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Endogenous Capital and Profitability in Banking

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Abstract

This paper investigates the relation between bank capital and profitability. To my knowledge, no previous paper has analysed this problem in a two-equation structural model. Contrary to what is reported with surprising frequency in this field of research, the results show no statistically significant relationship between capital and profitability. Given non-binding capital requirements this finding is consistent with the view that, while raising capital is costly for banks, it is associated with compensating benefits that offset these additional costs. Consequently, when capital structure is endogenously determined in a profit maximising equilibrium, no systematic relation between capital and profit is expected.

Key words: Banking, profitability, capital ratio, endogeneity

JEL Classification: G21, G28, L25

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1 Introduction

Over the past three decades deregulation, and more recently, reregulation have changed the landscape on which financial intermediaries operate and compete. At the forefront of the regulatory debate has been the issue of capital adequacy for banks, which ultimately saw the establishment of a landmark international regulatory agreement known as the Basel Capital Accord in 1988. Accordingly, it is important to understand what role, if any, bank capital plays in determining bank performance.

This paper takes a closer look at the relationship between profitability - as our measure of performance - and bank capital. Most of the early research (for example Short, 1979; Bourke, 1988; and Molyneux and Thornton 1993) on the determinants of bank profitability focuses on the relationship between earnings and concentration. This line of work fit into the structure-conduct-performance (SCP) paradigm which generally tries to explain the significant positive empirical relationship between bank earnings and industry concentration.

These studies, along with the more recent literature such as Dermirguc-Kunt and Huizinga (1999, 2000), Goddard *et al.* (2004a), Athanasoglou *et al.* (2005) and Davis and Zhu (2005) employ a linear single equation framework to estimate the impact of various factors on banking profitability. Two exceptions are papers by Berger (1995b) and Goddard *et al.* (2004b).

Goddard *et al.* (2004b) use a two equation reduced form vector autoregression (VAR) model construction to look at the relationship between growth - measured by the change in logarithmic size (total assets) of a given bank over a one year period - and return-on-equity (ROE). They find that there are few systematic influences on bank growth except for a negative relationship between the capital-to-asset ratio (CAR) and bank growth. They also find evidence supporting the view that bank profits are persistent and that banks with a higher CAR tend to record lower profitability. Berger (1995b) investigates the relationship between capital and earnings in a simple two equation reduced form framework where he regresses the CAR and ROE on three years of lagged CAR and ROE along with a number of control variables. His main finding is causation - via tests of Granger causality - runs in both directions between capital and earnings. Berger's (1995b) important contribution to the debate was to identify potential explanations for the positive relationship between capital and profit that, with few exceptions, have been found in the literature to date. He argues that this finding could be the result of either a reduction in insurance and/or borrowing costs when holding more capital or the result of a signalling equilibrium where it is easier for managers of less risky banks to signal quality by maintaining high levels of capital than managers of riskier banks. This empirical finding is in contrast to the orthodox theoretical conclusion which suggests the impact of raising capital on bank profits to be negative. Despite the fact that his paper alludes to the possibility that there may be a structural relationship between capital and earnings, little has been done in the recent literature to account for this and estimate an appropriate econometric model.

The results of testing reveal unequivocal evidence for endogeneity of CAR. With this is mind, the current paper employs a two equation structural model, where capital is modelled endogenously, to estimate the impacts of various factors on bank earnings. The paper reports no systematic relationship between CAR and profitability which is in stark contrast to the positive and significant relationship that is reported in the extant literature.

There is no doubt that raising capital comes at some cost. Herein lies the eternal struggle between regulators and the banks on the issue of capital and its adequacy. The central concern however, is whether increasing capital provides compensating benefits to the bank in the way that Berger (1995b) articulates.[1] If so, there should be no systematic relation between capital and earnings. Indeed, if the advantages are not fully compensating then we would expect a systematic relation. But this raises a natural question, if benefits are not fully compensating, then why do we observe banks holding capital well above what is officially required? It is therefore argued that, so long as capital requirements are not binding, a bank's capital ratio emerges endogenously within the profit maximisation equilibrium. Thus no systematic relation between capital and profit is expected.

None of this discussion is suggesting that previous research does not provide us with meaningful analyses of the determinants of banking performance. Nevertheless, the econometric techniques employed in previous studies that neglect potential endogeneity problems and either completely ignore or do not account adequately for some features of banking profitability (such as persistence) could result in misleading conclusions.

The rest of the paper is structured as follows. The determinants of bank profitability included in the analysis are discussed in the following section, of particular interest is the role of capital in determining profitability. Section three outlines the data and variables used. Section four outlines the econometric approach employed. Section five presents and discusses the results. Concluding remarks are presented in section six.

[1] In addition to the benefits outlined by Berger (1995b), Ngo (2006) presents a model of bank optimising behaviour in the presence of capital requirements and suggests that banks will issue capital so long as the benefits of a reduction in the expected costs associated with breaching regulatory guidelines is greater than the excess cost of equity financing.

2 The Determinants of Bank Performance

There is an extensive empirical literature on bank performance, so I do not attempt to cover it in full here. Rather, the focus is on the results of the more prominent studies that use profitability and earnings as a measure of performance. These studies vary significantly in their approach and subsequent findings. Some authors (for example Short, 1979; Bourke, 1988; and Molyneux and Thornton, 1993; Dermirguc-Kunt and Huizinga, 1999 & 2000; Bikker and Hu, 2002; Davis and Zhu, 2005) examine and compare the determinants of profitability across different countries, while others (for example Berger 1995a & 1995b; Goddard *et al.*, 2004a & 2004b; Athanasoglou *et al.*, 2005) focus on individual countries' banking sectors. Nevertheless, a review of the existing literature reveals the following list as the usual determinants of bank profitability.

Lagged Profitability: The persistence of profit (POP) literature concerns itself with testing the hypothesis that markets are sufficiently competitive such that any abnormal profits are eroded quickly, and that all firm's profits tend to some long term average. The alternative to this is that firms poses some kind of market power or comparative advantage enabling them to achieve abnormal profits persistently over time. There are few empirical tests of the POP hypothesis in the banking literature, however, one recent example by Berger *et al.* (2000) presents evidence of POP in U.S. banking. They show that profit converges more slowly to its long-run average value in banking than in manufacturing and that market power plays a crucial role in allowing abnormal profits to persist.

Capital: The debate surrounding capital and its 'adequacy' is an important concern for both banks as well as the regulators thus has been at the forefront of policy discussions for decades. Despite the immense amount of work that has been devoted to the issue, there has been little in the way of agreement among the various commentators as to the guiding principles (Pringle, 1975). First, the effectiveness of capital in curbing excessive risk taking by banks and reducing the probability of bankruptcy is contested. The orthodox argument (Berger, Herring and Szego, 1995; Kaufman, 1991; Furlong and Keeley, 1989; Keeley and Furlong, 1990) is that capital acts as a buffer against failure, thus regulations that force banks to hold more capital will reduce the likelihood of bankruptcy. Other authors however disagree and suggest that capital regulations may indeed lead to increased risk taking by banks (Kahane, 1977; Koehn and Santomero,1980; Lam and Chen, 1985). Second, whether capital regulations have any impact on a bank's actual capital decision is also a moot point. Previous empirical work on the effectiveness of bank capital regulation in determining actual capital levels have contrasting results.

Peltzman (1970) and Dietrich and James (1983) find no regulatory effect on bank capital whereas Mingo (1975) finds that capital adequacy regulation had a significant impact on bank capital.

The final area of contention - which this paper is predominantly interested in - is the impact of capital on bank performance or profitability. According to conventional wisdom a bank's riskiness is determined by its ability to absorb unforeseen losses. Given that capital is viewed to act as a buffer against losses, a high CAR tends to be associated with lower profitability. That is, capital tends to lower the risk on equity and thus lowers the equilibrium expected ROE (Berger, 1995b).[2] This hypothesised lower risk lower return relationship based on standard Markowitzian reasoning seems quite plausible, nevertheless, previous empirical studies on the impact of capital on profitability have provided conflicting results. Some authors (for example Bourke, 1989; Molyneux and Thornton, 1992; Berger, 1995b; Goddard *et. al.*, 2004a) find a positive relationship between capital and profitability, whereas others (for example Goddard *et. al.*, 2004b) provide evidence in favour of the hypothesised relationship. Berger (1995b) is the only paper that looks closely at the relationship between capital and earnings. In Granger-causality tests, he finds that positive causation runs both ways between CAR and ROE. The positive causation from ROE to CAR is not particularly surprising, given the hypothesis that banks retain part of their marginal earnings in the form of increases in capital (Berger, 1995b). The positive relationship that runs from CAR to ROE is more surprising, and is the result that is most relevant to the capital adequacy debate. Although not the first to report a positive relationship between CAR and ROE, Berger (1995b) was the first to propose some plausible theoretical explanations for this finding. Outside of the Markowitzian single period world with perfect capital markets, Berger (1995b) comes up with two seemingly possible reasons for a positive relationship between CAR and ROE. First, a bank that is maintaining a low CAR - relative to the equilibrium value - may have relatively high expected bankruptcy costs, thus an increase in the CAR may lead to an increase in the ROE by lowering insurance costs on uninsured debt. Second, Berger (1995b) suggests that this positive relationship could be the result of a signalling equilibrium. That is, bank managers may have private information about the bank's future profitability and/or a stake in the value of the bank through incentive

[2] Even if we do not believe the CAR is a good proxy for how risky a bank is, there are other arguments as to why raising capital may lead to reduced profits. First, debt is usually a cheaper form of financing thus forcing banks away from their optimal capital ratio should result in a reduction in profitability - although this is only a problem if capital requirements are binding. Second, from a bank's perspective holding idle capital is an expensive safeguard against risk because the bank's shareholders demand a return on their investment and idle capital provides no such return.

payments and it may be less expensive for managers of low risk banks to signal quality by maintaining a high CAR than for managers of high risk banks. Related to this, other authors (for example, Bernauer and Koubi, 2002) suggest that competitive forces may motivate banks to maintain higher capital ratios as a means of lowering their borrowing costs.

All this suggests that CAR may be endogenous, and although almost all the work that has followed Berger (1995b) have discussed his results, none have attempted to estimate a structural relationship. It is worth noting here that virtually all the theoretical literature analysing banking behaviour has assumed that capital requirements are a binding constraint on banking behaviour and therefore not treated capital as a managerial decision. Nevertheless, Baltensperger (1980) presents a model where banks choose a level of capital that weighs up the benefits of reduced insolvency costs against the costs of holding more capital which is assumed to be greater than the cost of debt - potential bankruptcy provides banks with an incentive to hold a positive amount of capital. Pringle (1974) has also discussed the bank's capital decision but in a model that ignores bankruptcy costs, which is stressed in Baltensperger's (1980) analysis. These two models however ignore any potential influence that formal capital requirements may have on the banks optimal choice of capital ratio. On this point Ngo (2006) presents a model of bank optimising behaviour in the presence of capital requirements. He shows that banks will tend to hold capital in excess of the official requirements in order to avoid the expected costs associated with regulatory breach and suggests that this might be an explanation for the observed over-compliance with capital regulations and therefore existence of non-binding capital requirements. Here the capital ratio is defined in accordance with the Basel Accord guidelines, CAR is the ratio of total capital (Tier 1 capital plus Tier 2 capital) to total risk weighted assets.[3]

[3]Tier 1 (core) capital for banks consists of: (1) common stockholders' equity capital; (2) noncumulative perpetual preferred stock and any related surplus; and (3) minority interests in equity capital accounts of consolidated subsidiaries, less goodwill, other disallowed intangible assets, and disallowed deferred tax assets, and any other amounts that are deducted in determining Tier 1 capital in accordance with the capital standards issued by the reporting bank's primary federal supervisory authority. Tier 2 (supplementary) capital is limited to 100 percent of Tier 1 capital and consists of: (1) cumulative perpetual preferred stock and any related surplus; (2) long-term preferred stock (original maturity of 20 years or more) and any related surplus (discounted for capital purposes as it approaches maturity); (3) auction rate and similar preferred stock (both cumulative and noncumulative); (4) hybrid capital instruments (including mandatory convertible debt securities); (5) term subordinated debt and intermediate-term preferred stock (original weighted average maturity of five years or more) to the extent of 50 percent of Tier 1 capital (and discounted for capital purposes as they approach maturity); and (6) the allowance for loan and lease losses (limited to the lesser of the balance of the allowance account or 1.25 percent of gross risk-weighted assets). When determining the amount of risk-weighted assets, on-balance sheet assets are assigned an appropriate risk weight (zero percent, 20 percent, 50 percent, or 100 percent) and

Size: Size is introduced to account for any (dis)economies of scale in the market. Akhavein *et al.* (1997) and Smirlock (1985) amongst others find a positive and significant relationship between size and profitability, however, other researchers (Berger *et al.*, 1987; Boyd and Grahame, 1991) indicate that economies of scale in banking tend to be exhausted at relatively low sizes, which suggests that large banks could eventually face scale inefficiencies. The relationship between size, capital and profitability is a particularly interesting one, which to date has not yet been sufficiently explored. Athanasoglou *et al.* (2005) suggest that size is closely related to capital in that large banks are able to raise capital relatively cheaply consequently making them appear more profitable. Moreover, large banks may posses market power through stronger brand image or implicit 'too-big-to-fail' regulatory protection. Another mechanism suggesting a (negative) causality from size to profitability (see Goddard *et. al.*, 2004b) can be found in the 'managerial firm' and agency costs literature. If managers of large firms have discretionary powers and pursue other objectives - such as, salaries, non-pecuniary benefits, power or prestige - size (or growth) may well enter the firm's objective function as well as profitability. Of course, growth in demand is constrained by the size of the market, thus there are limits to the size that a firm can grow before adversely affecting profitability. On the other hand, many authors have pointed out (for example Berger, 1995b; Goddard *et. al.*, 2004b) that a principal source of capital is retained earnings. Consequently, under the current regulatory regime where banks are required to meet certain capital adequacy requirements, profit is an important determinant for the expansion of a bank's portfolio of risky assets. The natural logarithm of total assets is included as a proxy for size, while the square of the natural logarithm of total assets is included to capture any nonlinearities in the size-profit relationship.

Diversification: International competition in banking started increasing in the 1970s and intensified through the 1980s and 1990s which resulted in falling fees and margins. In an attempt to maintain market share, many banks responded by expanding their product portfolio, merger and expansion into overseas markets. Product diversification was particularly important as it allowed banks to spread risks across different assets and was predominantly achieved via conducting a significant proportion of

off-balance sheet items are first converted to a credit equivalent amount and then assigned to one of the four risk weight categories. The on-balance sheet assets and the credit equivalent amounts of off-balance sheet items are then multiplied by the appropriate risk weight percentages and the sum of these risk-weighted amounts, less certain deductions, is the bank's gross risk-weighted assets. These deductions are for goodwill, other disallowed intangible assets, disallowed deferred tax assets, investments in banking and finance subsidiaries that are not consolidated for regulatory capital purposes, intentional reciprocal cross-holdings of banking organizations' capital instruments, and other deductions as determined by the reporting bank's primary federal supervisory authority.

their business 'off-balance-sheet' (OBS) - including loan commitments, letters of credit and derivatives. Demsetz and Strahan (1997) examine the role of diversification in US banking and find that the risk-reducing potential of diversification at large bank holding companies (BHCs) is offset by their lower capital ratios and larger commercial and industrial loan portfolios. The few other studies which included the size of a bank's OBS portfolio as a determinant of profitability have reported mixed results (see Goddard *et al.*, 2004a). Diversification is proxied in this study by including the ratio of nominal OBS business to the sum of total assets and nominal OBS business.

Credit Risk: Asset quality is also a determinant of profitability. Poor asset quality resulting in non-performing loans is a key element in bank failures. One would therefore anticipate that profitability is negatively associated with credit risk, *ceteris paribus*. While capital acts as a buffer against unforeseen losses, a bank presumably knows the credit risk of its portfolio and thus will provision for the likelihood of default. For this reason, the ratio of loan-loss provisions to loans is used as a proxy for credit risk. Banks can therefore improve profitability by improving screening, monitoring and forecasting of credit risk facilities. The empirical literature has tended to find a negative relationship between credit risk and earnings (Athanasoglou *et al.*, 2005).

Operating Expenses: The cost component of a standard profit function is important and should be captured in any analysis of profitability. Bourke (1989) and Molyneux and Thornton (1992) amongst others include staff expenses as a proxy for general overhead expenses. We would expect *a priori* that higher costs, all things equal, to be associated with lower profitability. It is interesting to note then that both Bourke (1989) and Molyneux and Thornton (1992) report a counter intuitive finding of a positive coefficient on their staff expenses variable. Molyneux and Thornton (1992) suggest that this finding could result from profits earned by firms in a regulated industry being appropriated in the form of payroll expenditures. Athanasoglou *et al.* (2005) suggest that higher staff expenses could be due to the hiring of higher quality management which ultimately leads to higher profits. We include the ratio of operating expenses to total assets to account for impact of costs on profitability.

Concentration: As mentioned previously, most of the early research in this area focused on the impact of industry concentration on profitability. The literature was principally concerned with explaining the common empirical finding of a positive relationship between concentration and profitability. Two opposing, nevertheless mutually acceptable explanations for this positive relationship have been advanced - the monopoly power (MP) or structure-conduct-performance (SCP) and the efficient structure (ES).[4]

[4] See Berger (1995a) for a comprehensive discussion and application to the U.S. banking industry.

Although there are slight variants on the MP and ES hypotheses, broadly, the MP asserts that the positive finding reflects the setting of less favourable prices to consumers (lower deposit rates, higher loan rates) in more concentrated markets as a result of market power. In contrast, the ES hypothesis - whether it is an X-efficiency or scale economies argument - advocates that larger firms can achieve cost savings and thus higher profits. The focus of this paper is not on trying to explain which of these hypotheses best explains the positive profit-structure relationship, rather, concentration is simply included as a control variable for completeness. Previous studies have employed a number of different measures including concentration ratios and various indices, here concentration is measured using the Herfindahl-Hirschman Index (HHI).[5]

Macroeconomy: The impact of demand side factors and the macroeconomic environment have always been recognised as potentially influencing bank performance. The variables that have been used in the past include gross domestic product (GDP), some measure of growth in the banking market, inflation and/or interest rate. GDP per capita and market growth - as typically measured by the annual growth in money supply (Bourke, 1989), growth in total deposits (Berger, 1995b) or growth in total assets - are generally included to account for changes in demand. An expanding market, particularly those associated with entry barriers, should be accompanied with increased profits. Revell (1979) - cf. Bourke (1989) - was the first to suggest that inflation may be an important determinant in explaining variations in bank profitability. Whether inflation affects profitability depends on whether wages and other non-interest cost are growing faster than the rate of inflation. Of course, if banks are sophisticated enough and are able to forecast and manage their costs accordingly then one may expect a positive relationship between inflation and earnings. That is, if inflation is fully anticipated and banks can appropriately adjust interest rates so as to increase their revenues faster than operating costs, it would be possible that higher inflation leads to greater profits. Most studies (including Bourke (1989) and Molyneux and Thornton (1992)) find a positive association between inflation and earnings. Accordingly, the growth in the consumer price index (CPI) as well as growth in real GDP are also included to the list of regressors.

3 Data and Other Variables

The data are collected from the Wharton Research Data Services (WRDS), Bank Regulatory Database. This database contains five sub-databases for regulated depository

[5] See Rhoades (1982) for a review of concentration ratios and the HHI.

financial institutions which provide accounting data for bank holding companies, commercial banks, savings banks, and savings and loans institutions. The source of the data comes from the required regulatory forms filled for supervisory purposes. This study focuses on commercial banks. The Commercial Bank Database, from the Federal Reserve Bank of Chicago (FRB Chicago), contains data of all banks filing the Report of Condition and Income (named "Call Report") that are regulated by the Federal Reserve System (the Fed), Federal Deposit Insurance Corporation (FDIC), and the Office of Comptroller of the Currency (OCC). These reports include balance sheet, income statements, risk-based capital measures and off-balance-sheet data. The Commercial Bank Database has data available quarterly from March 1976 to March 2005 and includes basically all commercial banks and savings banks. It does not have data from savings institutions (e.g. S&L associations) that file the Thrift Financial Report (TFR) with the Office of Thrift Supervision (OTS). Over the years, although there have been 37,962 banks in total that have filled out at least one Call Report, with failures, startups and mergers the number of commercial banks at any given point in time has varied significantly - averaging about 12,000 at a given time. For the purposes of this study, we sample the 2500 largest banks according to total assets in the March quarter of 1996 and track them through till March 2005 yielding a very large data set of over 62,000 bank observations.

The dependent variable of primary interest is bank earnings. The most common measures employed are net income to equity or return on equity (ROE) and net income to total assets or return on assets (ROA). Most studies typically use only one of the measures, but we will perform the analysis using both. Sundararajan *et al.* (2002) highlight the need to simultaneously look at several operating ratios when analysing bank performance due to variations in business practices across banks and time. For example, banks with lower leverage (higher equity) will tend to have a higher ROA but lower ROE. The problem is that banks can inflate their ROE by operating with extremely low levels of equity capital, often supported by implicit government guarantees (Dermirguc-Kunt and Huizinga, 1999). An analysis of ROE disregards the greater risks normally associated with greater debt financing, thus ROA emerges as a preferred measure of profitability - ideally, one would use a risk adjusted ROE but this is not available.

Year dummies are included to account for any time effects not captured by the macroeconomic and industry control variables, with the base year being 1976. We also include dummies indicating the state in which a bank is located to control for bank location, regulatory environment – for example, differing state chartering and branching laws - and any other state specific variation that have not been captured by the other variables, with the base being New York. Finally, a dummy variable indicating a bank's charter authority - either federal or state - is included to account for any differences between federal and various state chartering laws.

4 Econometric Model

Unlike previous research in this area, the present study proposes a two equation structural model. Of particular interest is the coefficient on CAR in equation (1), α_2. As discussed previously, although a few studies have found a negative coefficient, the majority of have found this coefficient to be significant and positive.

$$\begin{aligned} \Pi_{it} &= \alpha_{1i} + \alpha_2 CAR_{it} + \alpha_3 \Pi_{it-1} + \alpha_4 SIZE_{it} + \alpha_5 SSIZE_{it} + \alpha_6 OE_{it} \\ &\quad + \alpha_7 CR_{it} + \alpha_8 DIV_{it} + \alpha_9 GDP_t + \alpha_{10} CPI_t + \alpha_{11} HHI_t + \boldsymbol{\alpha}'_{12}\mathbf{X}_{it} + e_{it} \end{aligned} \tag{1}$$

and

$$\begin{aligned} CAR_{it} &= \beta_{1i} + \beta_2 \Pi_{it} + \beta_3 CAR_{it-1} + \beta_4 STOCK_t + \beta_5 SIZE_{it} + \beta_6 SSIZE_{it} \\ &\quad + \beta_7 CR_{it} + \beta_8 DIV_{it} + \beta_9 GDP_t + \beta_{10} CPI_t + \boldsymbol{\beta}'_{11}\mathbf{X}_{it} + u_{it} \end{aligned} \tag{2}$$

Where Π_{it} is either the ROE or ROA and $\mathbf{X}_{it}$ is a vector of time, state and charter dummy variables. Lagged CAR and STOCK are used to identify the capital ratio equation. The rationale for using lagged CAR as an instrument is obvious - we hypothesise that lagged values of CAR are highly correlated with current CAR but not correlated with the error term in equation 1. The variable STOCK is the Dow Jones Wilshire 5000 Index (in levels). The state of the stock market is hypothesised to be related to CAR for two reasons. First, there is extensive literature suggesting that issuing new equity is costly, and that these costs associated with new equity issuance will increase when the stock market is weaker which suggests a positive correlation between CAR and STOCK. Alternatively, it is possible that a negative relationship between CAR and STOCK exists because under current Basel Accord guidelines, banks are only allowed to count up to 50 percent of hidden reserves - unrealised capital gains on holdings of stock - as Tier 2 capital, thus in a bullish market banks may actually reduce their holdings of official capital due to the increased buffer they receive from increases in hidden reserves that do not go into official CAR calculations. Table 1 reports all the variables and their definitions used in this study while Table 2 provides summary statistics.[6]

Although the time dimension of this study is not overly large, we preempt any concerns that the proceeding results may be spurious on the grounds of non-stationarity of the panel. For an unbalance panel Maddala and Wu (1999) suggest using the Fisher test, which is based on the p-values of N independent unit root tests. Fisher's test assumes that all series are non-stationary under the null hypothesis against the alternative that at least one series in the panel is stationary. We test for a unit root in ROA, ROE and CAR. The results of the tests reject the null of a unit root at the one percent level of significance for all the variables.[7]

At this point we perform tests of endogeneity to confirm our hypothesis that capital is in fact endogenous to the profit equation and should be modelled as such. Table 3 presents the results of endogeneity tests for the pooled and fixed-effects least squares regressions. Two variants of the standard Hausman test are used to test for endogeneity in the pooled regression, while the Davidson-MacKinnon test is used for the panel regressions. The results for all regressions indicate a rejection of the null hypothesis of exogeneity in favour of the alternative (endogeneity) at the one percent level of significance. Similar results are found for the CAR regressions which is to be expected.

Both equations are estimated using pooled instrumental variables (IV)/two-stage least squares (2SLS), fixed-effects IV/2SLS, general methods of moments (GMM) IV as well as dynamic panel methods (differenced GMM).[8] Standard practice when estimating a system of equations is to use pooled or fixed-effects 2SLS, however this approach is not ideal in the presence of heteroscedasticity. In this situation, the standard least squares IV estimates of the standard errors are inconsistent, preventing valid inference. One way around this problem is to employ Hansen's (1982) general method of moments to estimate the system which will produce heteroscedasticity and autocorrelation consistent (HAC) standard errors. The advantages of GMM over least squares is clear, in the presence of heteroscedasticity, the GMM estimator is more efficient than the simple IV estimator,

[6] All tables are contained at the end of the of the paper.

[7] We do not present the results in a formal table in the paper. The Fisher test uses either the augmented Dickey-Fuller test or the Phillips-Perron test for the N independent unit root tests. Both the Dickey-Fuller and Phiilips-Perron tests are employed here with no discernible difference in the results.

[8] The appropriate panel model is chosen on the grounds of diagnostic testing, the results of which are not formally presented. First, for both equations, we reject the null that all fixed effects are zero at the one percent level of significance thus we favour a panel data model over pooled 2SLS/IV. Next, in the Hausman specification test for both equations, the null that the difference between the estimates of the fixed-effects and random-effects models is not systematic is rejected at the one percent level of significance. Consequently, we prefer the fixed-effects 2SLS/IV model over the random-effects 2SLS/IV model.

whereas if heteroscedasticity is not present, the GMM estimator is asymptotically no worse than the standard IV.[9]

In equations (1) and (2), α_{1i} and β_{1i} are individual (bank) effects. When the time dimension is small, allowing for both individual effects and lagged dependent variables implies that pooled and fixed-effects least squares estimates may be biased and inconsistent. Although developed in several stages, the general approach to circumventing this problem relies on a GMM estimator - normally known as the Differenced GMM estimator - developed by Arellano and Bond (1991) and Arellano and Bover (1995). In either the fixed-effect or random-effects models, this heterogeneity can be swept away by taking first differences, thus eliminating a potential source of omitted variable bias in estimation. However, in first differences, predetermined variables - that is, the lagged dependent variables - become endogenous. Therefore, predetermined variables and endogenous variables in first differences are instrumented with suitable lags of their own *levels* - here we use second order lags. Strictly exogenous variables, as well as any other instruments enter the instrument matrix in the conventional instrumental variables fashion - in first differences.

5 Results and Discussion

As mentioned earlier both equations are estimated using four different techniques, once with ROE as the proxy for profitability and then repeated using ROA as the proxy for profitability yielding eight sets of results for each equation which we now discuss in turn.

5.1 Profitability Regressions

Tables 4A and 4B present the results from the estimation of equation (1). There was little difference between the results whether ROE or ROA was used as the measure of profitability.

With the exception of the fixed-effects regression using ROE as the dependent variable, the coefficient on CAR in both the pooled and fixed-effects 2SLS/IV (Table 4A) is positive and significant. This conforms with the findings in almost all previous research looking at the determinants of banking performance that have included some measure of capital as a possible determinant. Orthodox reasoning suggests however that holding

[9] However, Hayashi (2000) points out that the GMM estimator may have poor small sample properties since obtaining reasonable estimates of fourth moments to form the optimal weighting matrix requires relatively large sample sizes. In this paper, we have a sufficiently large data set for this not to be a problem.

more capital should reduce profitability. Recall that Berger (1995b) suggested that this positive relationship could be the result of either a reduction in insurance and/or borrowing costs for banks with higher levels of capital or the result of some kind of signalling equilibrium where it is easier for managers of less risky banks to signal quality by maintaining high levels of capital than managers of riskier banks. This reasoning seems plausible and has been widely accepted in the literature that followed Berger's (1995b) contribution.

Nevertheless, when GMM is used to estimate the system *we find no statistically significant relationship between CAR and profitability in either levels or first differences* (Table 4B). It therefore appears that the finding of a systematic relationship between capital and profit is not robust to more rigorous estimation techniques. This finding is in stark contrast with the existing literature, but is consistent with the view that while holding more capital is costly according to orthodoxy, it also yields compensating advantages - as suggested by Berger (1995b) - that generally offset the costs. Consequently, if one believes that profit maximisation is the ultimate goal of banks then we would not expect any systematic relationship between capital and profitability. Rather, the amount of capital that banks choose is endogenously determined within the profit maximising equilibrium. An important point to note is that this story can only be true if capital adequacy regulations are non-binding. Of course, if capital adequacy requirements force banks to hold more capital than what is optimal then we would expect a negative relationship. Looking at the capital ratios of banks in this sample over the period in question suggests that banks choose to hold levels of capital well above what is required by regulatory authorities. Table 2 shows that the average CAR for the sample of banks over the period of this study was 14.2 percent, well above the nominal 8 percent requirement outlined in the Basel Accord. Moreover, Ngo (2006), Bernauer and Koubi (2002) and Flannery and Rangan (2004) provide further evidence that capital requirements are non-binding for U.S. banks.

Now turning to the other explanatory variables, the coefficient on lagged profitability is positive and statistically significant at the one percent level of significance for all eight regressions. This suggests that profits of U.S. banks tend to persist some what, which is supported by the findings of other studies (for example, Berger *et al.*, 2000) on the U.S. banking sector. This is in contrast to studies of European banks (for example, Goddard *et al.*, 2004a & 2004b) that have found the persistence of profit in banking to be weak.

The impact of size on bank profitability appears to be relatively weak. With the exception of the differenced GMM regression where ROE is used as the dependent variable, the coefficient on the size explanator is statistically insignificant for all the regressions performed. Similar findings have been found in recent studies by Athanasoglou *et al.* (2005) and Goddard *et al.* (2004a & 2004b).

The coefficient on the operating expenses variable, OE, is an interesting result. For all eight regressions, the coefficient on OE is positive and statistically significant at the one percent level of significance. Although this result goes against what one would expect the impact of higher costs on profitability to be, this paper is not the first to find this counter intuitive result (see Bourke, 1989 and Molyneux and Thornton,1992). Molyneux and Thornton (1992) suggest that this finding could be the result of profits being appropriated in the form of payroll expenditures by firms in a regulated industry. Alternatively, higher expenses could be due to the hiring of higher quality management which ultimately leads to higher profits.[10]

We used the ratio of OBS business to the sum of OBS business and total assets as our crude measure of diversification. The pooled least squares IV as well as the GMM in levels regressions where ROE is the dependent variable produced negative coefficients significant at the one percent level. However, all other regressions failed to find any systematic relationship between OBS activity and profitability. This evidence is weak at best - given the insignificant results obtained from most of the GMM regressions - and the lack of consistency in the results makes it difficult to draw any strong conclusions. Goddard *et al.* (2004a & 2004b) find similar mixed results in their recent work.

As expected, we find a systematic negative relationship between credit risk and profitability. An increase in credit risk - or reduction in asset quality - will tend to lead to greater proportion of non-performing loans and thus reduced profits. The proxy used for credit risk was the ratio of loan loss provisions to total loans, thus a negative relationship might also indicate an overly risk averse strategy by management in response to low quality assets - that is, management may hold more idle capital to provision for non-performing loans than what is optimal.

Macroeconomic performance appears to be a significant determinant of bank profitability. All regression results show a negative and significant coefficient on CPI, this is in contrast to the empirical findings of Bourke (1989), Molyneux and Thornton (1992) and Athanasoglou *et al.* (2005) who find a positive relationship. Whether inflation affects profitability positively or negatively depends on whether wages and other non-interest cost are growing faster than inflation. If inflation is not fully anticipated and banks cannot appropriately adjust their rates so that their revenues increase faster than

[10] The regressions were re-run with OE disagregated into interest expenses and non-interest expenses (e.g. wages, furniture etc.). The results of these regressions were similar to those obtained in the original estimation and did not provide any further insight so are consequently not reported.

operating costs, it would be possible that higher inflation leads to lower profits. As for GDP, apart from differenced GMM and fixed-effects estimation with ROA as the dependent variable where no significant relationship was found, economic growth seems to be positively related to profitability. This result is not surprising since one would expect growth to drive demand and hence profits.

We find a strong positive and statistically significant relationship between concentration, measured by the HHI, and profit. This finding is supported by most of the previous work, although Berger (1995a) does find that concentration is usually negatively related to profit once other variables are controlled for and concludes that the profit-concentration relationship is a spurious one created by correlations with other variables. This paper makes no attempt at trying to determine which of the SCP or the ES hypotheses is driving this positive relationship. Finally, there is little evidence of any systematic impact on profitability of a bank's choice of charter. That is, choosing a federal charter over a state charter seems to be irrelevant to profitability.

5.2 Capital Ratio Regressions

Although the focus of the paper was the profit equation, we briefly outline the results from the capital equation. Tables 5A and 5B present the detailed results for the capital ratio equation. Here, profitability (ROE or ROA) is modelled as an endogenous variable. The pooled and fixed-effects IV results show a positive and significant relationship between profit and the capital ratio. This is not surprising since one would expect banks to naturally hold some proportion of increased profits as capital (Berger, 1995b). Notwithstanding this, once more robust techniques are employed no systematic relationship is found between profitability and CAR.

As expected, the coefficient on lagged CAR is statistically significant and positive for all regressions except for the differenced GMM estimation. The coefficient on STOCK is negative and significant for all regressions apart from the differenced GMM. This provides us with some weak evidence that instead of increasing capital in a bullish market, banks will tend to reduce official capital levels in response to an increase in their hidden reserves.

Most of the regressions find a positive and significant relationship between size and the capital ratio. Thus it appears to some extent that as banks get larger they tend to hold more capital, possibly because it may be cheaper for larger banks to raise capital, all else equal. Nevertheless, the coefficient on S-SIZE is negative and statistically significant for all regressions which could possibly indicate that, although banks will hold more capital as they grow, the trend will start to reverse when banks become very large. One explanation for this may be that under a regulatory system that requires banks to meet certain capital requirements, an increase in capital is an important prerequisite for the expansion of a bank's portfolio of risky assets. However, once banks become so large that they fall into the 'too-big-to-fail' category they may receive regulatory concessions or at least an implicit guarantee of a bailout when needed which will induce them to become less prudent and hold less capital relative to their asset base.

Credit risk and OBS activity do not seem to impact on the capital decision. There is weak evidence of a positive association between inflation and capital, although the evidence is far from convincing. There is no evidence that growth in GDP influences the level of capital, although some authors suggest that capital accumulation may be procyclical, that is, more likely to occur during boom periods (Bikker and Hu, 2002). Finally, the coefficient on the charter dummy indicates that whether a bank charters with the federal or state authority does not impact on their capital decision.

6 Conclusion

This study set out to investigate in detail the relationship between capital and profitability in banking. Capital and its adequacy has been at the forefront of the regulatory debate for decades, yet we seem to be no closer to understanding what impact capital requirements have on banking performance. Banks are always opposed to stricter requirements suggesting that holding additional capital is costly and therefore hinders profitability, yet continue to maintain capital levels well above those officially required by the authorities. As with any economic activity, increasing capital comes at a cost but also provides additional benefits that are fully compensating. Thus given that capital requirements are not binding, we argue that a bank's capital ratio is endogenously determined within a profit maximisation process.

The results from the study yield unequivocal evidence for endogeneity of capital ratio. Contrary to what has been reported with surprising frequency in the past, we find no systematic relationship between capital and profitability in banking. It follows that the coefficients of single equation models of bank profitability that included capital as a determinant are biased.

The findings support the view that the market succeeds in bringing forth capital ratios that are approximately appropriate for various banks. These capital ratios differ across banks because of the differing circumstances facing banks. Indeed, if these varying capital ratios were outcomes of perfectly competitive markets, they would eliminate any systematic relation between capital and performance. While no claims are made that the market in which capital structures are formed is perfect, this evidence suggests that it is not so imperfect as to create a systematic relationship that is left unchanged by investors who seek to maximise the returns that they earn.

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Table 1 Definitions of Variables Used in the Study

	Definition
Endogenous Variables	
ROE_{it}	return on equity, defined as the ratio of net profit to total equity [net profit/total equity].
ROA_{it}	return on assets, defined as the ratio of net profit to total assets [net profit/total assets].
CAR_{it}	capital assets ratio, defined as the ratio of capital to total risk weighted assets [(tier 1 capital + tier 2 capital)/total risk weighted assets].
Control Variables	
ROE_{it-1}	ROE lagged one quarter
ROA_{it-1}	ROA lagged one quarter
CAR_{it-1}	CAR lagged one quarter
$SIZE_{it}$	proxy for size, defined as the natural logarithm of total assets [ln(total assets)].
$S-SIZE_{it}$	square of the natural logarithm of total assets [$\{\ln(\text{total assets})\}^2$]
OE_{it}	ratio of operating expenses to total assets [operating expenses/total assets].
DIV_{it}	proxy for diversification, defined as the ratio of off-balance-sheet (OBS) business to the sum of total assets and OBS business [OBS/(OBS + total assets)].
CR_t	proxy for credit risk, defined as the ratio of loan loss provisions to total loans [loan loss provisions/total loans].
GDP_t	quarterly growth in real gross domestic product
CPI_t	quarterly growth in consumer price index
HHI_t	Herfindahl-Hirschman Index for market concentration
$STOCK_t$	Dow Jones Wilshire 5000 (full-cap) index in levels
Charter Dummy	variable indicating charter authority, 1 = federal, 0 = state, n.a.
Time Dummies	set of 9 dummies, one for each year except 1996
State Dummies	set of 53 dummies, one for each state except New York

Table 2 Summary Statistics

This table presents the summary statistics for the variables used in the study. The notation used in the following table is defined as follows: ROE is the ratio of net profit to total equity; ROA is the ratio of net profit to total assets; CAR ratio of capital to total risk weighted assets [(tier 1 capital + tier 2 capital)/total risk-weighted assets]; SIZE is the natural logarithm of total assets; S-SIZE is the square of the natural logarithm of total assets; OE is ratio of operating expenses to total assets; DIV is the ratio of off-balance-sheet (OBS) business to the sum of total assets and OBS business [OBS/(OBS + total assets)]; CR is ratio of loan loss provisions to total loans; GDP is the quarterly growth in real gross domestic product; CPI is the quarterly growth in consumer price index; HHI is the Herfindahl-Hirschman Index for market concentration; and STOCK is the Dow Jones Wilshire 5000 (full-cap) index in levels.

Variables	*Observations*	*Arithmetic Mean*	*Standard Deviation*
ROE	62433	0.0706	0.1596
ROA	62433	0.0070	0.0204
CAR	62433	0.1420	0.1669
GDP	62433	3.5095	2.0721
CPI	62433	0.6273	0.5685
$STOCK$	62433	10031.78	2181.09
HHI	62433	0.0140	0.0044
$SIZE$	62433	13.4388	1.8358
OE	62433	0.0345	0.1011
DIV	62433	0.0371	0.1548
CR	62433	0.0137	0.3359

Table 3 Tests of Endogeneity

The table presents the results of tests of endogeneity of CAR in the ROE/ROA equation (equation 1) as well as the results of tests of endogeneity of ROE/ROA in the CAR equation (equation 2). The notation used in the following table is defined as follows: ROE is the ratio of net profit to total equity; ROA is the ratio of net profit to total assets; CAR ratio of capital to total risk weighted assets [(tier 1 capital + tier 2 capital)/total risk-weighted assets].

	Pooled IV		Fixed Effects IV	
Profit Equation (H0: CAR_{it} is exogenous)				
Dependent Variable	ROE_{it}	ROA_{it}	ROE_{it}	ROA_{it}
W-H F test	198.85386***	571.68055***	-	-
D-W-H χ^2 test	198.44373***	566.98143***	-	-
D-M F test	-	-	140.3064***	398.6949***
Capital-to-Asset Ratio Equation (H0: ROE_{it}/ROA_{it} is exogenous)				
Endogenous regressor	ROE_{it}	ROA_{it}	ROE_{it}	ROA_{it}
W-H F test	835.59277***	22.03150***	-	-
D-W-H χ^2 test	825.10693***	22.05062***	-	-
D-M F test	-	-	899.6859***	21.36332***

Notes: 1) */**/*** indicate test statistic is statistically significant (reject H0) at the 10/5/1 percent level of significance respectively. 2) W-H is Wu-Hausman, D-W-H is Durbin-Wu-Hausman, D-M is Davidson-MacKinnon.

Table 4A Least Squares Profitability Regressions

The table presents the regression results for the profitability equation (equation 1) using ROE as well as ROA as a measure of profitability. CAR is modelled endogenously in all regressions and results are included for pooled two-stage-least squares/instrumental variables (2SLS/IV) and fixed-effects 2SLS/IV model fits. The notation used in the following table is defined as follows: ROE is the ratio of net profit to total equity; ROA is the ratio of net profit to total assets; CAR ratio of capital to total risk weighted assets [(tier 1 capital + tier 2 capital)/total risk-weighted assets]; SIZE is the natural logarithm of total assets; S-SIZE is the square of the natural logarithm of total assets; OE is ratio of operating expenses to total assets; DIV is the ratio of off-balance-sheet (OBS) business to the sum of total assets and OBS business [OBS/(OBS + total assets)]; CR is ratio of loan loss provisions to total loans; GDP is the quarterly growth in real gross domestic product; CPI is the quarterly growth in consumer price index; HHI is the Herfindahl-Hirschman Index for market concentration; and STOCK is the Dow Jones Wilshire 5000 (full-cap) index in levels.

	Pooled IV		Fixed Effects IV	
Dependent Variable	ROE_{it}	ROA_{it}	ROE_{it}	ROA_{it}
CAR_{it}	0.167332***	0.0004673***	-0.0044509	0.0045426***
	(3.90)	(15.13)	(-0.54)	(5.08)
ROE_{it-1}	0.1608379***	-	0.0230811***	-
	(40.35)	-	(5.63)	-
ROA_{it-1}	-	0.3007003***	-	0.1993725***
	-	(70.10)	-	(43.51)
$SIZE_{it}$	0.0012539	-0.0001042	-0.0015185	-0.000317
	(0.244)	(-0.90)	(-0.70)	(-1.35)
$S-SIZE_{it}$	0.0001743***	0.0000109**	0.0000964	0.0000168
	(3.56)	(2.07)	(0.75)	(1.21)
OE_{it}	0.363626***	0.0970049***	0.4413421***	0.1121677***
	(56.99)	(139.79)	(61.08)	(143.39)
DIV_{it}	-0.0405613***	-0.0006533	-0.0033876	0.0003606
	(-8.15)	(-1.22)	(-0.31)	(0.31)
CR_{it}	-0.0518403***	-0.0073937***	-0.0887422***	-0.0078234***
	(-2.79)	(-3.71)	(-4.49)	(-3.64)
GDP_t	0.0013299***	0.0000928**	0.0007048*	0.0000394
	(3.26)	(2.12)	(1.81)	(0.93)
CPI_t	-0.0250927***	-0.0023131***	-0.02221675***	-0.0019684***
	(-18.37)	(-15.94)	(-17.17)	(-14.04)
HHI_t	13.28217***	0.7562759***	12.97762***	0.6457112***
	(18.37)	(9.75)	(18.77)	(8.60)
Charter Dummy	0.0032151**	0.0002758*	-0.0049293	-0.0001024
	(2.26)	(1.80)	(-0.73)	(-0.14)
Constant	-0.1165415***	-0.0057637***	-0.032712	-0.0046088*
	(-11.94)	(-5.50)	(-1.52)	(-1.82)
F stat	137.62***	534.43***	-	-
Wald χ^2 stat	-	-	21401.55***	40236.32***
R^2	0.1431	0.3973	-	-
Adjusted R^2	0.1420	0.3965	-	-
R^2 within	-	-	0.0976	0.3263
R^2 between	-	-	0.0318	0.1678
R^2 overall	-	-	0.0701	0.2479

Notes: 1) */**/*** indicate coefficient (or test statistic) is statistically significant at the 10/5/1 percent level of significance respectively. 2) Figures in the parentheses are t statistics.

Table 4B GMM Profitability Regressions

The table presents the regression results for the profitability equation (equation 1) using ROE as well as ROA as a measure of profitability. CAR is modelled endogenously in all regressions and results are included for general methods of moments (GMM) instrumental variables (IV) and differenced GMM (dynamic panel estimation) model fits. The notation used in the following table is defined as follows: ROE is the ratio of net profit to total equity; ROA is the ratio of net profit to total assets; CAR ratio of capital to total risk weighted assets [(tier 1 capital + tier 2 capital)/total risk-weighted assets]; SIZE is the natural logarithm of total assets; S-SIZE is the square of the natural logarithm of total assets; OE is ratio of operating expenses to total assets; DIV is the ratio of off-balance-sheet (OBS) business to the sum of total assets and OBS business [OBS/(OBS + total assets)]; CR is ratio of loan loss provisions to total loans; GDP is the quarterly growth in real gross domestic product; CPI is the quarterly growth in consumer price index; HHI is the Herfindahl-Hirschman Index for market concentration; and STOCK is the Dow Jones Wilshire 5000 (full-cap) index in levels.

	GMM		Differenced GMM	
Dependent Variable	ROE_{it}	ROA_{it}	ROE_{it}	ROA_{it}
CAR_{it}	0.006067	0.005816	-0.817483	0.0826427
	(0.30)	(1.52)	(-1.42)	(0.79)
ROE_{it-1}	0.30047***	-	0.2569367***	-
	(3.72)	-	(2.97)	-
ROA_{it-1}	-	0.3673068***	-	0.2617313***
	-	(4.22)	-	(3.51)
$SIZE_{it}$	0.0007217	-0.0000584	0.1010606***	0.0000186
	(0.87)	(-0.38)	(3.90)	(0.00)
$S-SIZE_{it}$	0.0001965***	0.00000828	-0.0073926***	-0.0000423
	(4.52)	(1.58)	(-4.01)	(-0.12)
OE_{it}	0.3595672***	0.0887353***	0.4327365***	0.14248***
	(3.96)	(3.20)	(4.49)	(4.77)
DIV_{it}	-0.0390136***	-0.0006268	0.0268154	0.0039642
	(-6.90)	(-1.15)	(1.06)	(0.88)
CR_{it}	-0.1561336***	-0.008296**	-0.2293659***	-0.0184459***
	(-4.35)	(-2.04)	(-8.38)	(-8.85)
GDP_t	0.0025464***	0.0001362**	0.0023046***	0.0000722
	(6.33)	(2.52)	(3.86)	(1.01)
CPI_t	-0.0259188***	-0.0024591***	-0.0131555***	-0.0010959***
	(-10.28)	(-7.39)	(-6.92)	(-4.41)
HHI_t	12.41451***	0.8122025***	5.321411***	-0.0412907
	(21.03)	(3.27)	(6.61)	(-0.29)
Charter Dummy	-0.0021414	0.0002616	0.717953	-0.0071856
	(-1.53)	(1.32)	(1.28)	(-.071)
Constant	-0.109891***	-0.0062032**	0.0130622***	0.0005903**
	(-14.23)	(-2.48)	(11.15)	(2.55)
R^2 centered	0.1231	0.3933	-0.2502[a]	0.1604
R^2 uncentered	0.2677	0.4577	-0.2502[a]	0.1604
Hansen J stat	6.507***	0.740	43.195***	0.896

Notes: 1) */**/*** indicate coefficient (or test statistic) is statistically significant at the 10/5/1 percent level of significance respectively. 2) Figures in the parentheses are t statistics. a) We report the R-squared for completeness however it really has no statistical meaning in the context of IV. For instrumental variables estimation, some of the regressors enter the model as instruments when the parameters are estimated. However, since our goal is to estimate the structural model, the actual values, not the instruments for the endogenous right-hand-side variables, are used to determine the model sum of squares (MSS). The model's residuals are computed over a set of regressors different from those used to fit the model. This means a constant-only model of the dependent variable is not nested within the IV model, even though the IV model estimates an intercept, and the residual sum of squares (RSS) is no longer constrained to be smaller than the total sum of squares (TSS). When RSS exceeds TSS, the MSS and the R-square will be negative.

Table 5A Least Squares Capital-to-Asset Ratio Regressions

The table presents the regression results for the capital ratio equation (equation 2). CAR is the dependent variable and profit (ROE or ROA) is modelled endogenously in all regressions. Results are included for pooled two-stage-least squares/instrumental variables (2SLS/IV) and fixed-effects 2SLS/IV model fits. The notation used in the following table is defined as follows: ROE is the ratio of net profit to total equity; ROA is the ratio of net profit to total assets; CAR ratio of capital to total risk weighted assets [(tier 1 capital + tier 2 capital)/total risk-weighted assets]; SIZE is the natural logarithm of total assets; S-SIZE is the square of the natural logarithm of total assets; OE is ratio of operating expenses to total assets; DIV is the ratio of off-balance-sheet (OBS) business to the sum of total assets and OBS business [OBS/(OBS + total assets)]; CR is ratio of loan loss provisions to total loans; GDP is the quarterly growth in real gross domestic product; CPI is the quarterly growth in consumer price index; HHI is the Herfindahl-Hirschman Index for market concentration; and STOCK is the Dow Jones Wilshire 5000 (full-cap) index in levels.

	Pooled IV		Fixed Effects IV	
Dependent Variable CAR_{it}				
Endogenous Regressor	ROE_{it}	ROA_{it}	ROE_{it}	ROA_{it}
ROE_{it}	0.1472165***	-	0.1814434***	-
	(24.23)	-	(24.07)	-
ROA_{it}	-	0.7117435***	-	0.7039691***
	-	(30.47)	-	(26.58)
CAR_{it-1}	0.9463259***	0.9385124***	0.7934596***	0.7891522***
	(479.08)	(499.778)	(239.2)	(262.60)
$STOCK_t$	-0.00000189***	-0.00000129***	-0.00000208***	-0.00000119***
	(-4.48)	(-3.33)	(-4.89)	(-3.13)
$SIZE_{it}$	0.0013371***	0.00157***	0.0112309***	0.0108315***
	(2.56)	(3.25)	(10.28)	(10.97)
$S-SIZE_{it}$	-0.0001563***	-0.0001305***	-0.0008576***	-0.0008267***
	(-6.59)	(-5.94)	(-13.27)	(-14.15)
CR_{it}	0.0456534***	0.043331***	0.0013858	-0.0109883
	(5.08)	(5.20)	(0.14)	(-1.21)
DIV_{it}	0.0099722***	0.0034049	0.0095234*	0.0080505
	(4.11)	(1.52)	(1.73)	(1.62)
GDP_t	0.0002609	0.0003191*	0.0002105	0.0002784
	(1.26)	(1.66)	(1.02)	(1.49)
CPI_t	0.0059894***	0.0034019***	0.0068473***	0.0029632***
	(9.15)	(5.90)	(10.11)	(5.23)
Charter Dummy	0.0008609	0.0007905	0.015653***	0.0146717***
	(1.25)	(1.24)	(4.59)	(4.76)
Constant	0.0181871***	0.0125039***	0.005657	0.155417
	(4.00)	(2.98)	(0.47)	(1.46)
F stat	3718.93***	4342.21***	-	-
Wald χ^2 stat	-	-	28892276***	354487.56***
R^2	0.8131	0.8398	-	-
Adjusted R^2	0.8128	0.8396	-	-
R^2 within	-	-	0.4734	0.5708
R^2 between	-	-	0.8028	0.8448
R^2 overall	-	-	0.6597	0.7216

Notes: 1) */**/*** indicate coefficient (or test statistic) is statistically significant at the 10/5/1 percent level of significance respectively. 2) Figures in the parentheses are t statistics.

Table 5B GMM Capital-to-Asset Ratio Regressions

The table presents the regression results for the capital ratio equation (equation 2). CAR is the dependent variable and profit (ROE or ROA) is modelled endogenously in all regressions. Results are included for general methods of moments (GMM) instrumental variables (IV) and differenced GMM (dynamic panel estimation) model fits. The notation used in the following table is defined as follows: ROE is the ratio of net profit to total equity; ROA is the ratio of net profit to total assets; CAR ratio of capital to total risk weighted assets [(tier 1 capital + tier 2 capital)/total risk-weighted assets]; SIZE is the natural logarithm of total assets; S-SIZE is the square of the natural logarithm of total assets; OE is ratio of operating expenses to total assets; DIV is the ratio of off-balance-sheet (OBS) business to the sum of total assets and OBS business [OBS/(OBS + total assets)]; CR is ratio of loan loss provisions to total loans; GDP is the quarterly growth in real gross domestic product; CPI is the quarterly growth in consumer price index; HHI is the Herfindahl-Hirschman Index for market concentration; and STOCK is the Dow Jones Wilshire 5000 (full-cap) index in levels.

	GMM		Differenced GMM	
Dependent Variable CAR_{it}				
Endogenous Regressor	ROE_{it}	ROA_{it}	ROE_{it}	ROA_{it}
ROE_{it}	0.0135359	-	0.0351384	-
	(0.67)	-	(0.21)	-
ROA_{it}	-	0.2454821	-	0.6065652
	-	(1.35)	-	(0.56)
CAR_{it-1}	0.9657093***	0.9595668***	1.200149	0.1977729
	(18.73)	(18.90)	(0.68)	(0.13)
$STOCK_t$	-0.00000103**	-0.00000115***	-0.00000091	-0.00000044
	(-2.34)	(-3.16)	(-0.72)	(-0.44)
$SIZE_{it}$	0.0015025	0.0015273	0.0448577***	0.0480063***
	(1.10)	(1.20)	(2.59)	(2.59)
$S-SIZE_{it}$	-0.0001188*	-0.0001196*	-0.0031615***	-0.0033986***
	(-1.68)	(-1.84)	(-3.03)	(-2.90)
CR_{it}	0.0373669	0.0383816	-0.0066156	0.0054711
	(0.77)	(0.83)	(-0.31)	(0.20)
DIV_{it}	0.0029742	0.0027976	-0.0477104	-0.0435088
	(0.90)	(0.91)	(-0.46)	(-0.35)
GDP_t	0.0003655*	0.000374**	0.0003529	0.0001188
	(1.79)	(2.01)	(0.80)	(0.21)
CPI_t	0.0014235	0.0018964**	0.0010032	0.0012205
	(1.46)	(2.15)	(0.42)	(0.53)
Charter Dummy	0.001488	0.0012939*	0.0481087	0.0752216
	(1.62)	(1.79)	(1.06)	(1.56)
Constant	0.0100408*	0.0106457***	-0.0002572	-0.0002518
	(2.37)	(2.82)	(-0.06)	(-0.10)
R^2 centered	0.83339	0.8378	-1.1333[a]	-0.033[a]
R^2 uncentered	0.9028	0.9051	-1.1333[a]	-0.0329[a]
Hansen J stat	2.519	4.039	5.883***	1.925

Notes: 1) */**/*** indicate coefficient (or test statistic) is statistically significant at the 10/5/1 percent level of significance respectively. 2) Figures in the parentheses are t statistics. a) We report the R-squared for completeness however it really has no statistical meaning in the context of IV. For instrumental variables estimation, some of the regressors enter the model as instruments when the parameters are estimated. However, since our goal is to estimate the structural model, the actual values, not the instruments for the endogenous right-hand-side variables, are used to determine the model sum of squares (MSS). The model's residuals are computed over a set of regressors different from those used to fit the model. This means a constant-only model of the dependent variable is not nested within the IV model, even though the IV model estimates an intercept, and the residual sum of squares (RSS) is no longer constrained to be smaller than the total sum of squares (TSS). When RSS exceeds TSS, the MSS and the R-square will be negative.