

What determines how much capital is held by UK banks and building societies?

Isaac Alfón
Isabel Argimon
Patricia Bascuñana-Ambrós

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Authors wishing to contribute to this series should contact Kari Hale or Andrew Sykes at:

The Financial Services Authority
25 The North Colonnade
Canary Wharf
London
E14 5HS

Telephone:(0)20 7066 1552

e-mail: kari.hale@fsa.gov.uk andrew.sykes@fsa.gov.uk

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ISAAC ALFON

ISABEL ARGIMON

PATRICIA BASCUÑANA-AMBRÓS

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Biographical note

Isaac Alfon, Isabel Argimon and Patricia Bascuñana-Ambrós are economists in the Economics of Financial Regulation team within the Finance, Strategy and Risk Division of the Financial Services Authority.

Abstract

In this paper we review hypotheses about how decisions on capital are taken and how they affect the ‘buffer’ between actual capital and the regulatory requirement. The hypotheses come from the literature and from discussion with policy makers, supervisors and practitioners. We argue that the amount of capital held by banks and building societies depends on risk management, market discipline and regulatory environment. Using both quantitative and qualitative approaches, we provide evidence on which hypotheses hold in the UK. We find that regulatory requirements affect the amount of capital held by banks and by building societies.

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1 Introduction

Most UK banks and building societies¹ hold considerably more capital than required by the regulator. This might lead one to assume that changes in capital requirements do not affect the amount of capital held by firms, as the changes will be fully absorbed by this excess or buffer.

However, the amount of capital held by firms is influenced by many different factors, not just regulatory requirements. The risk preferences of managers, shareholders and bondholders are also important in determining how much capital is held. In particular, it could be argued that the 8% requirement under the current Basel Accord is meant to act as a floor below which there is significant risk to consumers and, in some cases, to market confidence. Actual capital, on the other hand, should be determined by shareholders' preferences, which reflect their desire to be properly compensated in the form of risk adjusted investment returns and by wholesale depositors influence.

In practice, therefore, management need to weigh up different factors: the level of capital that the market demands for the risks taken (especially the level demanded by rating agencies to assign a given rating); the level of capital that shareholders think is appropriate; the regulatory minimum; and managers' own views and preferences on risk management. So regulatory requirements need not be decisive in determining capital holdings.

This does, however, prompt the questions of what impact capital requirements have, given that the actual level of capital held by the firm is often significantly above the regulatory level, and how firms respond to changes in regulatory capital. Clearly, we cannot observe firms holding less capital than required. We also cannot assume that, just because firms currently hold significantly more than the regulatory minimum, they will be unaffected by changes in the minimum. A better understanding of why firms hold excess capital will help in assessing the likely impact of changing capital requirements.

This paper analyses the factors that may affect the level of capital held by banks and building societies. We devote special attention to the role played by regulatory capital requirements. We review various hypotheses that explain firms' tendency to hold more

1 A building society is a mutual organisation whose main activity is mortgage lending for house purchase, financed mainly but not exclusively by taking deposits from retail customers.

capital than required. We also present the results of our quantitative and qualitative analysis to assess which hypotheses hold in the UK. The quantitative analysis uses data from regulatory capital returns from banks and building societies. The qualitative analysis was carried out through a questionnaire and interviews with market players.

Section 2 of the paper presents some information about individual capital requirements set by the FSA and about firms' desired and actual capital ratios over recent years.

Sections 3 to 6 summarise our main findings about the determinants of the amount of firms' capital. In particular, Section 3 outlines our framework for analysing the determinants of capital holdings by UK banks and building societies. Section 4 analyses the factors that are internal to firms, including their attitude to risk, their long-term strategy and the existence of adjustment costs. For each hypothesis we present the findings of our quantitative and qualitative analysis of how the various factors help determine the amount of capital held.

Section 5 reviews competition, the disciplinary effect of uninsured funding and how market discipline influences firms' decisions on capital.

Section 6 discusses how the prudential regulatory framework can affect the amount of capital that banks and building societies hold. The role of capital requirements and of supervisory behaviour are analysed here. The section ends with our empirical results about how firms respond to regulation. Section 7 presents our conclusions.

The paper ends with three annexes. Annex 1 summarises the hypotheses that we have explored as potential explanations of what determines the amount of capital that firms hold. For each hypothesis, we show the effect of changing the regulatory requirements. The charts in Annex 2 show the responses to the questionnaire sent to firms. And Annex 3 details the econometric results from a model that relates actual capital to its possible determinants.

2 Capital requirements and capital holdings: overview

Regulatory capital for UK banks and building societies

The FSA inherited from the Bank of England the practice of setting two separate capital requirements for each bank: a 'trigger ratio', which was the minimum individual capital ratio; and a 'target ratio' set above the trigger. The 'target ratio' was to act as a warning light and as a cushion of capital to help prevent an accidental breach of the individual capital requirement. For building societies, the Building Societies Commission set 'threshold ratios' that corresponded to banks' trigger ratios.

Following the Financial Services and Markets Act, which came into force in 2001, the FSA discontinued the practice of setting a target ratio for banks (FSA (2001)). The decision was accompanied by a review of all UK banks' individual capital requirements to make them consistent with the new framework. A similar review took place for building societies.

Some broad characteristics define the functioning of the UK regulatory system for banks and building societies during the whole period of analysis. The first one is that individual capital requirements are set at firm-specific level. The second one is that the FSA may at any time vary a firm's requirement. Finally, the FSA has declared that it "will consider it to be good management practice in the financial services industry for a UK bank to hold an appropriate capital buffer above the individual capital ratio advised by the FSA" (FSA (2001)).

For most banks and building societies, individual capital requirements exceed the Basel minimum of 8%. The "FSA considers that the basic 8% regulatory minimum capital requirement is only appropriate for a well-diversified firm whose business, management, systems and controls are strong and where the risks that it is exposed to are captured adequately by the existing capital model" (FSA(2001)). In fact, the Basel Committee of Banking Supervision recognised as weaknesses of the current system

its poor risk sensitivity, its difficulty in covering all risks and its inability in providing the right incentives for good risk management practices (BCBS (1999)).² These views are shared by many analysts (see, for example, Milne (2001) and Oliver, Wyman & Company (2001)).

Banks and building societies also accumulate provisions against loan default. These provisions protect against expected losses and are likely to vary over time.³ Provisions are therefore different from capital, which should be a buffer against unexpected losses. Other differences between capital and provisions are that: general provisions are classified as Tier 2 capital (i.e. regulatory capital) subject to a maximum; and the accumulation of capital (i.e. retained earnings) and provisions attract different tax treatments. Thus decisions about provisions and capital are unlikely to be independent.⁴ In this paper, we explore how capital requirements affect actual capital and we therefore focus on the difference between actual capital and regulatory capital.

Information sources and method

Our empirical analysis has used both a quantitative and a qualitative approach. Quantitative evidence on the main determinants of capital comes from data in banks' regulatory capital returns from September 1998 to September 2002 and in building societies' returns from the second quarter of 1997 to the second quarter of 2002.⁵ Our quantitative analysis is derived from the econometric estimation of an equation that

2 It also acknowledged that it mostly deals with credit and market risk: "While the original Accord focused mainly on credit risk, it has since been amended to address market risk. Interest rate risk in the banking book and other risks, such as operational, liquidity, legal and reputational risks, are not explicitly addressed. Implicitly, however, the present Accord takes account of such risks by setting a minimum ratio that has an acknowledged buffer to cover unquantified risks" (BCBS (1999)).

3 See Pain (2003) for a survey of the provisioning experience of UK banks and a review of factors that might help explain increases in provisions.

4 For example, Laeven and Majnoni (2002) explore the relationship between capital and provisions and find that banks tend to delay provisioning for bad loans, thereby possibly magnifying the economic cycle's impact on capital.

5 The frequency of reporting is quarterly for solo banks, but different banks have different reporting dates within the quarter. (We use the term "solo banks" as shorthand for "banks that submit unconsolidated returns".) For the building societies the dataset is a balanced panel (i.e. it contains the same firms throughout the period), so demutualisation does not affect the results. Initial work carried out with data from consolidated returns seems to show that banking groups respond differently from solo entities and building societies to some of the determinants of capital holdings.

expresses firms' capital ratios in terms of various possible determinants. Details of the dataset, method and results are in Annex 3.

We complement the quantitative analysis by qualitative analysis that uses the results of a small survey, carried out between June and November 2003 as a face to face discussion with eight banks and five building societies⁶ and with equity analysts and rating firms. The survey was based on a short questionnaire⁷, the responses to which are summarised graphically in Annex 2.

What the regulatory returns show

Unconsolidated (solo) entities, even within a bank group, are set individual capital requirements and submit quarterly returns.

Table 1 shows that, if weighted by total assets, the average capital ratios for banks are nearly 50% above the average individual capital requirements set by the FSA. This rises to over 85% for banks without trading book activity. On the other hand, building societies hold an average of just over 31% more than individually required in weighted terms. Building societies' average weighted buffer (i.e. capital minus individual capital required, as a percentage of individual capital required) is below that for banks, even for banks of similar size (not shown in the table). The weighted averages for actual capital ratios and percentage buffers are much lower than the unweighted averages, indicating that larger firms tend to have lower capital ratios and lower percentage buffers.

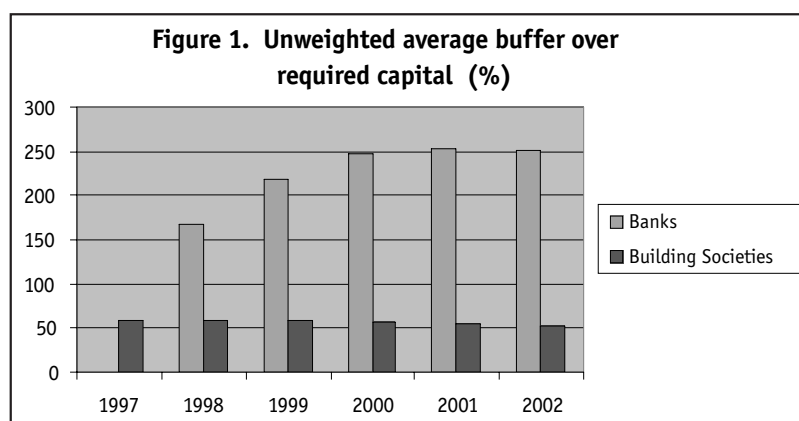
6 FSA supervisors suggested a sample of firms that would provide a reasonable coverage of the market. Those firms that agreed to take part in the survey were sent the questionnaire. They were 13 large and medium-sized firms (8 banks and 5 building societies).

7 The questionnaire asked firms various questions about how they decide their capital. We did not try to verify that firms' actions were consistent with their answers. Within a firm there may be different views about capital. Moreover, sometimes we spoke to people with a 'risk' background and sometimes to people with a 'finance' background. We have not controlled for any differences in views within each firm.

TABLE 1. Summary of data for banks (1998-2002) and building societies (1997-2002)									
		Average capital requirements	Average actual capital	Average buffer	Proportion of assets in trading book	Proportion of tier 1 capital	Average size	Number of firms	Number of observations
		% of risk weighted assets	% of risk weighted assets	% of capital requirement	% of risk weighted assets	% of total adjusted capital	£ billion of assets		
All banks	Unweighted	12.78	41.45	234.52	7.55	87.28			
	Weighted by total assets						14.54	187	2744
	Weighted by risk-weighted assets	9.42	14.16	48.06	9.83	84.78			
Banks with trading book activity	Unweighted	10.97	30.24	177.67	22.80	83.15			
	Weighted by total assets						33.74	59	909
	Weighted by risk-weighted assets	9.20	12.71	36.38	12.79	84.21			
Banks without trading book activity	Unweighted	9.24	12.49	33.82	11.23	97.04			
	Weighted by total assets								
	Weighted by risk-weighted assets	13.68	47.0	262.68	0	89.61			
Building societies	Unweighted	10.15	18.99	86.95	0	86.79	5.02	128	1835
	Weighted by total assets								
	Weighted by risk-weighted assets	10.01	14.33	39.03	0	88.88			
	Unweighted	9.65	15.16	56.92	n/a	95.45			
	Weighted by total assets						2.23	65	1365
	Weighted by risk-weighted assets	9.45	12.40	31.13	n/a	90.32			
		9.43	12.33	30.76	n/a	90.56			

In the period considered, the FSA has slightly reduced the average individual ratio for banks. The first signs of this came at the end of 2000 following the review of individual capital requirements that was undertaken before the implementation of the Financial Services and Markets Act so as to make the requirements consistent across different firms.⁸ The differences in capital ratios amongst banks have reduced in the same period. The pattern for building societies seems to be the contrary, as the dispersion has increased, especially since 2000.

As Figure 1 shows, over the period banks have increased their buffer (calculated as the percentage of excess capital over individual capital requirements). Building societies maintained theirs at a steady level. Because of the short length of the period analysed, it is difficult to assess how different factors have influenced such developments, but the economic cycle could be one of the contributory factors.



Actual capital ratios and individually required capital ratios vary more between firms than over time (see Annex 3). The dispersion is greater for actual capital ratios than for required ratios, suggesting that the market differentiates more between firms than does the regulator. Dispersion in capital ratios is much lower for building societies, suggesting that they are a more homogeneous group of firms.

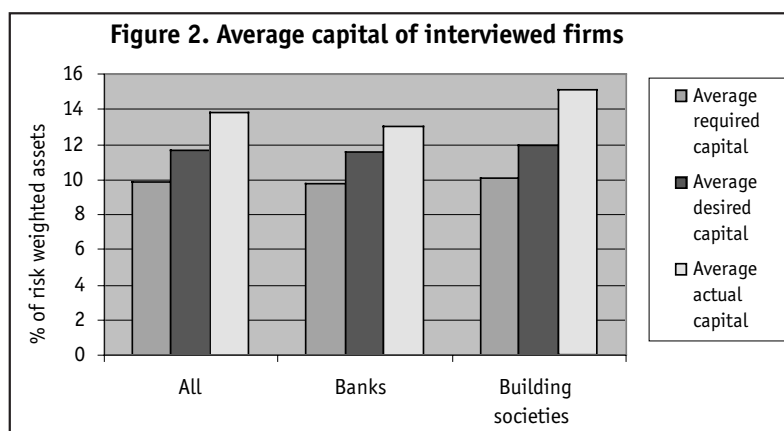
Predominantly it is large banks that report trading book activity and most of them have a non-UK parent. For those UK-owned banks that carry out trading, on average, this activity represents less of their business than for foreign-owned banks. On average, trading book activity accounts for a third of risk-weighted assets in firms with a foreign parent, compared with 16% in UK-owned banks.

8 The coefficient of variation (CV= standard error/mean) for the capital requirements for banks in 1998 was 0.59. It dropped to 0.42 at the end of 2000 and 0.27 in 2002. The CV for building societies has experienced the reverse pattern: from 0.04 in 1997 to 0.08 in 2002.

We find that the size of the financial institution, measured by total assets, seems to have a large influence on firms' actual capital ratio. In particular, small banks choose to have higher capital ratios than larger banks. Building societies seem to also show a negative relationship between size and capital held and required. The difference in actual capital ratios between large and small banks is much larger than the difference in individually required capital ratios between these same firms. So the size of the percentage buffer seems to be inversely related to the size of banks and building societies, with large firms having a smaller percentage buffer than small firms.

Information from interviews

From our interviews with banks and building societies we concluded that firms differentiate between their desired level of capital and their actual level of capital. As shown in Figure 2, as at the end of 2002 most of the interviewed firms had more capital than their desired level, which in turn was more than the individual regulatory requirement.⁹ In particular, the interviewed firms held on average 18% more capital than their declared "desired level"¹⁰ and 40% more than their individually required level.



All firms define their capital needs as a ratio in relation to the regulatory concept of risk weighted assets.¹¹ However, while all the building societies in the sample focus on

9 Figure 2 is based on firms' capital as at the end of 2002 or, if that was unavailable, as at the nearest subsequent date. Two banks responded that their actual capital tended to vary around their desired capital. This might be related to the mergers that both banks had recently experienced.

10 However, the relationship between actual and desired capital may fluctuate over the cycle.

11 This raises some issues about how firms' decisions on capital will be affected by the European application of the Basel Accord.

the capital definition used for regulatory purposes, most banks define their capital needs in relation to different forms of Tier 1.

Our discussions with firms showed that several factors may affect the type of capital on which they choose to base their capital decisions:

- Equity markets focus on Tier 1 capital.
- Because Tier 1 and Tier 2 capital have different costs, desired capital cannot be specified simply in terms of total capital.
- Regulatory requirements specify certain relationships between different types of capital. For example, the amount of Tier 2 subordinated term debt should not exceed 50% of the amount of Tier 1 capital.
- There is perceived to be a more limited supply of Tier 1 capital than Tier 2 capital.

3. DETERMINANTS OF CAPITAL HOLDINGS: OVERVIEW

After having reviewed the main features of capital ratios for UK banks and building societies, we now consider some explanations as to what determines these holdings. Currently there is little literature focusing on this issue, so we have mostly extracted the relevant implications from other lines of research. Most theoretical models assume that firms would always operate with exactly the regulatory minimum capital.¹²

Our starting point is Richardson and Stephenson (2000), who briefly discuss some possible explanations as to why banks might hold more capital than the regulator requires. They put forward some fairly high level suggestions that we now explore further.

We group the possible explanations for holding excess capital into three categories: explanations that focus on firms' internal factors; explanations based on the effect of market discipline; and explanations related to ways in which the regulator may affect the actual level of capital. There is inevitably an overlap between these

¹² See, for example, the literature reviews by Jackson et al. (1999) and Furfine (2000) on US banks' response to Basel I. The alternative is to regard capital requirements as an incentive mechanism. See Milne (2000) for a theoretical framework.

categories – for example markets may influence firms' management – and there may be additional explanations.

For each of these three types of explanation we summarise the relevant findings from our qualitative and quantitative approaches and consider whether they support or rebut the applicability of these particular explanations to the UK. The three types of explanation are dealt with in Sections 4, 5 and 6.

4. DETERMINANTS OF CAPITAL HOLDINGS: FIRMS' INTERNAL FACTORS

This section reviews the explanations for capital decisions that are directly linked to management's behaviour. They include the management's attitude towards risk, the approaches to risk management, the firm's business strategy, the opportunity cost of capital and the existence of adjustment costs. The applicability of these explanations is affected by the market in which the firm operates, but for the sake of simplicity we try to analyse them in isolation.

Risk assessment in individual firms

The level of capital set by the regulator might not take full account of the firm's risks. As stated by the Basel Committee on Banking Supervision (1999) to justify the proposal for the new Accord, "a bank's capital ratio, calculated using the current Accord, may not always be a good indicator of its financial condition". In particular it pointed at the current risk weighting of assets resulting in a crude measure of economic risk, as there is no adequate differentiation between borrowers' differing default risks.

It could also be that when firms decide on capital they take into account risks that the regulator is not concerned with, such as financial distress caused by loss of franchise value (i.e. the present value of the bank's ability to earn above-market rates of return because of, for example, the strength of its brand). For example, firms with a high franchise value may be more likely to hold capital in excess of the regulatory minimum, to limit the negative consequences of their exposure to high-risk borrowers. Demsetz et al. (1996) explore the relationship between franchise value and risk, analysing the 1986-94 period for 100 US banks with publicly traded stock. The paper finds that banks with

higher franchise value tend to hold more capital and have less risky assets than banks with lower franchise value. Although the proportions of risky loans held by banks do not vary hugely, banks with high franchise value have better-diversified loan portfolios.

Our evidence on the relevance of risk assessment for capital decisions seems to support the view that risk is a determinant of the capital ratio held by firms. In particular, three of the largest four banks in our sample said that they form their views about desired capital by assessing the risks rather than by deciding on a margin over regulatory requirements. One of the risks they consider is that of breaching the regulatory requirement. The following paragraphs provide some details on the evidence gathered.

In our quantitative approach, to test how risk affects capital ratios we have included in our equation a variable representing the risk profile of each firm. The different weights that assets receive to determine the amount of capital that needs to be held against the risk that they represent try to ensure that riskier portfolios are accompanied by higher capital. We might expect that well-managed firms hold more capital than required in relation to their risks. If so, the higher the proportion of high-risk assets in their portfolio the higher they would weigh them in order to determine the amount of capital to hold. However, theoretical models also show that an insured bank can exploit a risk-independent compensation scheme by increasing, for example, its gearing. If this effect is important, we would expect to find a negative relationship between risk and capital ratios.

In our model, we use an ex-post measure of risk as a proxy for risk appetite: the proportion of the total firm's assets that attracts a weight of 100%. This is a crude measure of risk that is also used in other papers such as Ayuso et al. (2004). We find a negative (and statistically significant) relationship between capital ratios and our measure of ex-post risk. In other words, the higher the risk appetite of a firm, the less capital it holds.¹³ This could be interpreted as evidence that firms assess risk differently from the regulator, maybe only because of the variety of assets in the category of 100% risk weighted assets.¹⁴

13 We have also assessed the role of risk using other proxies, such as the ratio of highest risk assets to risk weighted assets or including the proportion of assets weighted at 50% or the proportion of risk weighted assets to total assets. In every case the coefficients are negative and statistically significant. A similar result is obtained in other papers – see Annex 3.

14 It could be argued, however, that riskier firms also have stricter systems and controls allowing them to operate prudently with less capital for a given risk. However, firms' responses seem to indicate that they do not fully trade off one with the other. The negative relationship could also support the hypothesis that there is moral hazard in firms' behaviour. However, the results relating to the role played by insured deposits and commented below suggest that this is not the case

In our discussions some firms considered that regulatory capital overestimates the risks run by firms on specific assets. But no firm claimed that their decisions on desired capital were affected by risks different from those considered by the regulator.

Risk management in individual firms

High levels of capital may benefit managers because they can manage all types of risks less actively, with increased job security.¹⁵ In large institutions, with widely dispersed ownership, there may be less incentive for individual shareholders to monitor the behaviour of management and to ensure good risk management practices. There may also be no effective mechanisms for individual shareholders to express their views. If so, there is more scope for managers to seek a 'quiet life'. This agency problem could manifest itself in weak risk management practices and high levels of capital.¹⁶ However, the market for corporate control, especially the threat of a take-over, may mitigate this agency problem and may affect the trade-off between capital and active risk management. Listed banks, because of their greater susceptibility to unwelcome take-overs, may therefore be under greater pressure than their unlisted counterparts to use and hold the most efficient level of capital.

The agency problem is likely to be greater when the market is highly concentrated, as management can then charge sufficient for its products to remunerate all the capital adequately.¹⁷ For example, Berger and Hannan (1998) shows that high levels of market concentration allow banks to charge prices in excess of competitive levels. The paper finds strong evidence that banks in more concentrated markets are less cost efficient, which includes choosing to hold a larger amount of capital than an efficient allocation would suggest.

Of the 13 firms in our qualitative sample, two regarded risk management as very important and seven as important in deciding how much capital to hold. They considered that capital could be an imperfect substitute for good risk management. So firms' views seem to indicate that the negative relationship between risk profile and

15 Markets could also require firms to hold high levels of capital.

16 See BCBS (2001) for a cross sector comparison of risk management practices.

17 This is also relevant to deposit taking, where charging a high "price" means having a large margin between deposit rates and lending rates.

capital is because firms with higher levels of risk tend to have stricter systems and controls and therefore need less capital. However, management also considered that markets reward firms for being well capitalised even when they also have good risk management. As a result, firms may use capital to complement risk management and internal systems and controls and thus hold too much capital. In other words, there is only a limited trade-off between capital and active risk management.¹⁸

Business strategy and inertia

Senior management may decide to hold capital to enable them to exploit future business opportunities, such as mergers and acquisitions (M&A).¹⁹ The market for corporate control will put downward pressure on the amount of capital a listed firm holds. A firm can become a take-over target if, for example, senior management strategy is not credible or if the market concludes that the bank has been holding an excessive amount of capital for too long.

Our qualitative analysis found that excess capital may arise from the firm's need to finance its long term strategy. Firms regarded this as the second most important determinant of desired capital, after the desire to avoid the consequences of breaching regulatory requirements.²⁰ The importance arises from firms' perception that the market prefers any extra capital needed for growth to be financed from retained earnings.²¹ Other reasons for the importance of long-term strategy when deciding capital may be the desire to maintain a degree of operational flexibility and the extent to which the firm wishes to pre-fund future acquisitions. Interestingly, although banks

18 The role of systems and controls in prudential regulation is partly about ensuring that management makes adequate provision for expected losses that are not covered by capital requirements. For example, McDonnell (2003) suggests that inadequate underwriting and reserving were the main causes of the failures and near misses identified by a group of EU insurance regulators.

19 The causality link may go in the inverse direction.

20 The one firm for which financing its long-term strategy was not an important factor had a deliberate policy of not accumulating capital to finance future acquisitions.

21 The evidence found in the quantitative analysis of a negative relationship between capital ratio and size can support the hypothesis that small firms need excess capital to finance their long-term strategies. It could also support the hypothesis that small firms have larger adjustment costs and thus choose to hold more capital. The finding would also be consistent with the existence of diversification benefits that can arise with a large portfolio. Our quantitative analysis cannot distinguish between the contributions from these different hypotheses.

have access to the equity market to raise capital their views are very similar to those of building societies, which have limited access.

High levels of capital may simply be a historical legacy where firms have not had opportunities that they could profitably exploit. Maximisation of shareholder value might dictate that the bank gives back surplus capital to its shareholders.²² But managers may consider that they are employed by the shareholders to invest their capital, not return it to them, so that the instances when the return of capital takes place are not very frequent. Returning capital may also have negative market signalling implications. So under these circumstances the firm will have some undesired excess capital. Building societies, as mutuals, may seek to return excess capital directly to members, or benefit them through more favourable pricing or better service.

In our qualitative analysis we explored the relevance of ‘inertia’ as a possible determinant of the difference between actual and desired capital.²³ We found that four out of eight banks rated historical legacy as either not important or not relevant. It was nevertheless important for two banks. Two of the five building societies in the sample thought that historical legacy was an important determinant of their excess capital. The responses seem to support the view that banks have stronger incentives not to hold a large amount of excess capital over a protracted period of time. This is possibly because banks have to remunerate capital at the going market rate and if they carry a large amount of excess capital that they cannot remunerate adequately they will become a takeover target. Building societies differ in that they are less exposed to becoming a take-over target, although they might certainly be.²⁴

In our quantitative analysis, the estimated equations for the different types of firm all imply the existence of some inertia. This is indicated by the statistical significance of the coefficient of the lagged dependent variable. For building societies the coefficient is marginally larger than for banks, so the quantitative results are consistent with those from the qualitative analysis.

22 “Surplus capital” does not mean all capital above the regulatory minimum, but above what the management of the bank thinks it really needs.

23 Our evidence supporting the relevance of inertia could equally support the agency problem hypothesis.

24 A building society can be taken over by another building society subject to the FSA’s approval – see <http://www.fsa.gov.uk/pubs/press/2003/119.html> for a recent example. It can only be taken over by a firm that is not a building society after it decides to relinquish its mutual status.

Opportunity cost of capital

If firms optimise their behaviour they should balance the overall gain of holding excess capital against the cost of holding it. The opportunity cost of capital should discourage banks and building societies from holding too much capital. Empirical literature traditionally uses return on equity (in particular, profit as a percentage of reserves or of capital) as a proxy for the opportunity cost of capital.

Our quantitative results for building societies point weakly at a negative relationship²⁵ between return on equity and capital if no account is taken of adjustment costs.²⁶ However, when we allow for adjustment costs, by including the lagged value of capital as an additional determinant of capital, the coefficient of the return on equity (which is our proxy for the opportunity cost of capital) becomes positive and statistically significant. A possible explanation of this result is that profits are the main source of capital for building societies,²⁷ so that the proxy variable for cost used in the estimation is not appropriate.

For the banks that provide in their reporting returns data on their profit and loss account, the return on equity variable shows a positive coefficient that is not statistically significant. The role of the cost of capital and the need to find a meaningful proxy for it need to be explored further.

Adjustment costs and the economic cycle

It could be costly for banks to adjust their level of capital smoothly in response to unexpected changes in market conditions. Adjustment costs could arise either when the bank needs to issue new equity or when it needs to repurchase existing equity.²⁸

25 The estimated coefficient is negative and statistically significant at the 20% level of confidence. The results obtained using a fixed effect estimator are not shown.

26 Adjustment costs are the firm's costs associated with either raising extra capital or reducing its capital.

27 They can also raise Tier 2 capital.

28 The costs of issuing equity are likely to be higher than the costs of repurchasing equity and therefore asymmetrical.

In particular, there is inevitably a time lag between the decision to raise capital and the capital being available in the business, as – amongst other factors – the raising of capital needs legal and regulatory work. By the same token, the disposal of capital also requires time and gives rise to procedural costs. Moreover, the bank will incur transaction costs, for instance fees to investment banks and lawyers. Finally, there are indirect costs arising from information asymmetries between management and investors. For example, the investor may see issuing (or repurchasing) equity as a signal that the firm considers market prices to be above (or below) the intrinsic value of the firm. If so, the share price may go down when a new issue is announced, thereby increasing the cost of the adjustment. For example, Cornett and Tehranian (1994) reports statistically significant negative share price reactions to announcements of equity issues in the banking industry. Increasing equity may be less expensive if the shares are overvalued.

Our empirical findings support the hypothesis that accessing the desired amount of capital gives rise to adjustment costs and that these costs could be a determinant of the observed capital buffers.²⁹

Nine of the thirteen firms in our sample considered that the cost of raising extra capital is the main reason for holding a buffer over desired capital. Banks pointed out that adjustment costs included the indirect costs arising from movement in share price when capital is issued. Building societies, especially small ones, also considered their costs of raising extra capital at short notice to be extremely high, though it could be because some of their costs are independent of the amount raised.

Five of the eight banks in our sample rated adjustment costs due to unexpected developments within the firm as the second most important determinant of the difference between desired and actual capital. Four of the five building societies rated this as not important. Their different response could be partly because banks tend to be engaged in a wider range of activities than building societies.

²⁹ The adjustment costs of reducing capital are likely to be higher for banks than for building societies. This is because building societies, being mutual organisations, can reduce their capital by narrowing the interest margin between their lending rate and deposit rate. Banks, on the other hand, may find it difficult to adopt a business strategy that reduces operating profits. Thus, in practice, banks can reduce their capital only by increasing their dividend or repurchasing their stock – either of which sends a message to the market, with the associated costs discussed in the main text. This could be one reason why banks have, on average, larger buffers than building societies.

Our econometric analysis produced results consistent with the qualitative analysis of adjustment costs. However, the econometric analysis investigated the existence of adjustment costs by introducing the lagged capital ratio into the equation. As explained in the section on inertia, it is difficult to distinguish between the inertia hypothesis and the adjustment costs hypothesis, especially when return on equity does not seem to be a good proxy of the opportunity cost of capital.

The economic cycle may play a role in the determination of capital holdings, through its effect on the decisions of both current and past management. Firms may wish to hold extra capital to reduce adjustment costs, especially the cost of going to the capital markets when conditions for raising extra capital are less than ideal. The likelihood of needing extra capital in a downturn is much higher than in an upturn, so making it more costly for firms to raise the required amount. Firms might hold extra capital to guard against such an eventuality.

In a downturn, when risks are more likely to materialise, capital decreases because of write-offs and increases in specific provisions. Moreover, the default probabilities of loans and the value of collateral could be highly correlated, in which case many market participants might want to sell at the same time when the downturn hits the market. A macroeconomic downturn will lead to a decline in ratings and hence to additional demands on capital for those banks using ratings to assess their loans' risk and to decide on their capital. In an upturn, risk reduces and firms can safely hold less capital than in a downturn. The related empirical evidence is scant, although Ayuso et al. (2004) find a significant negative relationship between business cycles and capital buffers for Spanish banks.

Our capital ratio equation includes a GDP growth variable. The estimated coefficient for the variable is negative and statistically significant for banks. However, the data does not cover a full economic cycle as the period analysed is too short.³⁰ The statistically non-significant negative coefficient for building societies could be due to their larger weight of household-based retail business, which may be less affected by the economic cycle. Therefore our quantitative evidence could support the existence of a negative relationship in the UK between the economic cycle and bank capital.

30 Moreover, half the banks have a foreign parent, which may be linked to a more internationally diversified portfolio which could isolate them from changes in UK GDP.

One could then expect that, during a downturn, banks would try to hold larger capital ratios than during an upturn. Our qualitative analysis supports this, as eleven out of thirteen firms regard maintaining capital as a cushion against the effect of an economic downturn either important or very important.

5. DETERMINANTS OF CAPITAL HOLDINGS: MARKET DISCIPLINE

This section reviews the role that market discipline can play in the determination of capital holdings. The main focus is on the relevance of uninsured funding as a discipline mechanism and the role of information disclosure. Uninsured funding is much more significant for banks than building societies.

Banks' shareholders, depositors, and creditors face risks that increase with the risks borne by banks and may demand higher interest rates or withdraw their funds if the bank assumes more risk (Berger (1991)). In anticipation of this, the bank may therefore choose to hold high levels of capital. In the absence of regulation, market discipline could cause banks to hold even more capital than that set by the regulator. Market discipline may be weakened if stakeholders perceive themselves to be insulated from losses, either because of compensation arrangements or because they expect a government bail-out. Competition policy and market structure in the banking sector may also condition the effect of market discipline on the determination of capital holdings.³¹

Uninsured funding

Bondholders and investors in banks' liabilities, such as subordinated debt or uninsured deposits may feel that the probability of default resulting from holding an amount of capital very close to the regulatory minimum is insufficient to cover the risks they face. They will therefore seek a higher rate of interest. In order to reduce the costs of

31 See Carletti and Hartmann (2002) for a review of the empirical and theoretical literature on the relationship between competition and stability in banking.

this form of financing, banks may choose to hold more capital.³² This is supported by Nier and Baumann (2002), who find that a higher share of uninsured funding³³ has a disciplining effect, leading banks to choose a larger capital buffer for a given risk.

The discipline exerted by uninsured investors and depositors may be stronger if the bank is rated. Rating agencies act as intermediaries in the disclosure process. They gain access to information that it is not publicly available to investors and feed this information into the rating. Therefore, in effect, investors have more information about a rated bank than about a non-rated bank. Nier and Bauman (2002) find, for banks from a variety of countries, that rated banks have capital ratios 0.5 percentage points higher than banks without a rating. Overall they find evidence in favour of the idea that banks – rated or not – which disclose more information, limit their probability of default by choosing higher capital ratios. They find, however, that all of these effects are weaker when looking at the sub-sample of banks for which the market believes the government would bail out.

Banks may also hold high levels of capital to get a rating that gives them access to specific capital markets. This is likely to be more relevant to OTC markets, where the absence of a centralised market means that there is a material amount of counterparty risk. Jackson et al. (2002) examines the way in which banks' solvency standards (as shown by their ratings) appear to influence their access to the swap market. It finds evidence that banks rated below 'A' have very much smaller than average swap liabilities. The paper interprets this as indicating that banks with a rating below this level have much reduced access to the market. A bank moving from a rating of 'A' to 'BBB' would have to change its strategy to limit its trading in swaps, because of costs and access problems. So if market practice is that counterparties are only accepted if they have a rating above some agreed level, banks might build and maintain their capital ratios to achieve better ratings, enabling them to trade in these instruments and also reduce their funding costs. The greater use of collateralisation in the swap market over recent years makes it easier for lower-rated counterparties to have some access to the market, but they might need to limit their use of swaps because of cost.

32 This is not the only option. Banks will accept the imposition of covenants (e.g. restrictions on issuing new debt, restrictions on dividend payments, etc.) designed to protect bondholders from various actions that can diminish their security. However, no set of covenants can eliminate all risks, so a case for higher capital remains.

33 They use certificates of deposit as a measure of uninsured funding. The rationale is that the lending bank is likely to be subject to the same kinds of shocks to risk and profitability as the borrowing bank. As a result, certificates of deposit are likely to be sensitive to the risk that the borrowing bank is taking.

We might therefore expect a dependency between capital levels and ratings. The evidence in support of the hypothesis that banks raise their capital ratios to obtain a particular rating is inconclusive. The illustrative evidence in *Matten (1998)* suggests that high capital ratios do not guarantee a good credit rating but that low capital ratios seem to be associated with a low credit rating.

Overall, the evidence summarised above seems to support the hypothesis that uninsured funding is an effective mechanism of market discipline and that part of the excess capital held by banks arises from this. However, the impact of market discipline would show not necessarily in capital ratios but through its potential to curb the incentive that banks may have to take excessive risk, by making risk-taking more costly for banks.

Our quantitative analysis tested the strength of uninsured funding as a market discipline mechanism by including in the model a variable calculated as the proportion of (partially) insured deposits (non-interbank deposits) over total deposits.³⁴ The rationale is that insured funding, even if payments from the compensation scheme are capped, should weaken market discipline. We find that the higher a bank's proportion of partially insured deposits, the more capital it holds for a given level of risk. Therefore it does not seem that weaker market discipline results in lower levels of capital.

The qualitative analysis found that attracting and maintaining uninsured funding – wholesale deposits or access to money markets or both – was regarded as an important determinant of desired capital, not only by banks but also by building societies. Of the 13 firms in the sample, five regarded this as very important and seven as important. They said that in the short term relative costs will dominate the decisions on how firms can fund themselves. But in the medium to long term the objective is to develop and maintain a range of funding options that will support the firm's strategy. It is in this context that a rating and peer comparisons become important.

Information and peer pressure

The regulator might feel confident about the level of capital it sets for a bank on the basis of inspections and private information. The market does not have access to such information and, given that in practical terms there are too many limitations of

34 Commercial deposits, which are not covered by the Compensation scheme, are also included, thus affecting the interpretation of the results.

accounting, auditing and disclosure requirements (Oliver Wyman (2001)) – at least for financial conglomerates – it may force banks to hold a different amount of capital than that set by the regulator.

The quality and quantity of disclosure depends on where the bank is listed, as different regulators set different disclosure and accounting rules. Empirical research largely supports the view that financial statements complying with US GAAP are more useful than those in alternative disclosure regimes (Nier and Bauman (2002)).³⁵ In addition, a US listing may also entail more disclosure than required under the bank's national accounting rules. So whether a bank is listed in the US might affect the amount of capital held by the firm.

As a result of incomplete information, the views of the market and rating agencies about the bank may be affected by where its capital ratio stands in relation to others – i.e. by peer group pressure. The peer group may include banks from other countries and banks with similar capital requirements, if that is known. If so, changes in regulatory capital may affect not only the bank whose capital requirement has changed but also those within its peer group.

In conditions of imperfect information, banks may hold high levels of capital as a signalling mechanism to differentiate themselves from their peers. High capital ratios can be regarded as a substitute for information that firms cannot easily or convincingly disclose directly, e.g. adequate systems and controls, or good earnings prospects. For example, small or privately owned UK banks active in private banking may want to show potential depositors that they are well capitalised and thus that funds deposited with them are as safe as those deposited with a larger competitor.

If the signal is effective, the increase in actual capital should lead to an increase in earnings. However, the hypothesis that management signal private information about 'good' future prospects by increasing capital is not supported by the empirical work in Berger (1995).

35 It seems that the wave of accounting frauds in the US did not meet the US accounting standards. It is not clear whether these cases should change the belief that accounts apparently complying with US GAAP are more informative than accounts complying with other standards.

Our qualitative evidence suggests that ratings affect firms' behaviour. However, we cannot conclude that rated firms hold higher capital ratios than their non-rated counterparties,

We found that banks in the sample regarded the market's most likely reaction to an unexpected drop in capital as being a review of their rating (with a possible increase in funding costs) followed by their shares' trading at a lower multiple of earnings.³⁶ Withdrawal of wholesale funding was seen as a likely reaction only by four out of the thirteen firms. Firms' answers reflected their funding structure: those with significant dependency on wholesale funding rated this reaction as likely. Therefore firms perceive there to be a certain degree of market discipline, exercised through ratings and the wholesale markets.

In our qualitative analysis we also explored the role that rating can play in determining capital. The results indicate that desired capital is affected by management's intention to maintain the firm's credit rating. Of the 13 firms in the sample, five regarded this as very important in deciding desired capital and seven as important. The subsequent discussions with firms and rating agencies suggested that this is especially so where the firm relies heavily on non-retail deposits for its funds or where the firm's credit rating is an important factor in its strategy.³⁷

To gather further evidence on the role of ratings, we also asked firms to rank the likelihood of various reactions to a rating downgrade. We focused on the likelihood in the short and medium term of changes in desired capital, actual capital, and risk-weighted assets (as a proxy for changes in the business).³⁸ Most banks answered that they would change their desired capital, actual capital and distribution of risk

36 Most respondents said that the extent of the reaction would depend on the cause and materiality of the unexpected reduction in actual capital.

37 Firms recognised that some strategies demand particular ratings and hence that when a firm changes its strategy it must take account of the rating implications. More generally, rating agencies emphasise that they take account of more than just the firm's level of capital – a point also acknowledged by other stakeholders.

38 We want to distinguish between a decision to change the terms of existing business (e.g. the interest rates charged) and a decision to withdraw from some business. The first (if competitive pressures allow) may lead to higher profits and an increase in capital. We treat this as a change in actual capital – but it is by no means the only way of increasing the firm's capital. The second one may reduce the firm's risk-weighted assets but we treat it as a change in the business or in the firm's portfolio of activity.

weighted assets in the medium term only. Most building societies were not sensitive to changes in the rating, given that most of their funding comes from retail savings.

Peer pressure also seems to play a role in capital determination in the UK. In our quantitative analysis we test for it, by including in our regression, for each firm and for each period t , the average capital ratio for all other firms of similar size reporting at time t . We find evidence that peer pressure affects the level of capital. The result suggests either that firms are using their capital ratio as a signal or that the capital ratio of similar firms is a focal point for competition in capital markets.

The interviewed firms regarded peer pressure as at least an “important” factor in capital decisions. The firms gave various explanations and qualifications about the importance of peer pressure as a determinant of desired capital. Broadly speaking, firms responded to the questionnaire in terms of how they perceive that other firms take their decisions rather than how they do it themselves. Firms may aim to appear well capitalised in relation to their peers. Nevertheless, firms consider that peer comparisons can sometimes be overly simplistic and can ignore material issues such as the quality of capital – for example, by not taking sufficient account of the differences between Tier 1 and Tier 2 capital. For building societies, the absence of shareholders may limit the extent to which they use peer comparisons to form their views about desired capital. In spite of this, our quantitative results show evidence of such behaviour.

The negative relationship between volume of assets and capital ratios found in our quantitative analysis could support the hypothesis that small firms use overcapitalisation as a signal to the market. As poorly capitalised banks could lose their stakeholders’ confidence, small banks could be using their capital holdings as a mechanism to show the market their high prudential standards. In the qualitative analysis, ten firms regarded inaccurate market understanding of their risks as either not important or not relevant for determining their desired capital.³⁹ This probably implies that these information asymmetries can be more effectively corrected by means such as appropriate disclosures and covenants rather than by extra capital.

39 The interviews suggested that some firms may have thought the question about inaccurate market understanding of the firm’s risks referred to the firm’s misunderstanding of the risk of operating in certain product markets. We clarified this orally and were given no indication that this would change any firm’s answer. Furthermore, if a firm had misinterpreted the question and if it had considered inaccurate market understanding of the firm’s risks to be material, no doubt the firm would have mentioned it under “other”. However, none of the firms added other reasons for holding capital.

6. DETERMINANTS OF CAPITAL HOLDINGS: REGULATORY FRAMEWORK

This section reviews the regulatory environment's role in determining capital holdings. In particular, decisions on capital may be affected by how capital requirements are perceived and set by the regulator, by the degree of intervention through regulation and supervision and by the fines imposed for regulatory breaches.

Capital requirements as a minimum

The regulator may set a capital requirement with the explicit intention that banks always operate with a higher capital ratio. In fact, this is the interpretation of the 8% ratio of the current Basel Accord (BCBS (1999)). In the UK, the regulator sets individual capital requirements as minima with the expectation that firms will always exceed this. Ediz et al. (1998) explores UK banks' reaction to regulatory pressure. It finds evidence that banks boost their capital ratios as soon as they fall to a certain level above the regulatory minimum.⁴⁰ Holding capital above the minimum is thus consistent with the aims of prudential regulation⁴¹ and reflects an alignment between banks' behaviour and the regulator's prudent approach.

Our quantitative analysis for UK firms indicates that individual capital requirements are a significant factor in capital decisions.⁴² While Ediz et al. (1998) assessed the regulatory pressure created by target ratios, we have looked at how specific individual capital requirements and their changes affect capital holdings. We provide details of both quantitative and qualitative analysis below.

40 As explained earlier, historically the FSA has set a 'target' ratio above the individual capital ratios ('trigger ratios') to act both as a 'warning light' and as a cushion of capital to help prevent an accidental breach of the individual capital ratios.

41 This contrasts with Danielsson (2002), which suggests that excess capital is evidence of the impossibility of risk-based regulation.

42 We have run the regression with both the trigger ratio and the target ratio as explanatory variables. The results reported by Ediz et al. (1998) assess the relevance of the trigger ratio. Using the trigger ratio or the target ratio makes no major difference to our results.

It could be argued that the regulator and the firms might have similar views about the implications of shifts in the characteristics of business or in risk levels. If that were so, regulatory and actual (or desired) capital would tend to move together, but there would be no causality link.⁴³ Our quantitative analysis allows for such a dependency by including in the regression the other factors that are commonly suspected to determine firms' decisions about capital.

For both building societies and banks we obtain a clearly significant positive relationship between regulatory requirements and actual capital ratios, indicating that the higher the required individual capital ratio the higher the actual capital ratio.⁴⁴ The short term coefficients range from 0.28 for all banks to 0.43 for banks engaged in trading activities. The long term coefficients are 0.41 and 0.61 respectively. For building societies the short term coefficient is 0.18 and the long term one is 0.29. So there is never a one-to-one response. These figures suggest that, in general, less than 50% of changes in individual capital requirements is translated into changes in the capital ratio in the short term, and a little bit more in the long term. In other words, the buffer only partially absorbs changes in individual capital requirements.

We find that the estimated coefficient for the required capital ratio is higher for banks and building societies with low buffers than for those with larger buffers. In other words, firms with large buffers react less to changes in capital requirements. In fact, in many cases, firms with a large buffer seem not to react at all to changes in capital requirements: the coefficient is not statistically significant, whether or not the firm has experienced a change in the required capital ratio.

In order to assess the robustness of these results we test for asymmetric responses to changes in capital requirements. When the sample is split between firms that have experienced an increase in their required capital ratio during the period of our data and firms that have experienced a decrease the results show different responses to changes.⁴⁵ In particular, banks that have experienced an increase in their requirements raise their actual capital ratio by 50% of the increase in the requirement in the short

43 See note 54 in Annex 3 for further details on our causality test results.

44 Most of the empirical work for other countries has been carried out using the buffer as the explanatory variable (Ayuso et al. (2004) and Lindquist (2004)). The reason is that, in many cases, the regulator in these other countries does not set individual capital requirements.

45 In the period considered, our dataset has 58 instances of the capital requirement being raised and 18 instances of it being lowered.

term and by nearly 71% in the long term. For banks that have experienced a decrease, the adjustment is around 20%. This result seems to suggest that firms are more concerned with the possibility of regulatory breach than with the additional costs associated with holding excess capital.⁴⁶ Building societies do not seem to react very differently to increases or to reductions in regulatory capital requirements.

We also used the qualitative analysis to explore whether firms react to changes to their regulatory requirements. As stated above, nine of the 13 firms in the survey said that they form their views about desired capital by adding a margin to the required minimum. Some of the nine firms emphasised that they still assess specific risks from a bottom-up perspective – for example, to price new business. The other four firms said that they form their views about desired capital by assessing the risks. Three of these four were the largest banks in the sample.

We asked firms directly about their potential reaction to changes in their own individual capital requirements. In relation to desired capital, banks answered either that they would not change the amount or that they would change it in the same direction in the medium term. Building societies, on the other hand, said they would probably change their desired capital in the same proportion as the change in regulatory requirements in the short term. Building societies would change their actual capital, while banks would be less likely to do so.⁴⁷ Both banks and building societies said they were unlikely to change their business or portfolio composition.

All the firms that forecast a reduction in their capital requirements under Pillar 1 of the new Basel Accord said that the effect of this overall reduction would be to reduce both their desired and actual capital in the medium term. Most also said that this reduction in capital requirements would also affect their business or portfolio composition in the medium term.

46 The lack of statistical significance of the return on equity variable (ROE) in the estimation, mentioned above, could support such an interpretation. However, as already pointed out, the results on ROE must be treated with caution.

47 Four out of the five building societies said they would change actual capital, while only two out of the eight banks said they would.

Regulatory rules and supervisory behaviour

The regulator affects the actual level of capital in various ways, as well as by just setting the capital requirement. First, a breach of the capital requirement will usually attract serious enough regulatory intervention that firms will want to hold more capital than required, in order to avoid or reduce the likelihood of a breach. Milne (2002) suggests that capital requirements act as an incentive mechanism in which a breach gives rise to a penalty. It is then shown that banks would want to hold more capital than the regulatory minimum.

Goodhart (1995) has suggested that regulators commit themselves to specific types of action that are triggered when thresholds above the minimum margin are breached. This recognises that the underlying requirements must be somewhat arbitrary. For example, what is the difference between a minimum requirement of 8% or 7.9%? Goodhart suggests that the inevitable degree of arbitrariness in any set of minimum requirements will encourage regulators to retain some discretion in responding to breaches of the requirements. Goodhart further suggests that in reality the regulator's discretion means that the regulator will react with forbearance, partly because of a concern that its intervention will cause consumers to lose confidence in banks. If so, regulated banks will soon factor the regulator's behaviour into their decisions and hold less capital than they would otherwise do. The results presented in Aggarwal and Jacques (1998), for instance, show that regulatory commitment to action linked to the Federal Deposit Insurance Corporation Improvement Act was effective in getting US banks simultaneously to increase their capital ratios and reduce their portfolio risk

Regulators can also affect capital by indicating their willingness to intervene when banks find themselves in financial distress. For instance, the FSA's statement about non-zero failure (FSA (2003)) is an example of how the regulator can inform the market of its intentions. As with any regulatory policy the effect will depend on its credibility.

Our qualitative analysis found that avoiding "the consequences of a potential breach of regulatory capital" was regarded as "very important" by all firms in the sample. PricewaterhouseCoopers (2003) reports a similar result from a sample of internationally active European banks.⁴⁸ Our subsequent discussions with firms indicated that they regard capital requirements as the absolute minimum for capital rather than a sort of

⁴⁸ The survey covers amongst other things the determinants of capital in excess of the minimum required amount. About 80% of respondents identified avoiding a breach of capital requirements as very important or important.

target. Managers said that a regulatory breach might be regarded as comparable to “deceiving customers” and might therefore affect their position in the firm.

The statistically significant negative effect of size on capital holdings could reflect that larger banks tend to have better diversified portfolios. Also larger banks may have better risk controls than smaller banks, as there could be a significant fixed cost of implementing a control system – so capital ratio could be negatively associated with size.

7. SUMMARY AND CONCLUSIONS

In this paper we have argued that the amount of capital held by banks and building societies depends on risk management, market discipline and regulatory environment. Using both quantitative and qualitative approaches, we provide evidence on which hypotheses hold in the UK. In particular, we analysed prudential returns for UK banks and building societies and the responses to a questionnaire sent to a sample of firms that we later interviewed. Our findings are in line with the results obtained with data from other countries (Ayuso et al. (2004) and Lindquist (2004)).

Even though all firms have a buffer over individual capital requirements, our analysis indicates that changes in these individual capital requirements are very likely to be accompanied by some response in the capital ratio. For example, if a bank (building society) which is holding capital at 15% of risk weighted assets has its individual required capital ratio increased from 10% to 11%, it would on average increase its actual capital ratio to 15.6% (15.4%).

Our evidence indicates that the dependency of capital ratios on capital requirements is somewhat greater for firms operating close to their regulatory requirements than for those that hold a large amount of excess capital. As the firms with smaller capital buffers are generally the larger banks, it could be argued that capital policy changes introduced by the regulator will affect large banks more than smaller ones. The firm’s degree of risk aversion will determine the final impact.

Adjustment costs affect the amount that firms hold. They seem to be marginally larger for building societies than for banks, maybe because of the formers’ limited access to

capital markets. Firms say that the difference between actual and desired capital is mainly determined by the costs of raising further capital and by provision for unexpected events in the economy and in the firm. We find that the economic cycle is negatively associated with capital ratios, at least for banks. Firms also say that their desired capital is mainly determined by the need to finance their long term business strategy.

Risk appetite and risk management help determine capital holdings. Perhaps surprisingly, portfolios with a higher proportion of assets falling into the high risk group category (in our case, 100% weighted assets) are associated with lower capital ratios, a result also obtained by Lindquist (2004). Some firms consider systems and controls to be a partial substitute for capital.

Market discipline seems to affect how firms assess their capital needs and seems to play a complementary role to regulation in this assessment. Our analysis indicates that firms adjust their level of capital in response to changes in their peers' level. So changes in the regulatory capital requirement for a subset of firms could produce a similar change in actual capital for firms that have not experienced the change but are competing in the same market. Any regulatory change that enhances market discipline, such as requirements for firms to disclose new information, will not necessarily result in more capital in the system.

The implementation of the new Basel Accord will certainly change the relationship between regulatory capital requirements and capital held by firms. The fact that regulatory capital will more heavily rely on internal models devised by firms to set their desired capital suggests that the link may be reinforced. However, it is an area that requires further research.

Some of our evidence is consistent with a number of different hypotheses about firms' behaviour and the determinants of capital. Further evidence should also be gathered on how banks calculate the size of the margin of capital that they aim to hold over the regulatory minimum. The finding that nine of 13 interviewed firms said that they form their views about desired capital by adding a margin to the required minimum could provide a starting point. Milne's (2002) model could provide the framework.

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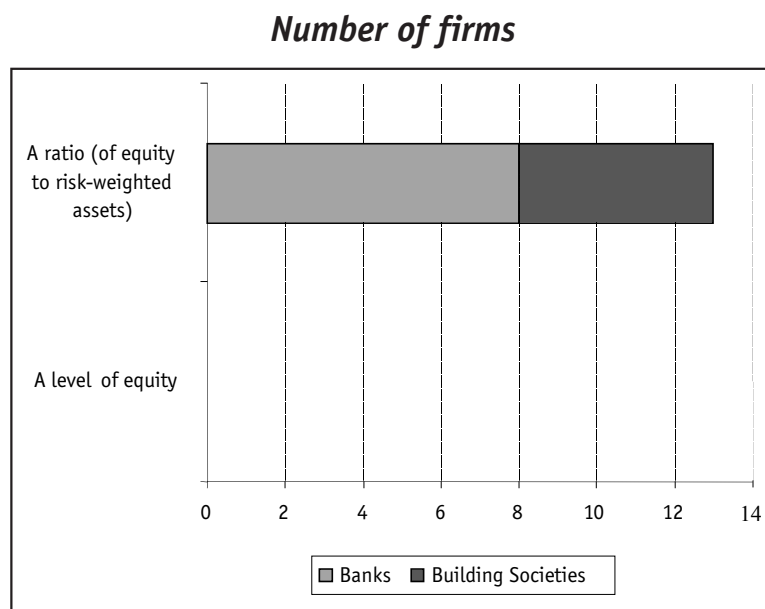
Annex 1: Summary of how changes in regulatory requirements might affect actual capital

Why firms might hold more capital than the regulatory minimum	Potential impact of increasing regulatory capital
<i>Excess capital as a result of how decisions on capital are taken within each firm</i>	
<ul style="list-style-type: none"> Excess capital as a result of firms taking account of risks not relevant to the regulator Excess capital as a result of firms assessing risks differently from the regulator 	The firm's response to a change in the regulator's requirements may depend on what drove the change. If it is to cover risks not covered under the current requirement, there may be no response; otherwise, the firm may wish to maintain the same buffer to mitigate those risks not taken into account by the regulator.
<ul style="list-style-type: none"> Excess capital as a result of agency problems 	If management have little pressure from shareholders for capital remuneration and other market discipline mechanism are weak, an increase in capital requirement will lead them to increase capital to maintain a "quiet life".
<ul style="list-style-type: none"> Excess capital as a result of weak risk management practices 	For a given a business risk profile, prudent firms with poor risk management will tend to hold more capital and will be likely to raise their capital in line with regulatory increases ⁴⁹ . However, changes in capital requirements that give adequate incentives for risk management should lead these firms to hold less excess capital.
<ul style="list-style-type: none"> Excess capital as financial slack to finance long term strategy 	If firms have a long-term strategy about their growth, an increase in capital requirements is likely to cause them either to raise capital to maintain their ability to deliver their long-term strategy or to change their strategy.
<ul style="list-style-type: none"> Excess capital as a historical legacy 	In this case, a change in capital requirement would not lead to a change in actual capital.
<ul style="list-style-type: none"> Excess capital as a result of adjustment costs from issuing equity 	If adjusting levels of capital is costly, firms may respond differently to increases and reductions in the regulatory minimum – possibly reacting to increases in the regulatory minimum but not significantly responding to reductions. Much may depend on the size of the change and on how the firm views its longer-term outlook and any possible future changes to its regulatory capital.
<ul style="list-style-type: none"> Excess capital as a result of firms' optimising their capital structure 	This may change the overall balance between the benefits and costs of holding excess capital. However, because of the opportunity cost of capital and if other things are equal, the higher the cost of capital the lower the amount of excess capital
<ul style="list-style-type: none"> Excess capital to cushion the effect of an economic downturn 	We would expect firms to raise their capital ratio

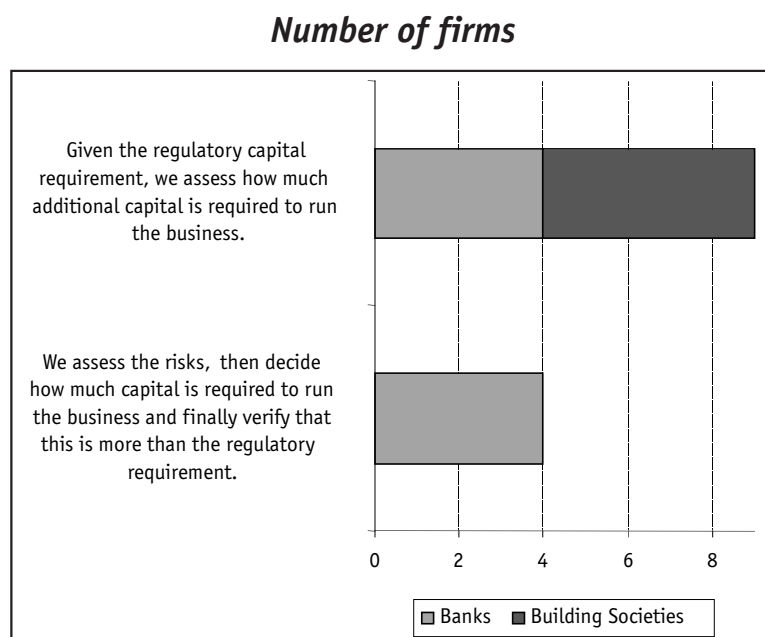
Why firms might hold more capital than the regulatory minimum	Potential impact of increasing regulatory capital
Excess capital as a result of market discipline	
<ul style="list-style-type: none"> Excess capital to reduce the risks faced by uninsured investors 	<p>The extent to which firms react to an increase in the capital requirement will then be conditioned by the possible effect on their funding costs. Firms are likely to react if:</p>
<ul style="list-style-type: none"> Excess capital to obtain access to certain capital markets 	<ul style="list-style-type: none"> the increase is observed by uninsured investors (whether or not through a change in rating) and this reveals new information that would lead them to demand a higher yield unless capital is increased; or the increase leads to a lower rating that reduces the firms' ability to access certain capital markets, thereby increasing their funding costs.
<ul style="list-style-type: none"> Excess capital as a result of inaccurate information in the market 	<ul style="list-style-type: none"> Changes in regulatory capital may affect not only the firm whose capital requirement has increased but also those within its peer group. In this case, an increase in the capital ratio set by the regulator may have knock-on effects amongst a peer group and tend to drive capital levels upwards. This would imply that the market indirectly² observes the change in regulatory capital and alters its judgement as a result. An increase in regulatory capital will make the firm react if the market interprets the change as deterioration in the firm's relative capital position. In this case a firm will have to choose between increasing its capital, taking other credible remedial action or accepting the consequences of the deterioration.
Excess capital as a result of the regulatory framework	
<ul style="list-style-type: none"> Capital requirements set only the minimum amount of capital 	<p>We would expect banks to either not respond or raise their actual capital ratio.</p>
<ul style="list-style-type: none"> Excess capital to avoid regulatory intervention when faced with a breach or likely breach of the capital requirement 	<p>To avoid the costs of regulatory intervention, banks will want to hold a buffer above the level of capital set by the regulator, and will increase their actual capital in line with any increase in the likelihood or severity of intervention.</p>
<ul style="list-style-type: none"> Excess capital as a result of the market's perception of a non-zero failure regime 	<p>An increase in the credibility of a non zero failure regime would lead to more excess capital and vice versa.</p>

Annex 2: Summary of firms' replies to the questionnaire

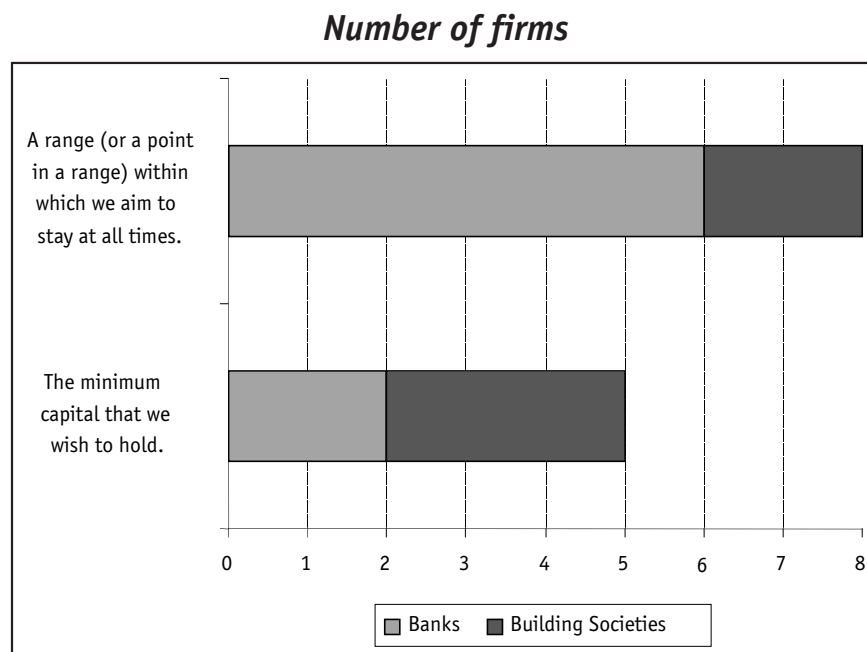
Q1: How is desired capital specified?



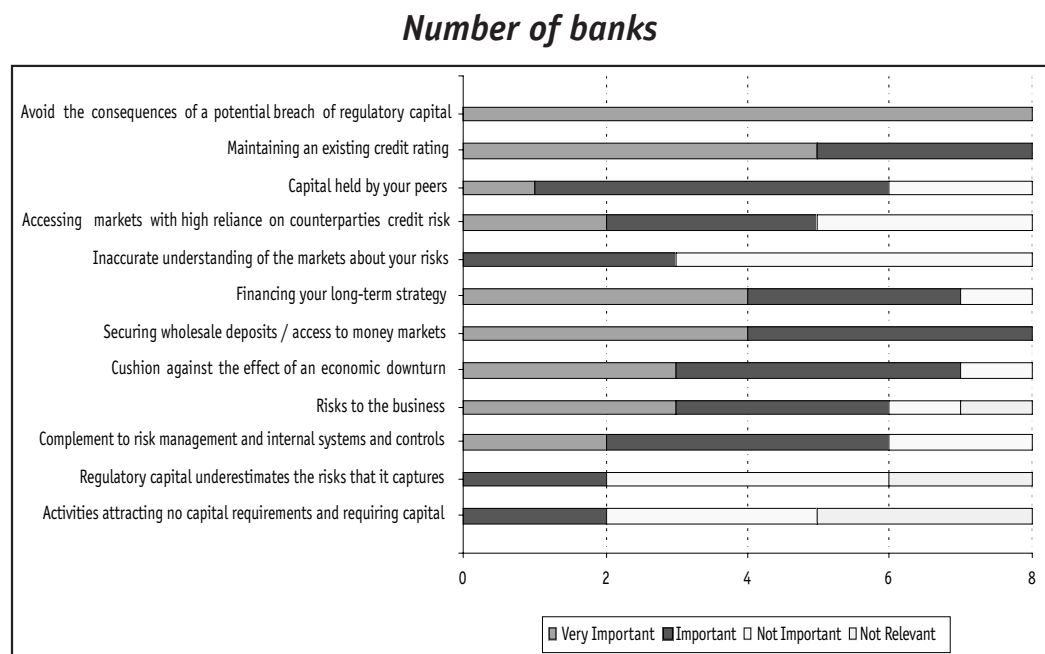
Q2: What are the determinants of the firm's desired capital and regulatory requirements?



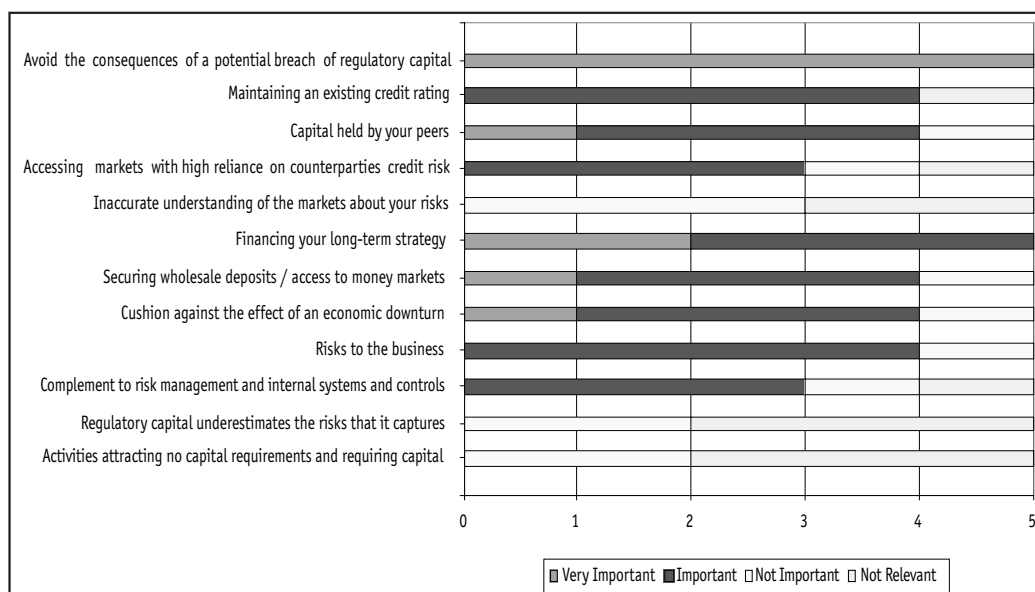
Q3: What does the desired capital represent?



Q4: What are the determinants of the firm's desired capital?

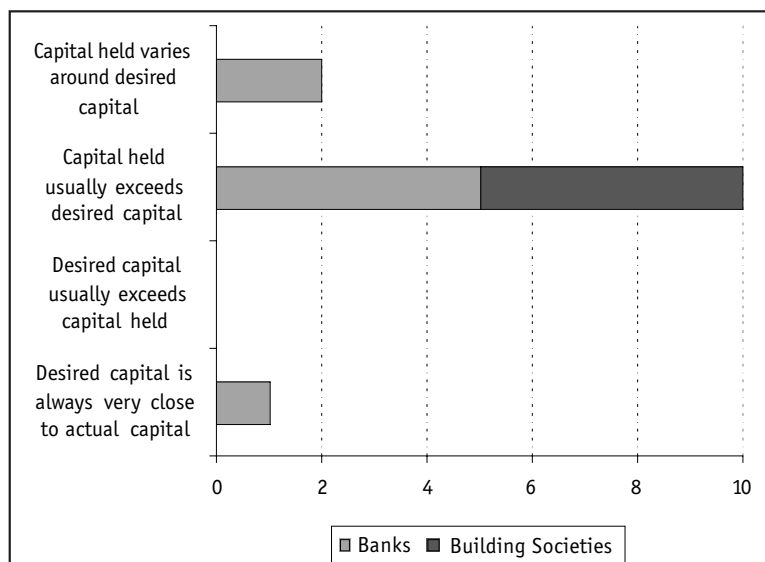


Number of building societies

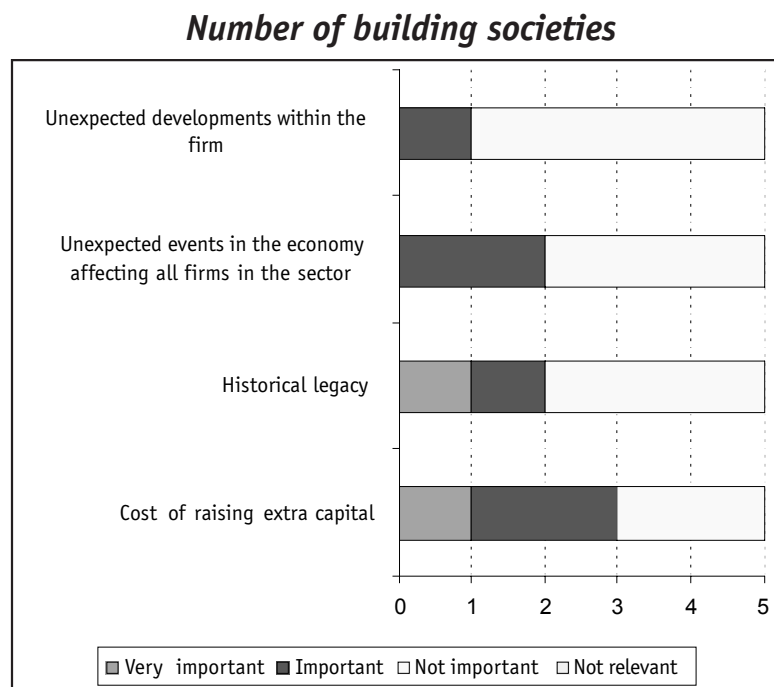
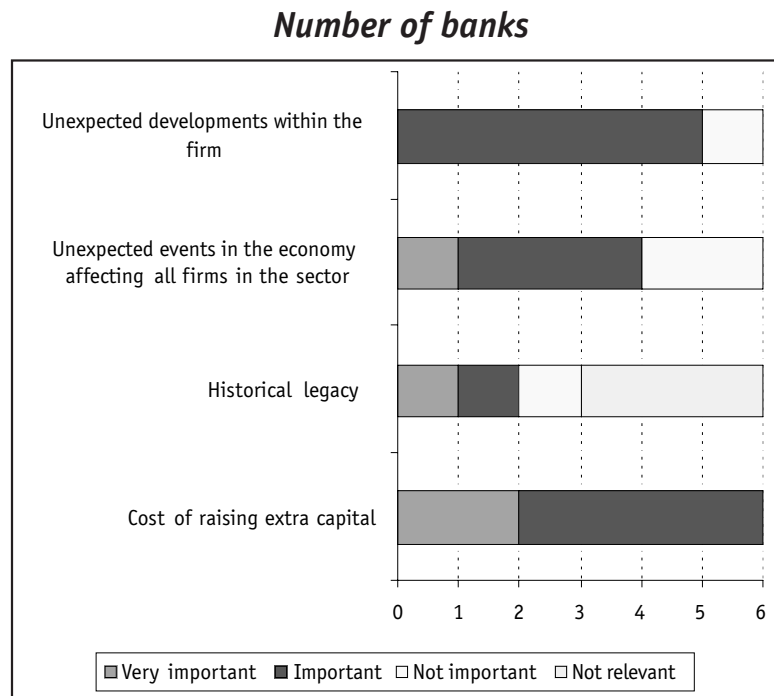


Q5: How does desired capital differ from actual capital?

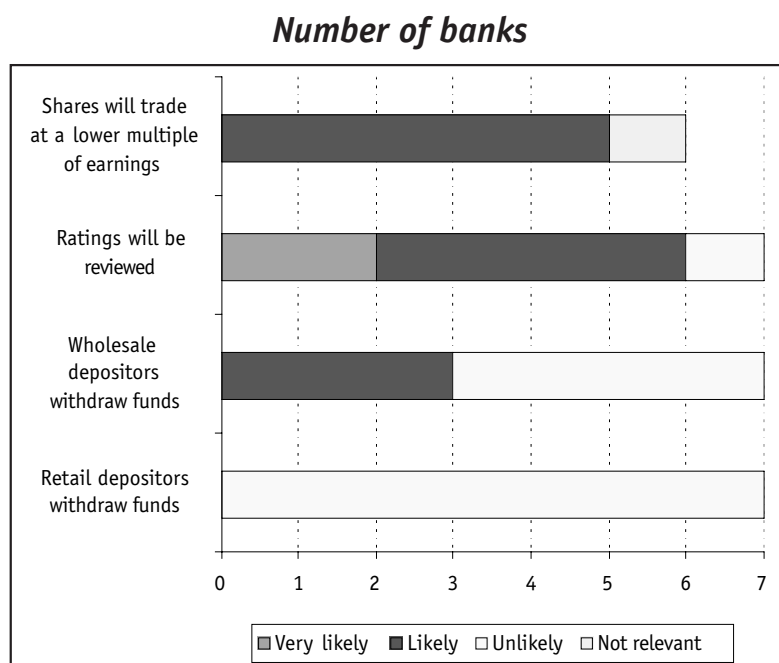
Number of firms



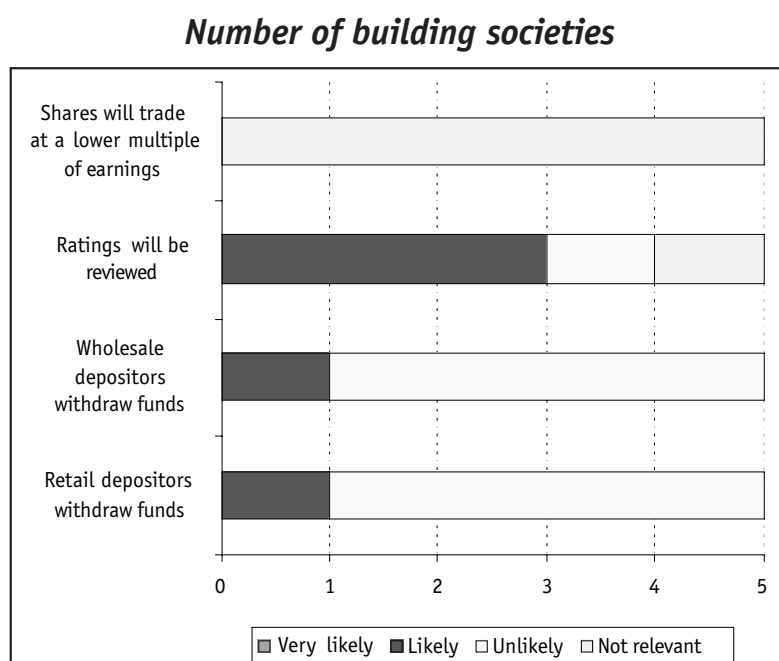
Q6: Why does actual capital differ from desired capital?



Q7: What would be the reaction to an unexpected reduction in the actual capital arising from, say, a reduction in profits

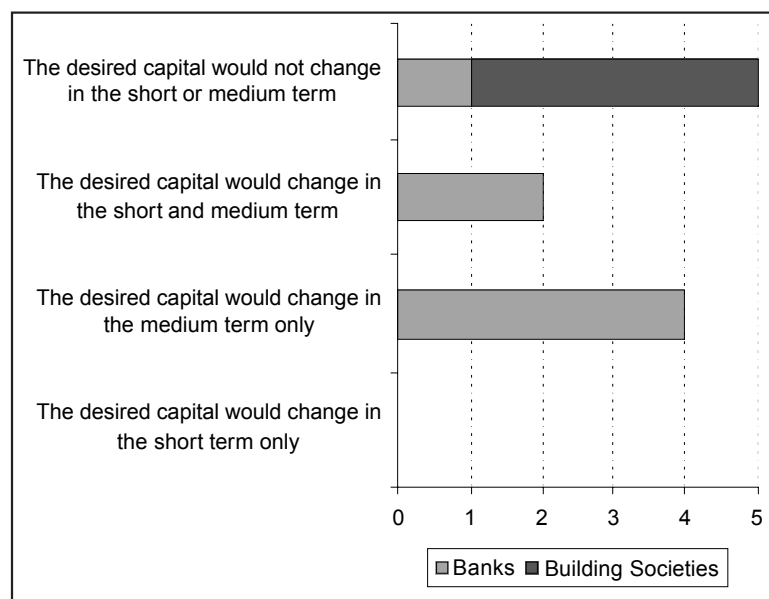


Note: One bank did not answer this question and another did not say whether it would affect the share price

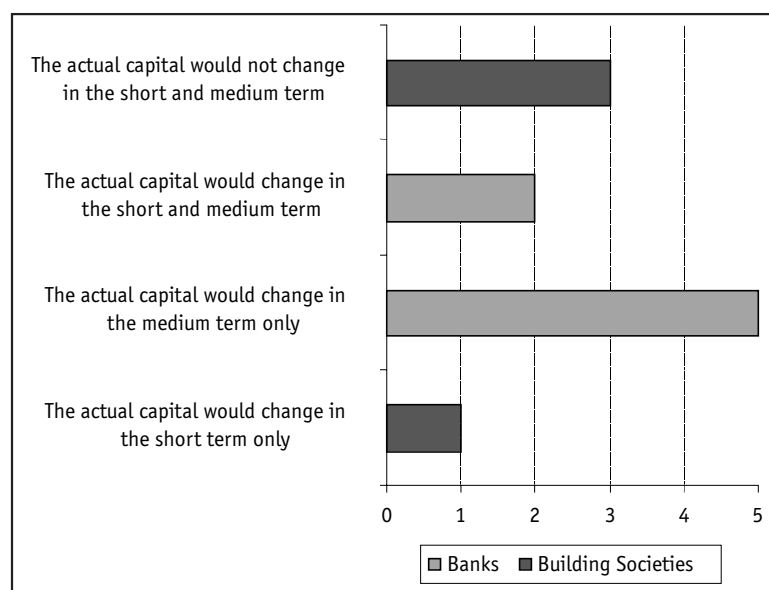


Q8: Suppose you had experienced a downgrade in your rating as a result of an event affecting you such as an unexpected reduction in profits. How would you have reacted to the downgrade?

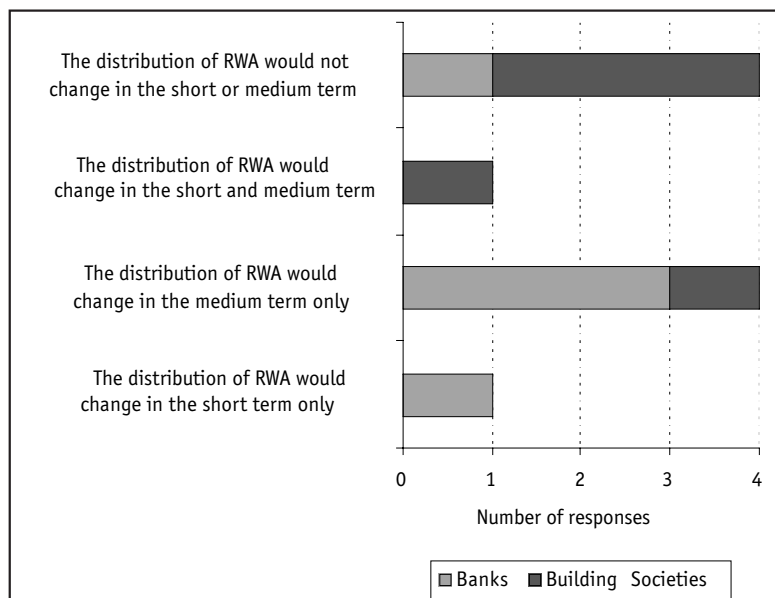
Change in desired capital: number of firms



Change in actual capital: number of firms

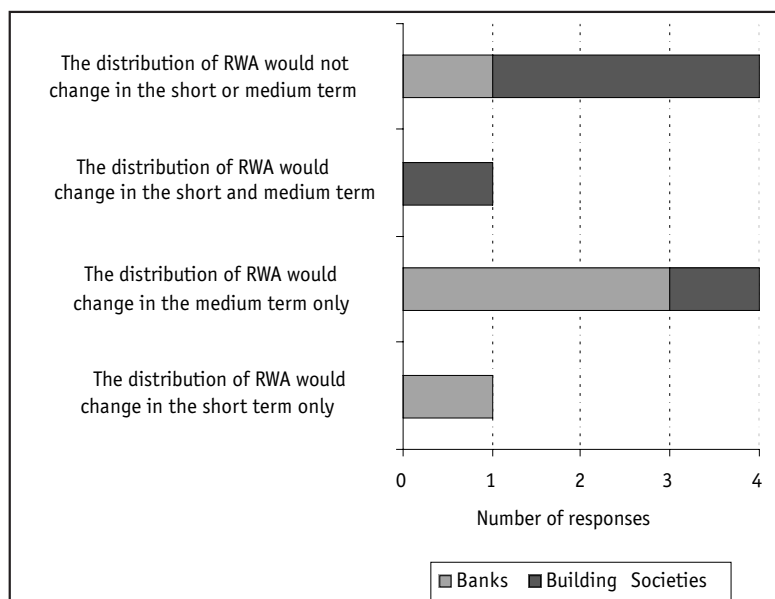


Change in the distribution of risk weighted assets (RWA): number of firms

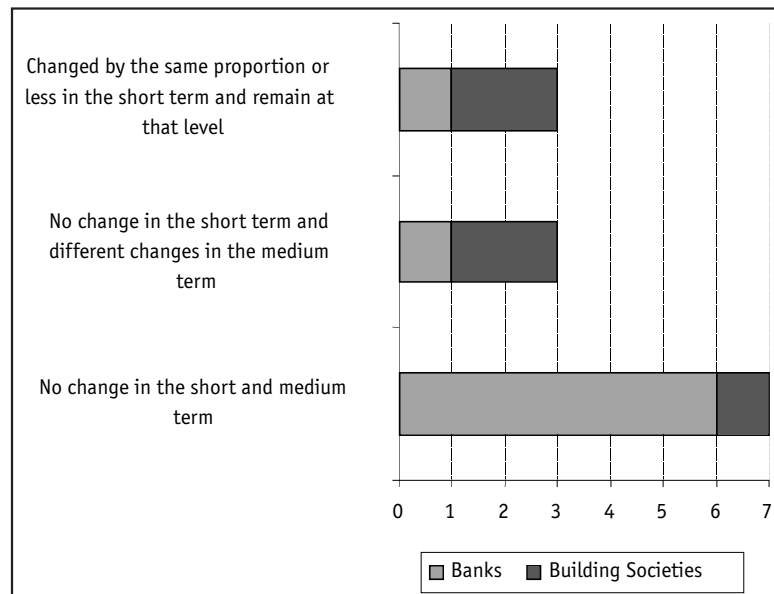


Q9: If your individual capital requirement [increased by 1 percentage point from 9.0% to 10.0%]. How would you react to it?

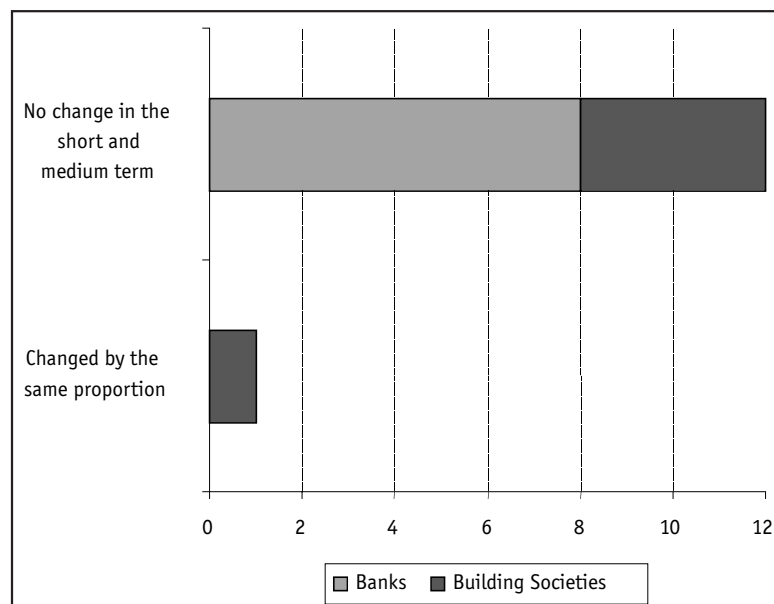
Change in desired capital: number of firms



Change in actual capital: number of firms



Change in distribution of RWA: number of firms



Q10: How would the implementation of Basel II requirements for regulatory capital (Pillar I) affect your capital requirement? How would you react to it?

- Of the 13 firms interviewed, six firms took the view that Basel II's new Pillar 1 would mean that they need less regulatory capital to support the current business. Two other firms said that they expected the effect of Pillar 1 to be neutral. The remaining firms did not express a view.
- The six firms that expected a reduction in regulatory capital said that it would lead to a reduction of actual and desired capital in the medium term. Five of them also said that it would also affect the distribution of assets in the medium term.

ANNEX 3: QUANTITATIVE ESTIMATION OF THE DETERMINANTS OF CAPITAL RATIOS

The model

This annex presents the empirical results from our quantitative approach. The starting point of the analysis is Ayuso et al. (2004) with the extension incorporated by Lindquist (2004). These two papers analyse the behaviour of the buffer capital of Spanish and Norwegian banks respectively.

We specify the model in terms of capital ratios.⁵¹ The most general specification of our model can be represented as:

$$K_{it} = A_{it} Kr_{it}^{\alpha} Risk_{it}^{\beta} Size_{it}^{\delta} G_t^{\gamma} Dep_{it}^{\tau} Peer_{it}^{\lambda} Z_{it}^{\varsigma} K_{it-1}^{\mu} \eta_i \varepsilon_{it} \quad (1)$$

where the subscript i denotes the firm and t the period. K is the capital as a proportion of risk weighted assets⁵² and Z are other explanatory variables that are relevant to the specific dataset (building societies and banks) and that will be described below.

Kr is the individual capital requirements as a proportion of risk weighted assets, using the trigger ratio (i.e. threshold ratio) as the regulatory requirement.⁵³ The

⁵¹ The empirical work for Spain (Ayuso et al. (2004)) and Norway (Lindquist (2004)) has used the buffer as the explanatory variable. The reason is that, in many cases, the regulators in these two countries do not set individual capital requirements. We have also run the regressions specifying the buffer as a dependent variable and not including the capital requirement as a regressor. The results show that a) there is inertia b) risk, size, quality of capital and growth have a negative impact on the buffer, while c) non-wholesale deposits and peer pressure have a positive effect (although the latter is not statistically significant). Also foreign firms have a larger buffer.

⁵² We have also run the regression with the ratio of tier 1 capital to risk weighted assets as the explained variable. This produces no major differences in the estimated coefficients.

⁵³ As already mentioned, we also ran the regression using the target ratio for banks, with not significantly different results.

coefficient α is expected to be positive and statistically significant,⁵⁴ as we expect that firms react to individual regulatory requirements.⁵⁵

The variable **Risk** is a proxy for risk: it is an ex-post measure of risk, calculated as the proportion of a firm's highest risk assets (i.e. those with a 100% risk weight) over its total assets.⁵⁶ A statistically significant β could be interpreted as evidence that firms assess risk differently from regulators. A positive β would suggest that increases in the riskiness of the portfolio are associated with capital increases beyond those required by the heavier regulatory weight given to those assets. This would suggest that firms assign an even larger risk to these assets than the regulator; a negative β would be compatible with either the presence of moral hazard behaviour in firms or the possibility that riskier firms also have better risk management mechanisms.⁵⁷

⁵⁴ We carry out a Granger causality test to assess the hypothesis that the changes in the trigger ratio precede the changes in the capital ratio and not the other way round. We carry out the test by running the regression of both variables on the lagged values of the other and the variable itself, using a random-effects (within) estimator. The p-value of the lagged capital ratio in the trigger equation is 0.33 (0.64 in the within estimation) for banks. The p-value for the lagged trigger in the capital specification is 0.03 (0.43 in the within estimation). Therefore, there is some evidence that the changes in the trigger ratio precede the capital changes.

⁵⁵ We have tested for the relevance of the quality of capital by running the regression including the ratio of Tier 1 capital to total adjusted capital as an additional endogenous regressor. The coefficient is negative but not statistically significant. So there seems to be a limited degree of trade-off between quantity and quality.

⁵⁶ As shown in Tables A1 and A2, the average of such a proxy of risk is around 7% for building societies and 30% for banks. The pattern that emerges for the relationship between banks' size and riskiness shows that the largest firms seem to be holding the lowest proportion of risky assets (25.6% against 38.5% on average for the smallest firms). On the other hand, the relationship between growth and this measure of risk is negative but not statistically significant.

⁵⁷ If an index of governance were available it could be used to distinguish between the two possibilities. We have also used the proportion of risk weighted assets to total assets as an alternative measure of risk appetite. The coefficient is negative and statistically significant.

Size is measured here by total assets.⁵⁸ Most hypotheses suggest a negative relationship between size and capital held by firms, so that δ is expected to be negative.⁵⁹

G is the real annual GDP growth rate by quarter. We would expect a negative sign if buffers are pro-cyclical.

For each period t , the variable **Peer** is the average capital ratio of all firms, except firm i , that report at time t and that are of similar size to firm i .⁶⁰ We would expect the sign of λ to be positive if peer pressure is relevant.

Dep is the proportion of non-inter-bank deposits (commercial and retail deposits, the latter being insured) over total deposits, so that it partially captures the relevance of insurance.⁶¹ The larger the amount of insured funding the weaker market discipline can be, so that a negative τ could be regarded as evidence of moral hazard behaviour by firms.

Other variables (**Z**) have been also included in the estimation depending on their availability and relevance within the different databases. In particular, for building societies, return on equity (**ROE**) – measured as the proportion of profits over capital⁶² is included as an additional regressor. This variable is also

⁵⁸ Building societies data provides information on number of employees. When that is tried as a measure of size the estimated coefficient is negative but not statistically significant.

⁵⁹ We are therefore not using risk-weighted assets as an explanatory variable in our equation because it conflates the effect of size and risk. Our approach is based on separating size and risk and is more in line with FSA's ARROW approach (FSA (2000)) in that this distinguishes between impact (proxied by an indicator of size) and probability (proxied by risks).

⁶⁰ For each firm, the variable is calculated as the mean of the capital ratios of all firms, except the firm itself, that submit returns in the same period and that are in the same quartile. Lindquist (2004) proposes a similar but simpler measure, as he does not group firms by size.

⁶¹ On the liability side of a bank's balance sheet.

⁶² An alternative to ROE for building societies is the ratio of profit to reserves. The results are very similar to those reported here with the ratio defined relative to capital.

constructed for those banks that report a profit in their financial returns (BSD3). **ROE** is a proxy for the opportunity cost of capital, so the sign of the coefficient is expected to be negative. However, for building societies, profits are one of the main sources of capital, so changes in capital are closely equivalent to profits.

For banks, the variable **trade**, measured as the proportion of the trading book's notional risk weighted assets over total risk weighted assets, is a proxy for the amount of trading book activity. It is included as it could be argued that the assessment of risk associated with these activities could have different implications for capital than credit risk. The variable could capture business differences⁶³ associated with investment banking activities in the portfolio.

The dummy variable **foreign** is a trend dummy that takes that value of 0 if the country of origin of the firm's parent is the UK and 1 otherwise.⁶⁴

The hypothesis that there are adjustment costs in attaining the desired level of capital justifies the inclusion of the dependent variable lagged one period.

Finally, η_i is an unobservable variable that captures the idiosyncratic features of each firm that are constant over time but vary from firm to firm. These could cover management's aversion to regulatory risk, management's strategy for new business opportunities or management's freedom from shareholders. ε_{it} is a random shock.

Data

We estimate the model with two different sets of data. First, we use building societies' FSA quarterly capital returns covering the period 1997 Q2 - 2002 Q2, that constitute a balanced panel dataset. These returns include both capital statements and the income and expenditure account. Second, we use quarterly

⁶³ The average value of the variable *trade* for banks is 2.3% for UK-owned banks, 13.3% for other EU-owned banks, 17.1% for US-owned banks and 12.2% for other non-UK banks.

⁶⁴ We have tested not only whether foreign-owned banks have different capital ratios but also whether they respond differently to changes. The coefficient of the slope variable is not statistically significant.

capital returns submitted to the FSA by UK incorporated banks, covering the period 1998 Q3 – 2002 Q3.⁶⁵ Banks report at different months, in some cases their reporting pattern is not regular and some have changed it during the period analysed. It is an unbalanced panel dataset that in most cases does not contain information on income and expenditure but only on capital accounts.

Tables A1 and A2 summarise the main statistics of the variables used in the estimations for building societies and UK banks respectively.⁶⁶ The tables show three measures of standard deviation of the relevant variables: “total”, “over time” and “within firms”. The first measures the overall dispersion of the dataset; the second measures the deviation in firms’ average over time; the third measures the deviation within each firm over time.

All variables in the tables, except for **ROE**, show more dispersion across firms than within a given firm over time.⁶⁷ In many instances, the differences among firms are four times larger than the differences across time. These variations suggest that the different behaviour among firms needs to be properly analysed.⁶⁸

⁶⁵ In particular we used BSD3 returns.

⁶⁶ We have dropped for bank returns observations where:

- the value of the capital ratio or the capital requirement was missing;
- the capital ratio exceeded 500%;
- the variable *risk* or *dep* was larger than 100.

We have also excluded two observations with capital ratios below or at the required minimum level, as these banks would have been subject to intervention by the supervisory authorities.

⁶⁷ The mean of ROE for banks is 6.88 and the dispersion is higher across firms than within a given firm over time.

⁶⁸ Average buffers (and their dispersion) for UK banks are higher than those reported for Spanish (Ayuso et al. (2004)) and Norwegian (Lindquist (2004)) banks. The average buffer for building societies is below or close to the ones reported there. In particular, the variable *buffer2* for Norwegian banks is 9.4% with a 6.3 standard deviation and the variable *buffer* for Spanish banks is 40.3% with 40.4 of standard deviation.

A comparison of the tables shows that much higher average capital ratios are observed for banks than for building societies. Regulatory capital requirements are also set at a higher level for banks than for building societies, but the dispersion of the former is much higher than the one for the latter.

TABLE A1: SUMMARY STATISTICS OF BUILDING SOCIETIES ⁽¹⁾				
Variable ⁽²⁾	Mean	Standard deviation	Standard deviation over time	Standard deviation within firms
<i>K</i>	15.16	4.11	4.05	0.88
<i>Kr</i>	9.65	0.50	0.40	0.30
<i>Tier 1</i> ⁽³⁾	95.45	6.89	6.52	2.37
<i>Buffer</i> ⁽⁴⁾	56.92	40.51	39.70	9.39
<i>Buffer2</i> ⁽⁵⁾	5.50	4.02	3.96	0.87
<i>Size</i>	2229.0	7947.4	7859.9	1513.1
<i>Risk</i>	6.88	4.18	3.75	1.89
<i>Peer</i>	15.16	1.31	1.25	0.43
<i>ROE</i>	6.83	4.52	2.55	3.75
Observations	1365			
Firms	65			

(1) Variable definitions are in the text.

(2) *Size* in millions of £; *K*, *Kr*, *Buffer*, *Risk*, *Peer* and *ROE* in % terms.

(3) Tier 1 capital/capital in % terms.

(4) *Buffer* is defined as $(K-Kr)/Kr$ in % terms.

(5) *Buffer2* is defined as $K-Kr$.

TABLE A2: SUMMARY STATISTICS OF BANKS ⁽¹⁾				
Variable ⁽²⁾	Mean	Standard deviation	Standard deviation over time	Standard deviation within firms
<i>K</i>	41.45	61.01	61.44	22.60
<i>Kr</i>	12.78	5.90	5.21	3.33
<i>Tier 1</i> ⁽³⁾	87.28	14.89	13.89	5.87
<i>Buffer</i> ⁽⁴⁾	234.52	558.38	546.15	223.14
<i>Buffer2</i> ⁽⁵⁾	28.67	59.67	60.02	22.81
<i>Size</i>	14536.48	46452.24	42617.7	11559.41
<i>Risk</i>	30.82	26.22	24.69	9.29
<i>Dep</i>	63.04	35.00	32.72	13.14
<i>Peer</i>	41.45	18.07	15.49	9.38
<i>Trade</i>	7.55	20.08	18.62	6.04
Observations	2744			
Firms (foreign)	187 (92)			

(1) Variable definitions are in the text.

(2) *Size* in millions of £; *K*, *Kr*, *Buffer*, *Risk*, *Dep*, *Peer* and *Trade* in % terms.

(3) Tier 1 capital/adjusted capital in % terms.

(4) If target ratios are used the *buffer* mean is 213.99.

(5) If target ratios are used the *buffer2* mean is 27.66.

Empirical results

In order to carry out the estimation, we re-specify equation (1) in logs, so that it becomes:

$$\begin{aligned} k_{it} = & a_{it} + \alpha kr_{it} + \beta risk_{it} + \delta size_{it} + \gamma g_t + \tau dep_{it} \\ & + \lambda peer_{it} + \tau dep_{it} + \xi z_{it} + \mu k_{it-1} + \eta_i + \varepsilon_{it} \end{aligned} \quad (2)$$

where the lower case names indicate variables in logs.

We treat the risk variable (**risk**), the deposits variable (**dep**), the trading book variable (**trade**) and the opportunity costs variable (**roe**) as endogenous. As the lagged endogenous variable is included among the regressors, we proceed to transform the above equation into first differences, as is traditionally done with panel data.⁶⁹ We estimate equation (2) using instrumental variables.⁷⁰ We report the coefficients and their robust standard errors from the robust one-step estimators. We report the Sargan test of over-identifying restrictions and autocorrelation tests of first and second order. When we use differenced data, we should observe first order autocorrelation and no second order autocorrelation.

We present the results from the two different types of return. Table A3 has the results for building societies and Table A4 the results for banks.

In columns 1 to 4 in Table A3 a first difference estimate is reported, using a GMM estimator with lagged levels of the dependent variable and the endogenous variables (second, third and fourth lags) and the lagged differences of the exogenous as instruments. The variables **risk** and **roe** are treated as endogenous.

⁶⁹ For the static estimation with building society data to assess the role of ROE we use a fixed effect estimate. The fixed effects estimator leads to consistent estimates even if the time-invariant component of the error term (η_i) is correlated with the regressors.

⁷⁰ A GMM estimator is used for the coefficients using lagged levels of the dependent variable and the endogenous variables (second or more lagged periods) and differences of the strictly exogenous variables.

TABLE A3: DETERMINANTS OF BUILDING SOCIETIES CAPITAL RATIOS (1997 Q2-2002 Q2) ⁽¹⁾				
Variable	All sample	Firms that experienced an increase in <i>kr</i>	Firms that experienced a reduction in <i>kr</i>	Firms with a low buffer ⁽²⁾
<i>kr</i>	0.18 (0.07)**	0.22 (0.10)**	0.21 (0.10)**	0.29 (0.14)**
<i>size</i>	-0.02 (0.02)	-0.05 (0.03)**	0.01 (0.01)	-0.08 (0.04)**
<i>risk</i>	-0.04 (0.01)**	-0.05 (0.01)**	-0.04 (0.01)**	-0.01 (0.02)
<i>g</i>	-0.002 (0.005)	-0.003 (0.007)	-0.004 (0.006)	-0.01 (0.009)
<i>peer</i>	0.16 (0.06)**	0.17 (0.09)**	0.04 (0.08)	0.17 (0.13)
<i>roe</i>	0.01 (0.004)**			
<i>k</i> _{<i>t-1</i>}	0.48 (0.06)**	0.39 (0.06)**	0.63 (0.12)**	0.34 (0.09)**
<i>k</i> _{<i>t-2</i>}	-0.10 (0.04)**	-0.10 (0.04)**		
Instrumented variable	<i>risk, roe, k</i> _{<i>t-1</i>} , <i>k</i> _{<i>t-2</i>}	<i>risk, k</i> _{<i>t-1</i>} , <i>k</i> _{<i>t-2</i>}	<i>risk, k</i> _{<i>t-1</i>} , <i>k</i> _{<i>t-2</i>}	<i>risk, k</i> _{<i>t-1</i>} , <i>k</i> _{<i>t-2</i>}
Instruments (all exogenous and...)	2 nd , 3 rd and 4 th lag of <i>risk, k</i> _{<i>t-1</i>} and <i>roe</i>	2 nd , 3 rd and 4 th lag of <i>risk, k</i> _{<i>t-1</i>}	2 nd , 3 rd and 4 th lag of <i>risk, k</i> _{<i>t-1</i>}	2 nd , 3 rd and 4 th lag of <i>risk, k</i> _{<i>t-1</i>}
Sargan test ⁽³⁾	1.00 (291)	1.00 (239)	1.00 (242)	1.00 (242)
H ₀ = No 1 st order autocorrelation Prob > z	0.000	0.0004	0.13	0.03
H ₀ = No 2 nd order autocorrelation Prob > z	0.87	0.93	0.80	0.55
Observations	1162	954	304	305
Firms	65	53	16	33

(1) First difference regression. First-step robust standard errors in brackets. All equations include quarterly dummies.

(2) Observations with an excess capital lower than 30.5%, which corresponds to the lowest quarter of the population.

(3) Prob > χ^2 (degrees of freedom).

(*) Statistically significant at 10%.

(**) Statistically significant at 5%.

Robust standard errors and the estimated coefficient from first step estimates are reported. Column 1 reports the results obtained for the whole sample. Column 2 and 3 report the results obtained when firms that have experienced an increase or a decline in requirements are considered, respectively. The last column shows the results obtained with the observations corresponding to those building societies whose buffer (difference between capital held and capital required) is in the lowest quartile.

Table A4 shows the results obtained with the banks' quarterly returns. As already mentioned, some of them have changed their reporting pattern, some new firms have appeared and some have stopped reporting. It is therefore an unbalanced panel.

All columns in Table A4 show first difference estimates, obtained using a GMM estimator with lagged levels of the dependent variable and the endogenous variables (second, third, fourth lags) and the lagged differences of the exogenous variables as instruments. Column 1 show the results obtained for the whole sample. Column 2 shows the results only for the firms that carry out trading book activity. Columns 3 and 4 show the results for firms that have experienced an increase and a decline, respectively in their regulatory capital requirements. 33 firms have experienced both an increase and a decrease in their requirements during the period considered and so are included in both columns. Column 5 reflects the results obtained for banks that have the lowest buffer (those in the lowest quartile).

None of the estimated equations presented in Tables A3 and A4 can reject the Sargan test of over-identifying restrictions. They all show good properties in the face of autocorrelation: as expected, they show first order autocorrelation, but the hypothesis of no second order autocorrelation can be rejected in all cases.

TABLE A4: DETERMINANTS OF BANKS CAPITAL RATIOS (1998 Q3-2002 Q3) ⁽¹⁾					
Variable	All sample	Firms with trading book	Firms that experienced an increase in $kr^{(2)}$	Firms that experienced a reduction in $kr^{(3)}$	Firms with a low buffer ⁽⁴⁾
<i>kr</i>	0.28 (0.14)**	0.43 (0.23)**	0.49 (0.23)**	0.19 (0.10)**	0.41 (0.15)**
<i>size</i>	-0.23 (0.06)**	-0.38 (0.07)**	-0.25 (0.04)**	-0.26 (0.06)**	-0.13 (0.06)**
<i>risk</i>	-0.22 (0.07)**	-0.23 (0.05)**	-0.17 (0.04)**	-0.25 (0.07)**	-0.12 (0.06)**
<i>g</i>	-0.04 (0.02)**	-0.11 (0.04)**	-0.08 (0.04)**	-0.01 (0.02)	-0.04 (0.02)**
<i>peer</i>	0.07 (0.02)**	0.06 (0.03)*	0.08 (0.03)**	0.06 (0.03)**	0.01 (0.01)
<i>dep</i>	0.02 (0.03)	0.02 (0.01)**	0.02 (0.01)*	-0.03 (0.03)	-0.02 (0.06)
<i>trade</i>	-	-0.06 (0.03)**	-	-	-
<i>foreign</i>	0.005 (0.005)	0.008 (0.007)	-0.002 (0.007)	0.01 (0.007)*	0.0005 (0.006)
k_{t-1}	0.32 (0.09)**	0.30 (0.06)**	0.31 (0.07)**	0.24 (0.05)**	0.22 (0.07)**
Const	0.007 (0.003)**	0.006 (0.006)	0.01 (0.005)*	0.006 (0.004)	-0.02 (0.004)**
Sargan test ⁽⁵⁾	0.93 (201)	1.00 (242)	1.00 (201)	1.00 (201)	1.00 (190)
H_0 = No 1 st order autocorrelation Prob > z	0.000	0.005	0.009	0.0004	0.05
H_0 = No 2 nd order autocorrelation Prob > z	0.92	0.99	0.75	0.78	0.47
Observations	2052	646	821	1180	403
Firms	182	59	72	97	76

(1) First difference regression. First-step robust standard errors in brackets. *Risk*, *dep*, *trade*, k_{t-1} and k_{t-2} have been instrumented with their 2nd, 3rd and 4th lags and the lagged differences of the exogenous variable.

(2) Includes only firms that have experienced an increase in regulatory capital requirements. 35 of them carry out trading book activity.

(3) Includes only firms that have experienced a decrease in regulatory capital requirement. 32 of them carry out trade book activity.

(4) Includes only observations corresponding to an excess capital lower than 27.78 %, which corresponds to the lowest quartile of the population.

(5) Prob > χ^2 (degrees of freedom).

(**) Statistically significant at 5%.

(*) Statistically significant at 10%.

We observe a clearly significant positive relationship between capital requirements and observed capital ratios in the building societies and banks' returns datasets, suggesting that the higher the required capital ratio the higher the actual capital ratio. The value of the coefficient for the short term ranges from 0.28 for all banks to 0.43 for banks engaged in trading activities. The long term coefficient for these same groups of firms is estimated to be 0.41 and 0.61 respectively. For the whole building societies sample the short term coefficient is 0.18 and the long term 0.29. The figures in columns 3 and 4 of Table A4 suggest that, when faced with an increase in the regulatory requirements, banks transfer nearly 50% of the change into changes in the capital ratio in the short term. In the long term it could reach 71%. When faced with a regulatory reduction, they reduce their holdings just below 20% of the change in the short term (25% in the long run). Building societies do not seem to have such an asymmetric response.

We might also expect that firms whose actual capital ratio is closer to their regulatory individual requirement would react more strongly to changes in capital requirements, because of the regulatory pressure. To test this hypothesis, we estimate the equation for various groups of firms defined according to their buffer. However, only the results for the lowest quartile are reported (last column of Tables A3 and A4). Both building societies and banks whose buffer is in the lowest quartile, show an estimated coefficient for the regulatory capital much higher than for the whole sample. Firms with a large buffer do not seem in general to react to changes in the required capital: the coefficient of *kr* is either not statistically significant or much lower than for firms whose capital is closer to the regulator's requirement. So capital requirements seem not to be a binding constraint for those firms with a large enough buffer.

We find a statistically significant negative effect of size on capital holdings, so the larger the firm the lower its capital ratio. This negative relationship could reflect any of the various hypotheses that have been discussed in the main text. The current specification does not allow for a unique interpretation.

The relationship between capital ratios and the proposed measure of ex-post risk is estimated to be negative, so the higher the risk appetite of a firm, the less

capital it holds.⁷¹ Evidence of a negative risk effect is also obtained in Ayuso et al. (2004) and Lindquist (2004). This result could support the hypothesis that there is moral hazard in firms' behaviour. However, this interpretation is not consistent with the positive relationship estimated between the ratio of partially insured deposits over total deposits and capital holdings. It could be argued, moreover, that riskier firms also have stricter systems and controls allowing them to be comfortable with less capital for a given risk.⁷²

We tried including a multiplicative variable composed of risk and size and either it is not statistically significant or it is positive, reflecting the compound effect of the two variables.

We find a negative relationship between the economic cycle and the capital ratio, the coefficient being statistically significant for banks. Not surprisingly, for building societies the results are more mixed. So we can tentatively conclude that the amount of capital held by firms depends negatively on GDP growth. We can therefore expect that, during a contraction, banks would try to hold more capital than in a boom. Thus we cannot find evidence of the buffer being procyclical.

We find evidence of peer pressure through the capital ratio. This suggests that firms may be using the capital ratio as a signalling device and that the capital ratio of similar firms is a relevant area for competition. Peer pressure seems to be relevant for all the types of firm considered, although the coefficient is not very high. Lindquist (2004) also finds evidence that competitors' buffer capital weakly affects the size of the firm's buffer.

We estimate a negative relationship between the amount of assets in the trading book and capital holdings. Again it could suggest that firms engaging in these activities value risks differently, at least as regards the risks that could be

⁷¹ We have tried other proxies for risk such as the ratio of highest risk assets over risk weighted assets or including the proportion of assets weighted at 50%. The coefficients are always negative and statistically significant.

⁷² Rather similar results are obtained when we proxied risk by the ratio of Tier one capital over total eligible capital and when we used other risk buckets.

reflected in capital. When we consider only firms engaging in trading activities, the coefficient of capital requirements rises. It seems that this type of firm is more responsive to regulatory pressure.

The coefficient of the opportunity cost of capital for building societies is positive, when the dynamic specification is used. Profits are the main source for building society capital and this dependency may explain the positive relationship. For banks we have not been able to find a meaningful proxy.⁷³

For banks, the parents' origin (i.e. whether it is UK or foreign) seems to have no influence neither on the average capital ratio held nor on the reaction to changes in capital requirements.

⁷³ Following Lindquist (2004), we have tried including a market value of beta obtained from 8 large banks. The coefficient is positive and not statistically significant.

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The Financial Services Authority
25 The North Colonnade Canary Wharf London E14 5HS
Telephone: +44 (0)20 7066 1000 Fax: +44 (0)20 7066 1099
Website: <http://www.fsa.gov.uk>

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