.2985
	[0.039]	[0.036]	[0.017]	[0.000]	[0.109]	[0.000]	[0.000]	[0.000]
CDTA	0.0043	-0.0032	0.0024	0.0054	-0.0087	-0.057	0.0071	0.0638
	[0.134]	[0.300]	[0.318]	[0.283]	[0.651]	[0.171]	[0.797]	[0.127]
TIATA	0.0044	-0.0021	0.0033	0.0045	0.0005	-0.0301	0.0576	0.0559
	[0.034]	[0.198]	[0.083]	[0.013]	[0.973]	[0.291]	[0.008]	[0.006]
PE	-0.0001	-0.0002	0	-0.0001	-0.001	-0.0023	-0.0004	-0.0035
	[0.461]	[0.014]	[0.226]	[0.526]	[0.027]	[0.016]	[0.395]	[0.030]
Constant	-8.5413	3.0212	2.259	-0.4314	-17.1939	43.9243	31.0964	-5.4962
	[0.000]	[0.138]	[0.114]	[0.213]	[0.024]	[0.110]	[0.073]	[0.219]
Obs.	4543	5144	5134	5291	4543	5144	5134	5291
# banks	274	323	289	185	274	323	289	185
R-sq	0.24	0.5	0.39	0.1	0.31	0.43	0.32	0.14

Robust p values in brackets

Table 17: Disaggregation by size into quartiles with baseline OLS regression (with conc2)

Depvar	ROA	ROA	ROA	ROA	ROE	ROE	ROE	ROE
Quartile	**quartile1**	**quartile2**	**quartile3**	**quartile4**	**quartile1**	**quartile2**	**quartile3**	**quartile4**
conc2	0.0317	0.0046	0.041	0.0564	0.3007	0.0764	0.3515	0.8236
	[0.032]	[0.644]	[0.071]	[0.000]	[0.000]	[0.560]	[0.101]	[0.000]
MS	112.9643	82.3949	24.2144	0.0998	985.2502	985.8984	241.5821	1.3826
	[0.002]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
lnTA	3.0294	-0.8116	-0.6059	0.1347	6.4032	-11.6224	-8.648	2.7136
	[0.000]	[0.216]	[0.149]	[0.096]	[0.023]	[0.180]	[0.082]	[0.008]
lnTA2	-0.2876	0.0456	0.0281	-0.0134	-0.5783	0.7312	0.4989	-0.2307
	[0.000]	[0.387]	[0.366]	[0.002]	[0.030]	[0.290]	[0.167]	[0.000]
OPEFF	0	0	0	0	0.0001	0.0002	0	0.0004
	[0.348]	[0.056]	[0.112]	[0.885]	[0.045]	[0.065]	[0.552]	[0.051]
CA	0.0145	0.0065	0.0074	0.017	-0.0354	-0.2062	-0.2084	-0.2992
	[0.039]	[0.037]	[0.017]	[0.000]	[0.106]	[0.000]	[0.000]	[0.000]
CDTA	0.0043	-0.0032	0.0025	0.0055	-0.0083	-0.0569	0.0081	0.0646
	[0.129]	[0.301]	[0.307]	[0.276]	[0.666]	[0.172]	[0.769]	[0.123]
TIATA	0.0044	-0.0021	0.0033	0.0045	0.0003	-0.0302	0.0576	0.0564
	[0.034]	[0.195]	[0.084]	[0.013]	[0.983]	[0.289]	[0.008]	[0.006]
PE	-0.0001	-0.0002	0	-0.0001	-0.001	-0.0023	-0.0004	-0.0035
	[0.459]	[0.014]	[0.234]	[0.523]	[0.027]	[0.016]	[0.404]	[0.030]
Constant	-8.538	3.0262	2.2591	-0.4341	-17.2061	43.9352	31.2208	-5.534
	[0.000]	[0.137]	[0.113]	[0.210]	[0.024]	[0.110]	[0.071]	[0.216]
Obs.	4543	5144	5134	5291	4543	5144	5134	5291
# banks	274	323	289	185	274	323	289	185
R-sq	0.24	0.5	0.39	0.1	0.31	0.43	0.31	0.14

Robust p values in brackets

Table 18: Disaggregation by size into thirds with baseline OLS regression (with conc1)

Depvar	**ROA**	**ROA**	**ROA**	**ROE**	**ROE**	**ROE**
Third	**third1**	**third2**	**third3**	**third1**	**third2**	**third3**
conc1	0.025	0.0166	0.0441	0.2196	0.0289	0.6947
	[0.039]	[0.031]	[0.000]	[0.001]	[0.740]	[0.000]
MS	107.8311	43.1536	0.1002	1,095.57	490.3864	1.3765
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
lnTA	2.2514	-0.6837	0.0489	7.1067	-6.9512	1.2968
	[0.000]	[0.030]	[0.489]	[0.002]	[0.064]	[0.133]
lnTA2	-0.2115	0.0327	-0.0089	-0.6946	0.3222	-0.1614
	[0.000]	[0.165]	[0.015]	[0.001]	[0.251]	[0.000]
OPEFF	0	0	0	0.0001	0.0001	0.0002
	[0.294]	[0.079]	[0.287]	[0.035]	[0.220]	[0.270]
CA	0.0113	0.01	0.0154	-0.0581	-0.2059	-0.2612
	[0.044]	[0.000]	[0.000]	[0.007]	[0.000]	[0.000]
CDTA	0.0014	0.0029	0.0052	-0.0438	0.0418	0.0543
	[0.595]	[0.244]	[0.253]	[0.038]	[0.156]	[0.157]
TIATA	0.0006	0.0024	0.0058	-0.0405	0.0431	0.056
	[0.761]	[0.043]	[0.001]	[0.013]	[0.014]	[0.000]
PE	-0.0001	-0.0001	0	-0.0011	-0.0011	-0.0018
	[0.412]	[0.007]	[0.958]	[0.031]	[0.030]	[0.164]
Constant	-6.1951	2.4752	-0.1612	-14.3829	26.3747	0.7929
	[0.000]	[0.018]	[0.640]	[0.025]	[0.030]	[0.839]
Obs.	6246	6829	7037	6246	6829	7037
# banks	338	369	244	338	369	244
R-sq	0.27	0.38	0.08	0.34	0.31	0.11

Robust p values in brackets

Table 19: Disaggregation by size into thirds with baseline OLS regression (with conc2)

Depvar	**ROA**	**ROA**	**ROA**	**ROE**	**ROE**	**ROE**
Third	**third1**	**third2**	**third3**	**third1**	**third2**	**third3**
conc2	0.0271	0.0171	0.0458	0.2288	0.0119	0.7344
	[0.048]	[0.035]	[0.000]	[0.002]	[0.896]	[0.000]
MS	107.84	43.1522	0.1003	1,095.69	490.4287	1.3772
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
lnTA	2.2513	-0.6862	0.0483	7.1113	-6.9378	1.2843
	[0.000]	[0.029]	[0.495]	[0.002]	[0.064]	[0.137]
lnTA2	-0.2115	0.0329	-0.0089	-0.6954	0.3206	-0.1608
	[0.000]	[0.163]	[0.016]	[0.001]	[0.253]	[0.000]
OPEFF	0	0	0	0.0001	0.0001	0.0002
	[0.294]	[0.080]	[0.288]	[0.035]	[0.221]	[0.270]
CA	0.0113	0.01	0.0154	-0.0584	-0.2063	-0.2617
	[0.045]	[0.000]	[0.000]	[0.007]	[0.000]	[0.000]
CDTA	0.0014	0.0029	0.0053	-0.0434	0.0419	0.0551
	[0.584]	[0.236]	[0.247]	[0.039]	[0.153]	[0.152]
TIATA	0.0006	0.0024	0.0058	-0.0406	0.0428	0.0562
	[0.761]	[0.043]	[0.001]	[0.013]	[0.015]	[0.000]
PE	-0.0001	-0.0001	0	-0.0011	-0.0011	-0.0018
	[0.411]	[0.007]	[0.958]	[0.031]	[0.030]	[0.165]
Constant	-6.1971	2.4844	-0.1607	-14.3845	26.4004	0.8026
	[0.000]	[0.017]	[0.641]	[0.026]	[0.030]	[0.837]
Obs.	6246	6829	7037	6246	6829	7037
# banks	338	369	244	338	369	244
R-sq	0.27	0.38	0.08	0.34	0.31	0.11

Robust p values in brackets

Table 20: Interest intermediate variables regressions in OLS

Depvar	**total gross interest income /TA**	**total gross interest income /equity**	**total gross interest income /TA**	**total gross interest income /equity**	**interest expense /TA**	**interest expense /equity**	**interest expense /TA**	**interest expense /equity**
conc1	0.0004	0.0005			0.0002	-0.0016		
	[0.084]	[0.054]			[0.406]	[0.086]		
conc2			0.0004	0.0004			0.0002	-0.002
			[0.011]	[0.049]			[0.429]	[0.073]
MS	0.0009	0.0109	0.001	0.0109	0.0005	0.0061	0.0005	0.0061
	[0.004]	[0.010]	[0.004]	[0.010]	[0.006]	[0.015]	[0.006]	[0.015]
lnTA	0.004	0.0608	0.004	0.0607	0.002	0.0337	0.002	0.0336
	[0.002]	[0.000]	[0.002]	[0.000]	[0.057]	[0.000]	[0.058]	[0.000]
lnTA2	-0.0004	-0.0047	-0.0004	-0.0047	-0.0002	-0.0028	-0.0002	-0.0028
	[0.001]	[0.000]	[0.001]	[0.000]	[0.011]	[0.000]	[0.011]	[0.000]
OPEFF	0	0	0	0	0	0	0	0
	[0.982]	[0.401]	[0.982]	[0.401]	[0.890]	[0.216]	[0.890]	[0.216]
CA	0.0002	-0.0071	0.0002	-0.0071	0.0002	-0.0063	0.0002	-0.0063
	[0.353]	[0.000]	[0.353]	[0.000]	[0.342]	[0.000]	[0.343]	[0.000]
CDTA	-0.0001	0.0003	-0.0001	0.0003	-0.0001	0.0004	-0.0001	0.0004
	[0.095]	[0.293]	[0.096]	[0.285]	[0.132]	[0.069]	[0.133]	[0.067]
TIATA	-0.0001	0.0003	-0.0001	0.0003	-0.0001	0.0004	-0.0001	0.0004
	[0.173]	[0.209]	[0.172]	[0.210]	[0.224]	[0.040]	[0.223]	[0.040]
PE	0	0	0	0	0	0	0	0
	[0.770]	[0.069]	[0.770]	[0.069]	[0.683]	[0.043]	[0.684]	[0.043]
Constant	0.0064	-0.0407	0.0063	-0.0402	0.0093	0.0147	0.0092	0.0156
	[0.109]	[0.274]	[0.112]	[0.281]	[0.005]	[0.671]	[0.005]	[0.653]
Obs	20094	20094	20094	20094	20108	20108	20108	20108
# banks	644	644	644	644	644	644	644	644
R-sq	0.17	0.43	0.17	0.43	0.19	0.48	0.19	0.48

Robust p values in brackets

Table 21: Interest intermediate variables regressions in two-step efficient GMM

Depvar	**total gross interest income /TA**	**total gross interest income /equity**	**total gross interest income /TA**	**total gross interest income /equity**	**interest expense /TA**	**interest expense /equity**	**interest expense /TA**	**interest expense /equity**
conc1	0.0002	0.0008			-0.0001	-0.0029		
	[0.019]	[0.060]			[0.57]	[0.034]		
conc2			0.0002	0.0011			-0.0001	-0.0035
			[0.026]	[0.054]			[0.45]	[0.020]
MS	0	0.0007	0	0.0006	-0.0001	-0.0004	-0.0001	-0.0004
	[0.90]	[0.76]	[0.91]	[0.78]	[0.45]	[0.85]	[0.46]	[0.83]
lnTA	0.0051	0.0478	0.0052	0.0479	0.0019	0.0008	0.0019	0.001
	[0.000]	[0.000]	[0.000]	[0.000]	[0.045]	[0.92]	[0.043]	[0.91]
lnTA2	-0.0004	-0.0034	-0.0004	-0.0034	-0.0002	-0.0003	-0.0002	-0.0003
	[0.000]	[0.000]	[0.000]	[0.000]	[0.010]	[0.60]	[0.009]	[0.58]
OPEFF	0	0	0	0	0	0	0	0
	[0.70]	[0.000]	[0.69]	[0.000]	[0.65]	[0.000]	[0.61]	[0.000]
CA	-0.0001	-0.0114	-0.0001	-0.0114	-0.0001	-0.0106	-0.0002	-0.0106
	[0.16]	[0]	[0.16]	[0]	[0.057]	[0]	[0.054]	[0]
CDTA	0	0.0006	0	0.0007	0	0.0005	0	0.0005
	[0.80]	[0.20]	[0.80]	[0.19]	[0.72]	[0.28]	[0.75]	[0.28]
TIATA	0	0.0001	0	0.0001	0	-0.0003	0	-0.0003
	[0.77]	[0.69]	[0.76]	[0.67]	[0.86]	[0.29]	[0.89]	[0.30]
PE	0	0.0004	0	0.0004	0	0.0004	0	0.0004
	[0.71]	[0.000]	[0.68]	[0.000]	[0.51]	[0.000]	[0.48]	[0.000]
Obs	17108	17108	17108	17108	17153	17153	17153	17153
# banks	627	627	627	627	627	627	627	627
R-sq	0.122	0.3	0.122	0.296	0.138	0.324	0.138	0.328

Robust p values in brackets

Table 22: Interest intermediate variables regressions with one-step Arellano-Bond dynamic GMM

Depvar	total gross interest income /TA	total gross interest income /equity	total gross interest income /TA	total gross interest income /equity	interest expense /TA	interest expense /equity	interest expense /TA	interest expense /equity
LD.depvar	0.374	0.3738	0.3738	0.3753	0.3805	0.4209	0.3806	0.4229
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
D.conc1	0.0036	0.0189			-0.0032	-0.0144		
	[0.022]	[0.000]			[0.030]	[0.000]		
D.conc2			0.0041	0.0202			-0.0036	-0.0152
			[0.028]	[0.000]			[0.037]	[0.000]
D.MS	0.0005	0.0049	0.0005	0.0049	0.0003	0.0024	0.0003	0.0024
	[0.004]	[0.071]	[0.004]	[0.071]	[0.021]	[0.22]	[0.019]	[0.22]
D.lnTA	-0.0025	-0.025	-0.0028	-0.0247	-0.0044	-0.0524	-0.0046	-0.0518
	[0.56]	[0.23]	[0.54]	[0.24]	[0.21]	[0.000]	[0.22]	[0.000]
D.lnTA2	-0.0006	-0.0038	-0.0006	-0.0038	-0.0004	-0.0006	-0.0004	-0.0006
	[0.000]	[0.002]	[0.000]	[0.002]	[0.008]	[0.42]	[0.009]	[0.42]
D.OPEFF	0	0	0	0	0	0	0	0
	[0.069]	[0.66]	[0.074]	[0.70]	[0.13]	[0.62]	[0.13]	[0.67]
D.CA	0.0006	-0.0066	0.0006	-0.0066	0.0006	-0.0055	0.0006	-0.0055
	[0.037]	[0]	[0.035]	[0]	[0.049]	[0]	[0.048]	[0]
D.CDTA	-0.0005	-0.0009	-0.0005	-0.0009	-0.0005	-0.0007	-0.0005	-0.0007
	[0.024]	[0.060]	[0.024]	[0.066]	[0.035]	[0.024]	[0.035]	[0.026]
D.TIATA	-0.0004	0.0003	-0.0004	0.0003	-0.0004	0.0005	-0.0004	0.0005
	[0.063]	[0.49]	[0.061]	[0.47]	[0.10]	[0.016]	[0.098]	[0.016]
D.PE	0	0	0	0	0	0	0	0
	[0.024]	[0.074]	[0.025]	[0.093]	[0.061]	[0.047]	[0.063]	[0.065]
Obs	18766	18759	18766	18759	18797	18790	18797	18790
# banks	640	640	640	640	640	640	640	640

Robust p values in brackets

Table 23: Interest intermediate variables regressions with two-step Arellano-Bover/Blundell-Bond dynamic GMM

Depvar	**total gross interest income /TA**	**total gross interest income /equity**	**total gross interest income /TA**	**total gross interest income /equity**	**interest expense /TA**	**interest expense /equity**	**interest expense /TA**	**interest expense /equity**
l.depvar	0.4195	0.2661	0.4198	0.2664	0.4154	0.2475	0.4155	0.2467
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
conc1	0.0026	0.001			-0.0022	-0.0043		
	[0.019]	[0.067]			[0.20]	[0.029]		
conc2			0.003	0.0001			-0.0026	-0.006
			[0.020]	[0.096]			[0.22]	[0.006]
MS	0.0003	0.0043	0.0003	0.0043	0.0001	0.0018	0.0001	0.0018
	[0.18]	[0.096]	[0.17]	[0.096]	[0.43]	[0.33]	[0.41]	[0.33]
lnTA	0.0123	0.1103	0.0122	0.1103	0.0089	0.0515	0.0089	0.0514
	[0.000]	[0.000]	[0.00051]	[0.000]	[0.015]	[0.000]	[0.015]	[0.000]
lnTA2	-0.0007	-0.0066	-0.0007	-0.0066	-0.0005	-0.0031	-0.0005	-0.0031
	[0.002]	[0]	[0.002]	[0]	[0.029]	[0.000]	[0.028]	[0.000]
OPEFF	0	0	0	0	0	0	0	0
	[0.27]	[0.47]	[0.28]	[0.47]	[0.27]	[0.31]	[0.27]	[0.34]
CA	0.0005	-0.0059	0.0005	-0.006	0.0005	-0.0056	0.0005	-0.0057
	[0.12]	[0]	[0.13]	[0]	[0.12]	[0]	[0.12]	[0]
CDTA	-0.0005	-0.0007	-0.0005	-0.0007	-0.0005	-0.0003	-0.0005	-0.0003
	[0.079]	[0.19]	[0.081]	[0.22]	[0.084]	[0.45]	[0.090]	[0.50]
TIATA	-0.0006	-0.0007	-0.0006	-0.0007	-0.0005	-0.0003	-0.0005	-0.0003
	[0.10]	[0.13]	[0.11]	[0.13]	[0.11]	[0.39]	[0.12]	[0.40]
PE	0	0	0	0	0	0	0	0
	[0.28]	[0.69]	[0.28]	[0.68]	[0.27]	[0.36]	[0.28]	[0.38]
Constant	-0.0061	-0.2705	-0.0071	-0.2673	0.0036	-0.0711	0.0028	-0.0658
	[0.71]	[0.000]	[0.65]	[0.000]	[0.79]	[0.095]	[0.83]	[0.13]
Obs	19521	19513	19521	19513	19542	19534	19542	19534
# banks	644	644	644	644	644	644	644	644

Robust p values in brackets

Table 24: Non-interest intermediate variables regressions in OLS

Depvar	other income /TA	other income /equity	other income /TA	other income /equity	other expense /TA	other expense /equity	other expense /TA	other expense /equity
conc1	0.0002	0.0023			-0.0006	-0.0042		
	[0.061]	[0.020]			[0.002]	[0.000]		
conc2			0.0002	0.0026			-0.0006	-0.0046
			[0.052]	[0.016]			[0.003]	[0.000]
MS	0.0005	0.0057	0.0005	0.0057	-0.0002	-0.0013	-0.0002	-0.0013
	[0.000]	[0.000]	[0.000]	[0.000]	[0.171]	[0.616]	[0.170]	[0.615]
lnTA	0.0005	0.0076	0.0005	0.0076	0.0015	0.0076	0.0015	0.0075
	[0.319]	[0.165]	[0.316]	[0.163]	[0.113]	[0.381]	[0.118]	[0.383]
lnTA2	-0.0001	-0.0003	-0.0001	-0.0003	0.0001	0.0001	0.0001	0.0001
	[0.002]	[0.479]	[0.002]	[0.477]	[0.329]	[0.824]	[0.328]	[0.823]
OPEFF	0	0	0	0	0	0	0	0
	[0.565]	[0.003]	[0.565]	[0.003]	[0.698]	[0.082]	[0.698]	[0.082]
CA	0.0002	-0.0053	0.0002	-0.0053	-0.0002	0.0086	-0.0002	0.0086
	[0.083]	[0.000]	[0.083]	[0.000]	[0.276]	[0.000]	[0.276]	[0.000]
CDTA	-0.0002	0.0013	-0.0002	0.0013	0.0001	-0.002	0.0001	-0.002
	[0.000]	[0.036]	[0.000]	[0.036]	[0.083]	[0.001]	[0.084]	[0.001]
TIATA	-0.0002	0.0005	-0.0002	0.0005	0.0002	-0.0008	0.0002	-0.0008
	[0.000]	[0.341]	[0.000]	[0.341]	[0.001]	[0.103]	[0.001]	[0.102]
PE	0	-0.0001	0	-0.0001	0	0.0001	0	0.0001
	[0.501]	[0.002]	[0.502]	[0.002]	[0.461]	[0.037]	[0.462]	[0.037]
Constant	0.026	-0.0042	0.026	-0.0049	-0.0352	-0.1525	-0.0351	-0.1518
	[0.000]	[0.938]	[0.000]	[0.928]	[0.000]	[0.012]	[0.000]	[0.013]
Obs	20102	20102	20102	20102	20101	20101	20101	20101
# banks	644	644	644	644	644	644	644	644
R-sq	0.14	0.15	0.14	0.15	0.09	0.22	0.09	0.22

Robust p values in brackets

Table 25: Non-interest intermediate variables regressions in two-step efficient GMM

Depvar	**other income /TA**	**other income /equity**	**other income /TA**	**other income /equity**	**other expense /TA**	**other expense /equity**	**other expense /TA**	**other expense /equity**
conc1	-0.0001	-0.0018			-0.0003	-0.0001		
	[0.21]	[0.51]			[0.016]	[0.098]		
conc2			-0.0001	-0.0025			-0.0003	-0.0003
			[0.35]	[0.42]			[0.012]	[0.092]
MS	0	-0.0032	0	-0.0032	0.0002	0.0043	0.0002	0.0043
	[0.67]	[0.36]	[0.71]	[0.36]	[0.36]	[0.20]	[0.36]	[0.20]
lnTA	0.0008	0.0106	0.0009	0.0108	0	-0.0063	-0.0001	-0.0063
	[0.072]	[0.31]	[0.051]	[0.30]	[0.98]	[0.60]	[0.90]	[0.60]
lnTA2	-0.0001	-0.0011	-0.0001	-0.0011	0.0002	0.0018	0.0002	0.0018
	[0.000]	[0.082]	[0.000]	[0.079]	[0.009]	[0.028]	[0.0061]	[0.028]
OPEFF	0	0.0001	0	0.0001	0	-0.0001	0	-0.0001
	[0.57]	[0.0091]	[0.54]	[0.0058]	[0.26]	[0.000]	[0.22]	[0.000]
CA	0.0001	-0.0032	0.0001	-0.0032	-0.0002	0.0057	-0.0002	0.0057
	[0.12]	[0.0038]	[0.055]	[0.0041]	[0.072]	[0.000]	[0.038]	[0.000]
CDTA	-0.0002	-0.0008	-0.0002	-0.0009	0.0001	0	0.0001	0.0001
	[0.000]	[0.40]	[0.000]	[0.36]	[0.20]	[0.98]	[0.13]	[0.92]
TIATA	-0.0003	-0.0009	-0.0003	-0.0009	0.0002	0.0005	0.0002	0.0005
	[0]	[0.083]	[0]	[0.072]	[0.000]	[0.30]	[0.000]	[0.28]
PE	0	-0.0003	0	-0.0003	0	0.0004	0	0.0004
	[0.98]	[0.051]	[0.78]	[0.048]	[0.64]	[0.007]	[0.76]	[0.005]
Obs	17125	17125	17125	17125	17121	17121	17121	17121
# banks	627	627	627	627	627	627	627	627
R-sq	0.143	-0.063	0.14	-0.114	0.055	-0.048	0.04	-0.111

Robust p values in brackets

Table 26: Non-interest intermediate variables regressions with one-step Arellano-Bond dynamic GMM

Depvar	**other income /TA**	**other income /equity**	**other income /TA**	**other income /equity**	**other expense /TA**	**other expense /equity**	**other expense /TA**	**other expense /equity**
LD.depvar	0.1758	0.0218	0.1747	0.0215	0.262	0.0383	0.261	0.0383
	[0.003]	[0.57]	[0.003]	[0.57]	[0.000]	[0.20]	[0.000]	[0.21]
D.conc1	0.0015	0.0028			-0.0021	-0.0057		
	[0.001]	[0.51]			[0.039]	[0.14]		
D.conc2			0.0018	0.0034			-0.0024	-0.0063
			[0.001]	[0.47]			[0.041]	[0.13]
D.MS	0.0003	0.0032	0.0003	0.0032	0.0001	0.0024	0.0001	0.0024
	[0.002]	[0.005]	[0.001]	[0.005]	[0.51]	[0.065]	[0.52]	[0.065]
D.lnTA	0.0024	0.0427	0.0022	0.0421	-0.0019	-0.0173	-0.0016	-0.017
	[0.040]	[0.009]	[0.078]	[0.010]	[0.38]	[0.21]	[0.47]	[0.21]
D.lnTA2	-0.0003	-0.0028	-0.0003	-0.0028	0.0005	0.003	0.0005	0.003
	[0.000]	[0.001]	[0.000]	[0.001]	[0.000]	[0.005]	[0.000]	[0.005]
D.OPEFF	0	0	0	0	0	0	0	0
	[0.35]	[0.40]	[0.38]	[0.40]	[0.44]	[0.42]	[0.46]	[0.42]
D.CA	0.0005	-0.0014	0.0005	-0.0014	-0.0006	0.0053	-0.0006	0.0053
	[0.001]	[0.008]	[0.001]	[0.009]	[0.008]	[0.000]	[0.007]	[0.000]
D.CDTA	-0.0003	-0.0005	-0.0003	-0.0005	0.0004	0.0011	0.0004	0.0011
	[0.006]	[0.65]	[0.006]	[0.65]	[0.002]	[0.24]	[0.002]	[0.24]
D.TIATA	-0.0003	-0.0011	-0.0003	-0.0011	0.0004	0.0007	0.0004	0.0007
	[0.004]	[0.10]	[0.004]	[0.11]	[0.013]	[0.38]	[0.012]	[0.39]
D.PE	0	0	0	0	0	0	0	0
	[0.15]	[0.34]	[0.17]	[0.35]	[0.22]	[0.34]	[0.23]	[0.34]
Obs	18759	18752	18759	18752	18756	18749	18756	18749
# banks	640	640	640	640	640	640	640	640

Robust p values in brackets

Table 27: Non-interest intermediate variables regressions with two-step Arellano-Bover/ Blundell-Bond dynamic GMM

Depvar	**other income /TA**	**other income /equity**	**other income /TA**	**other income /equity**	**other expense /TA**	**other expense /equity**	**other expense /TA**	**other expense /equity**
l.depvar	0.2341	0.0819	0.2334	0.0817	0.3304	0.085	0.3294	0.0845
	[0.003]	[0.027]	[0.002]	[0.027]	[0.000]	[0.005]	[0.000]	[0.005]
conc1	0.001	0.001			-0.0022	-0.0065		
	[0.011]	[0.069]			[0.055]	[0.051]		
conc2			0.0013	0.0024			-0.0026	-0.0083
			[0.011]	[0.035]			[0.061]	[0.009]
MS	0.0002	0.0048	0.0002	0.0048	0.0002	0.001	0.0002	0.001
	[0.096]	[0.014]	[0.096]	[0.014]	[0.20]	[0.47]	[0.20]	[0.48]
lnTA	0.0046	0.0151	0.0046	0.0152	-0.0071	-0.019	-0.0071	-0.0192
	[0.044]	[0.38]	[0.042]	[0.37]	[0.034]	[0.25]	[0.037]	[0.25]
lnTA2	-0.0003	-0.0008	-0.0003	-0.0008	0.0004	0.0015	0.0004	0.0016
	[0.065]	[0.49]	[0.062]	[0.48]	[0.033]	[0.19]	[0.035]	[0.18]
OPEFF	0	0	0	0	0	0	0	0
	[0.24]	[0.28]	[0.24]	[0.28]	[0.35]	[0.37]	[0.35]	[0.38]
CA	0.0003	-0.0031	0.0003	-0.0031	-0.0004	0.0062	-0.0004	0.0061
	[0.18]	[0.002]	[0.17]	[0.002]	[0.15]	[0.000]	[0.16]	[0.000]
CDTA	-0.0002	0.0002	-0.0002	0.0002	0.0003	-0.0009	0.0004	-0.0009
	[0.003]	[0.92]	[0.0029]	[0.92]	[0.034]	[0.69]	[0.034]	[0.69]
TIATA	-0.0002	-0.0002	-0.0002	-0.0002	0.0003	-0.0009	0.0003	-0.0009
	[0.013]	[0.87]	[0.014]	[0.87]	[0.10]	[0.63]	[0.10]	[0.63]
PE	0	-0.0001	0	-0.0001	0	0	0	0
	[0.16]	[0.26]	[0.16]	[0.26]	[0.31]	[0.33]	[0.31]	[0.33]
Constant	-0.002	0.0116	-0.0025	0.0068	0.0055	0.0223	0.006	0.0279
	[0.77]	[0.89]	[0.71]	[0.94]	[0.45]	[0.88]	[0.43]	[0.85]
Obs	19510	19502	19510	19502	19508	19500	19508	19500
# banks	644	644	644	644	644	644	644	644

Robust p values in brackets

Table 28: Interest rate regressions with OLS

Depvar	**deposit interest rate**	**deposit interest rate**	**lending interest rate**	**lending interest rate**	**interest rate spread**	**interest rate spread**
conc1	-0.0001		0.001		0.0011	
	[0.117]		[0.000]		[0.000]	
conc2		-0.0001		0.0011		0.0012
		[0.162]		[0.000]		[0.000]
MS	0.0005	0.0005	0.0014	0.0014	0.0009	0.0009
	[0.010]	[0.010]	[0.010]	[0.010]	[0.011]	[0.011]
lnTA	0.0036	0.0036	0.0051	0.0051	0.0014	0.0014
	[0.004]	[0.004]	[0.126]	[0.126]	[0.520]	[0.519]
lnTA2	-0.0002	-0.0002	-0.0005	-0.0005	-0.0002	-0.0002
	[0.000]	[0.000]	[0.013]	[0.013]	[0.087]	[0.087]
OPEFF	0	0	0	0	0	0
	[0.147]	[0.146]	[0.202]	[0.202]	[0.283]	[0.283]
CA	0.0001	0.0001	0.0004	0.0004	0.0003	0.0003
	[0.011]	[0.012]	[0.001]	[0.001]	[0.001]	[0.001]
CDTA	-0.0001	-0.0001	-0.0002	-0.0002	-0.0001	-0.0001
	[0.005]	[0.005]	[0.002]	[0.002]	[0.011]	[0.011]
TIATA	0	0	-0.0002	-0.0002	-0.0002	-0.0002
	[0.085]	[0.084]	[0.000]	[0.000]	[0.000]	[0.000]
PE	0	0	0	0	0	0
	[0.159]	[0.159]	[0.183]	[0.184]	[0.228]	[0.228]
Constant	-0.0037	-0.0037	0.03	0.0299	0.0334	0.0334
	[0.537]	[0.536]	[0.049]	[0.050]	[0.001]	[0.001]
Obs	2531	2531	2525	2525	2522	2522
# banks	58	58	58	58	58	58
R-sq	0.61	0.61	0.4	0.4	0.22	0.22

Robust p values in brackets

Table 29: Interest rate regressions with two-step efficient GMM

Depvar	**deposit interest rate**	**deposit interest rate**	**lending interest rate**	**lending interest rate**	**interest rate spread**	**interest rate spread**
conc1	-0.0002		0.0008		0.001	
	[0.093]		[0.001]		[0.000]	
conc2		-0.0002		0.0009		0.0011
		[0.015]		[0.001]		[0.000]
MS	0	0	0.0002	0.0002	0.0002	0.0002
	[0.77]	[0.70]	[0.37]	[0.36]	[0.14]	[0.14]
lnTA	0.0015	0.0015	-0.0027	-0.0027	-0.0029	-0.003
	[0.15]	[0.16]	[0.33]	[0.32]	[0.16]	[0.15]
lnTA2	-0.0001	-0.0001	0	0	0	0
	[0.018]	[0.022]	[0.92]	[0.96]	[0.88]	[0.82]
OPEFF	0	0	0	0	0	0
	[0.006]	[0.005]	[0.005]	[0.003]	[0.009]	[0.006]
CA	0	0	0.0002	0.0002	0.0002	0.0002
	[0.72]	[0.64]	[0.074]	[0.077]	[0.016]	[0.016]
CDTA	-0.0001	-0.0001	-0.0003	-0.0003	-0.0002	-0.0002
	[0.023]	[0.029]	[0.011]	[0.012]	[0.065]	[0.066]
TIATA	0	0	-0.0002	-0.0002	-0.0002	-0.0002
	[0.005]	[0.005]	[0.000]	[0.000]	[0.000]	[0.000]
PE	0	0	0	0	0	0
	[0.001]	[0.001]	[0.0036]	[0.002]	[0.006]	[0.004]
Obs	2250	2250	2248	2248	2241	2241
# banks	58	58	58	58	58	58
R-sq	0.647	0.643	0.403	0.397	0.111	0.101

Robust p values in brackets

Table 30: Interest rate regressions with one-step Arellano-Bond dynamic GMM

Depvar	**deposit interest rate**	**deposit interest rate**	**lending interest rate**	**lending interest rate**	**interest rate spread**	**interest rate spread**
LD.depvar	0.583	0.5848	0.4053	0.4079	0.304	0.3055
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
D.conc1	-0.0004		0.002		0.0016	
	[0.069]		[0.006]		[0.002]	
D.conc2		-0.0003		0.002		0.0017
		[0.22]		[0.015]		[0.003]
D.MS	0.0003	0.0003	0.0006	0.0006	0.0003	0.0003
	[0.002]	[0.002]	[0.015]	[0.015]	[0.061]	[0.061]
D.lnTA	0.0016	0.0019	0.0047	0.0052	0.0038	0.0039
	[0.56]	[0.49]	[0.53]	[0.49]	[0.46]	[0.46]
D.lnTA2	-0.0002	-0.0002	-0.0007	-0.0007	-0.0005	-0.0005
	[0.11]	[0.099]	[0.074]	[0.070]	[0.072]	[0.072]
D.OPEFF	0	0	0	0	0	0
	[0.70]	[0.68]	[0.74]	[0.70]	[0.58]	[0.62]
D.CA	-0.0002	-0.0002	-0.0004	-0.0004	0	0
	[0.14]	[0.13]	[0.24]	[0.24]	[0.93]	[0.93]
D.CDTA	-0.0001	-0.0001	-0.0002	-0.0002	-0.0001	-0.0001
	[0.032]	[0.027]	[0.15]	[0.13]	[0.29]	[0.27]
D.TIATA	0	0	-0.0002	-0.0002	-0.0002	-0.0002
	[0.36]	[0.33]	[0.18]	[0.18]	[0.15]	[0.15]
D.PE	0	0	0	0	0	0
	[0.89]	[0.87]	[0.98]	[0.95]	[0.44]	[0.47]
Obs	2391	2391	2387	2387	2382	2382
# banks	58	58	58	58	58	58

Robust p values in brackets

Table 31: Interest rate regressions with two-step Arellano-Bover/Blundell-Bond dynamic GMM

Depvar	**deposit interest rate**	**deposit interest rate**	**lending interest rate**	**lending interest rate**	**interest rate spread**	**interest rate spread**
L.depvar	0.4111	0.4111	0.3762	0.3765	0.3588	0.3595
	[0.000]	[0.000	[0.000	[0.000	[0.000	[0.000
conc1	-0.0006		0.0033		0.0024	
	[0.12]		[0.011]		[0.003]	
conc2		-0.0006		0.0034		0.0025
		[0.11]		[0.012]		[0.003]
MS	0.0003	0.0003	0.0006	0.0006	0.0003	0.0004
	[0.001]	[0.001]	[0.007]	[0.007]	[0.034]	[0.034]
lnTA	0.0037	0.0037	0.0112	0.011	0.0054	0.0053
	[0.074]	[0.074]	[0.044]	[0.048]	[0.18]	[0.19]
lnTA2	-0.0002	-0.0002	-0.0007	-0.0007	-0.0004	-0.0004
	[0.036]	[0.035]	[0.011]	[0.012]	[0.051]	[0.056]
OPEFF	0	0	0	0	0	0
	[0.26]	[0.26]	[0.29]	[0.28]	[0.28]	[0.27]
CA	0	0	0.0001	0.0001	0	0
	[0.58]	[0.64]	[0.74]	[0.68]	[0.87]	[0.83]
CDTA	-0.0001	-0.0001	0	0	0	0
	[0.026]	[0.030]	[0.85]	[0.86]	[0.95]	[0.95]
TIATA	0	0	0	0	0	0
	[0.23]	[0.23]	[0.61]	[0.61]	[0.53]	[0.53]
PE	0	0	0	0	0	0
	[0.26]	[0.26]	[0.22]	[0.21]	[0.17]	[0.17]
Constant	-0.0114	-0.0114	-0.0354	-0.0343	-0.01	-0.0092
	[0.26]	[0.26]	[0.24]	[0.26]	[0.66]	[0.68]
Obs	2462	2462	2457	2457	2453	2453
# banks	58	58	58	58	58	58

Robust p values in brackets

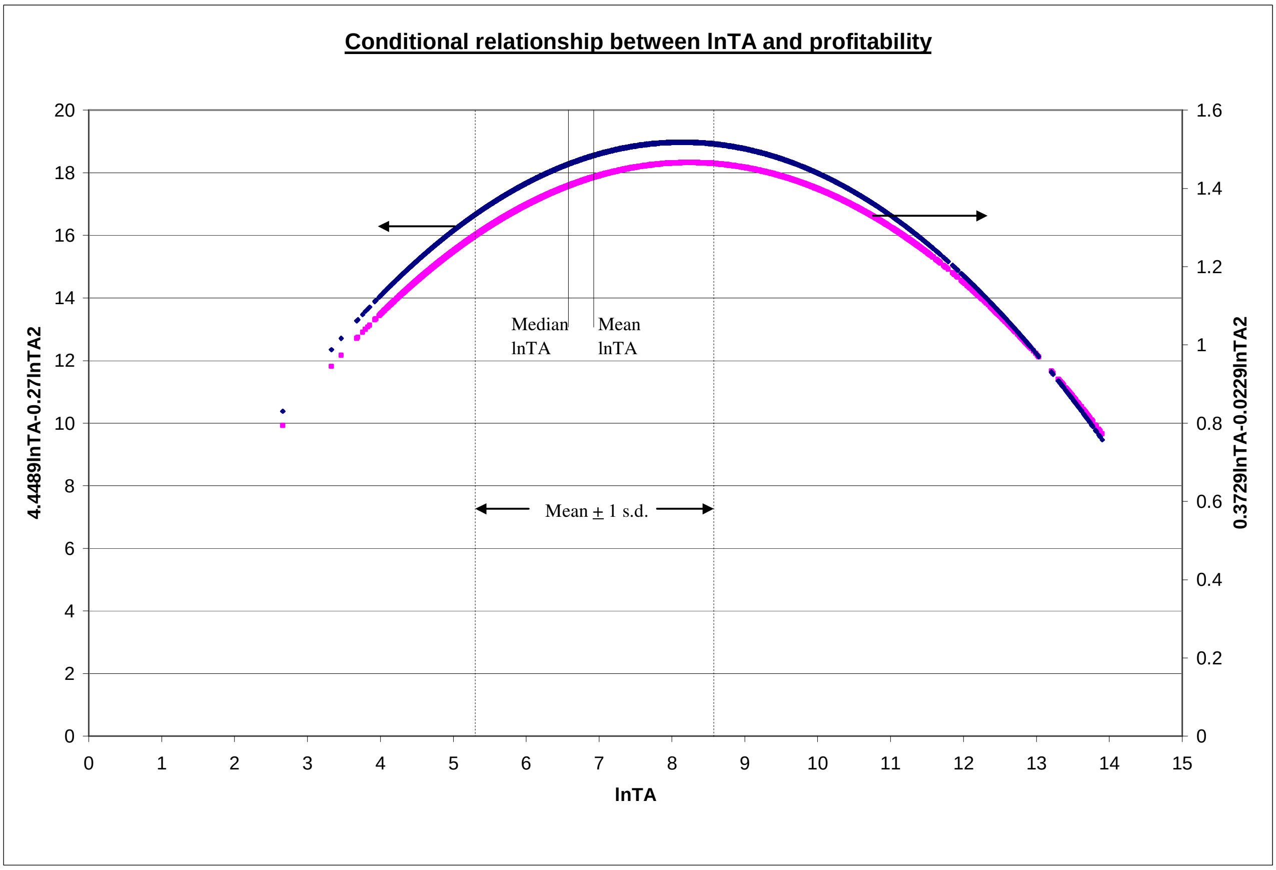
Appendix 3: Conditional relationship between size and profitability

This appendix discusses, in more detail than in the main text, the relationship between size and profitability that emerges from the regression analysis.

Figure A1 depicts the 'conditional' relationship between the measure of size (lnTA), on the x-axis, and the combined effects of the linear and quadratic size parameters (lnTA + $lnTA^2$ on profitability. The object of this analysis is to establish at which point the diseconomies of scale associated with a negative estimates coefficient on $lnTA^2$ are realized, particularly vis-à-vis the actual size distribution of the sample.

The estimated coefficients are from the baseline specification with two-step Arellano-Bover-Blundell-Bond dynamic GMM. The equation of the upper, darker curve, corresponding to the left-hand y-axis, are based on the specification with ROE as the dependent variable, while the equation of the lower, lighter-shaded curve, corresponding to the right-hand y-axis, is based on the specification with ROA as the dependent variables. The explanatory variables are conc1, lnTA, $lnTA^2$, OPEFF, and the control variables CA, CDTA, TIATA, and PE. Each curve is a scatterplot of 20 797 points.

Figure A1



The parabolic shape suggests economies of scale in banking but only up to a certain point, whereafter diseconomies of scale may kick in. This is likely to be at least in part associated with the U-shaped average cost curves in banking typically found in the literature.

The peak of the upper (ROE regression) curve is where lnTA=8.238, while the lower (ROA regression) curve peaks at a similar point of lnTA=8.142[19]. These are of course the same points that are found when solving for the first order conditions of $\frac{\partial \text{ROE}}{\partial (\ln \text{TA})}$ and $\frac{\partial \text{ROA}}{\partial (\ln \text{TA})}$ respectively, and could be interpreted as the 'optimal' values of lnTA for profit maximisation.

[19] Corresponding to TA=$3 785.196m and $3 437.645m respectively (in 2000$).

Regarding the distribution of the actual sample used in the regressions, the mean and median points of the sample (marked on the chart) are clearly on the upward-sloping part of the parabola. 81% of the banks in the sample fall below the turning points of the parabolas, suggesting that they are enjoying economies of scale.

It should of course be noted that the estimated coefficients used in this analysis are derived from a specification focussed on the effects of market structure on concentration, rather than an explicit modelling of the size-profitability relationship which would be undertaken for a study focussed on that particular issue. Notwithstanding this, the estimates obtained from this exercise do make economic sense. These results, although not the main focus of this paper, relate to an important debate in the literature concerning the extent of economies of scale in banking.

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