Understanding European Banks Capital Buffer Fluctuations

Terhi Jokipii[♣]
Monetary Policy and Research Department
Bank of Finland
and
Institute for International Integration Studies
Trinity College Dublin

Alistair Milne
Monetary Policy and Research Department
Bank of Finland
and
Faculty of Finance
Cass Business School

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Abstract

This paper serves to understand the relationship that exists between the business cycle and the capital buffers of European banks. Using an unbalanced panel of European commercial, savings and cooperative banks between 1997 and 2004, we specifically control for potential determinants of capital buffers in order to analyse the sign and the magnitude of the effect that the business cycle has on capital buffer fluctuations. Our results highlight a distinct difference that appears to exist between banks operative in the recently accessed member states (RAM) and those of the European Union (EU) 25, 15 and euro area (EA). Evidence tends to indicate that the capital buffers of the RAM banks appear to have a significant positive relationship with the cycle while for the EU25, EU15, and the EA, the relationship is robustly signficantly negative. We further distinguish between type and size of bank, and find that commercial and savings banks, as well as large banks move counter-cyclically. We particularly find that savings banks drive the negative effect for the EU25, EU15 and EA samples. Cooperative banks and smaller banks on the other hand, are found to be pro-cyclical in their fluctuation.

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[♣] Corresponding Author: Jokipiit@tcd.ie; Institute for International Integration Studies, Trinity College Dublin, College Green, Dublin-2; +353- 1-608-3209.

1. Introduction

Bank insolvencies or collapses are widely perceived to have greater adverse economic effects than a failure in any other industry. With the potential to spread in domino fashion throughout the banking system destroying both solvent as well as insolvent banks, failures within the banking system are considered to be far more damaging than those in any other industry. The reason for the destructive potential of failures in the banking system compared to other sectors stems from the tight network of credit inter-connections that exists between institutions. Such linkages create a special source of risk that can induce chain reactions originating from the distress of very few banks, something often referred to as systemic risk. This phenomenon is widespread, and appears to exist in almost every country at almost every point in time regardless of the existing economic or political structure. As a result, bank failures have been, and continue to be, a major public policy concern in all countries and a principal reason that banks are regulated far more rigorously than firms in any other sector.

Several instruments have therefore been adopted for the regulation of banking institutions, the most prominent taking the form of the capital requirement regulation. As imposed by the 1988 Basel Capital Accord and its subsequent amendments, the regulation requires that banks hold a minimum amount of capital equal to eight percent of its risk-weighted assets. An updated version of Capital Accord, Basel II, will come into force in 2007 with the objective of bringing bank capital requirements more in line with actual risks. The move towards increased risk-sensitivity in the bank capital requirements has sparked a debate relating to the potential amplification of the cycles that could consequently arise[1]. Much of the work relating to the cyclicality of the capital requirements have however failed to consider that most banks hold capital to a large degree in excess of that required by the regulators. (see for example Berger and Undell, 1994; Berger, 1995; Kwan and Eisenbeis, 1997; Jackson, 1999; Furfine, 2000). Table 1 highlights the fact that all banks operating in Europe hold a capital ratio in the region of five percentage points above that required of them.

Literature in this field has hence become concerned with understanding the determinants of this excess capital under the current Accord in an attempt to shed some light on the possible implications of the introduction of the new framework (see Ediz, 1998; Rime, 2001; Ayuso et al., 2004; Bikker and Metzemakers, 2004; Estrella, 2004; Lindqvist, 2004; Stoltz and Wedow, 2005). Many of these authors have concentrated on studying certain aspects of capitalization within a single country framework, the notable exception being Bikker and Metzemakers (2004), who perform a cross-country analysis on 29 OECD countries. A further gap in this literature stems from the inability of these studies to uncover significant evidence relating

[1] See among others BCBS (2001), Borio et al. (2001), Daníelsson et al. (2001), DNB (2001) and ECB (2001).

to capital buffer movements between different types or sizes of banks. Ayuso et al. (2004) concentrate on a panel of Spanish savings and commercial banks, finding a robustly significant negative relationship between the cycle and the buffer. Lindqvist, (2004) estimates a similar model for Norwegian savings and commercial banks and find a similar negative effect. Bikker and Metzemakers (2004), analyse the buffer-cycle relationship for a set of OECD countries. Their analysis focuses on commercial banks only and uncovers a similar negative relationship. In their study on the buffer movements of German savings and cooperative banks over the cycle, Stoltz and Wedow (2005) separate their sample by type of bank. They find a similar negative effect to other authors in this field, but discover that the fluctuations appear to be stronger for savings banks than they are for commercial banks.

The apparent anti-cyclical nature of the buffers, as uncovered by various studies noted above, has resulted in a subsequent concern that the pro-cyclicality effect has the potential to become further amplified under the Basel II regime[2]. In this paper, we consequently estimate the relationship between capital buffers and the business cycle for a sample of banks operating in Europe in order to shed some further light on this relationship. We define the capital buffer as the amount of capital banks hold in excess of that required of them by the national regulator. Splitting the banks in our sample by countries so as to obtain EU25, EU15, EA, Denmark, Sweden and the United Kingdom (DK,SE,UK) and RAM sub-samples, we estimate a set of equations in order to determine whether differences in the buffer-cycle relationship exists. For further analysis, we separate banks by both type and size to further scrutinize this relationship.

Our estimation results indicate that differences between the natures of the fluctuations of capital buffers of the various sub-groups are substantial. We find that RAM banks appear to fluctuate pro-cyclically with the business cycle while banks operative in the EU25, EU15, DK,SE,UK and EA samples fluctuate anti-cyclically. Breaking the sample down further by size and type of bank, we find additional distinctions. Here, capital buffers of commercial and savings banks, as well as those of larger banks appear to fluctuate counter-cyclically while those of cooperative banks and of smaller banks move together with the cycle.

The remainder of the paper is organized as follows. Section 2 gives a short overview of bank regulation. Section 3 describes the motivation for holding excess capital. Section 4 details the data used briefly introduces the empirical specification adopted in our analysis. Section 5 presents our empirical results. Section 6 works through various robustness checks. Finally, section 7 concludes.

[2] It should be noted that for the purpose of this paper, pro-cyclical fluctuations of capital buffers refer to the co-movements between these two variables, rather than to the amplification of the cycles as per the Basel II literature.

2. Bank Regulation

The combination of the general instability of banking institutions, their complex web of inter-connections, together with their important facilitating role in the economy has led the banking sector to become a thoroughly regulated industry. Various different instruments have been adopted for the regulation of the banking sector, and can broadly be characterized by the following: the government safety net, restrictions on asset holdings, capital requirements, chartering and bank examination, disclosure requirements, consumer protection and restrictions on competition (Greenbaum and Thakor, 1995; Freixas and Rochet, 1997; Mishkin, 2000).

Capital regulation has become one of the key instruments of modern banking regulation with the aim of providing both a 'buffer' during adverse economic conditions, as well as a mechanism aimed at preventing excessive risk taking ex ante (Rochet, 1992; Dewatripont and Tirole, 1993). Broadly speaking, a bank has only two distinct means to finance its operations; either through the use of borrowed money or alternatively, it can make use of funds provided by its owners. Borrowings (including deposits) generate contractual liabilities, which, if not paid when due, can result in bank failure. On the contrary, the owners' investments can either gain or lose value without causing the bank to default on its obligations. Thus, all other things being equal, the greater the proportion of a bank's operations that are financed with capital funds contributed by its owners, the higher the chance that the bank will continue to be able to pay its obligations during periods of economic adversity. This simple reasoning is the basis for the longstanding emphasis that bank supervisors have placed on capital adequacy as a key element of bank safety and soundness.

With the intention of indirectly affecting capital structure by reducing the relative amount of debt, capital regulation requires that banks hold an amount of capital dependent on both the quantity and the quality of its assets. The ideology stems from a combination of the legal construction of limited liability together with an important incentive feature of debt finance. The concept of limited liability implies that cash flows can not become negative, as debt remaining after all assets have been liquidated and all outstanding debt repaid as far as possible, will be forgiven[3]. In a largely leveraged firm, owners are able to reap the gains of success while shifting losses to the lenders via limited liability. Consequently, incentives for risk taking beyond Pareto optimality are significantly increased[4]. Since banks often times have capital structures with substantial amounts of debt, the possibility of such risk shifting behaviour in this sector is particularly problematic.

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[3] See Eichberger and Harper, 1997.

[4] For a more detailed discussion of the risk shifting phenomenon in banking and the role of capital requirement regulation in mitigating this, see ; Milgrom and Roberts 1992; Greenbaum and Thakor, 1995 and Keely, 1990.

The regulation, as implemented by the Basel Accord of 1988, applies to all internationally active banks. Over 100 countries to date have adopted the rules, most of which additionally require locally active banks to adhere to them. The capital adequacy ratio is set equal to eight percent of the banks' risk weighted assets, and acts as an indicator of the banks' ability to absorb losses. The numerator of the ratio comprises total capital which is a combination of tier one and tier two capital. Tier one capital refers to the banks core capital, including equity and disclosed reserves and can absorb losses without a bank being required to cease trading. The ratio of the banks' tier one capital to risk-weighted assets should be no less than four percent. Tier two capital on the other hand, relates to secondary bank capital, and includes items such as undisclosed reserves, general loss reserves and subordinated term debt. Tier two capital can absorb losses in the event of a winding-up and so provides a lesser degree of protection for depositors. The denominator of the ratio is obtained by multiplying assets by a pre-defined weighting coefficient[5].

The capital regulation rules, as outlined above, are a minimum to be implemented by the individual supervisory authorities with the aim of creating a level playing field for market operatives, as well as for ensuring a sound and stable financial environment. Several of the supervisory authorities acting in the countries within our sample have, for various reasons, either set capital ratios above those recommended by the Accord, or, alternatively, supplemented the rules with a range of additional requirements. Table 2 presents the implementation of the minimum capital requirements adopted by the national regulators of the countries in our sample. Further individual country measures are outlined in Annex 1.

2.2 New rules

Since its implementation in 1988, The Basel Accord has helped to strengthen the soundness and the stability of the international banking system as a result of the higher capital ratios that it required. The revised version of the Capital Regulations (Basel II), to be implemented by 2007, aims to bring the framework more in line with modern banking by becoming more risk-sensitive and representative of current risk management practices. There are several components to the new framework. First, it is more sensitive to the risks that firms face: the new framework includes an explicit measure for operational risk and additionally updates the existing weightings that exist against credit risk. Under the standardised approach, banks will be permitted to make use of external ratings by acknowledged ratings agencies; introducing differing weight coefficients for counterparties distinct from the set risk buckets defined under Basel I. Risk coefficients for enterprises under Basel II, will range between 20 and 150 percent depending on the risk involved.

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[5] Under the Basel I Accord, four risk buckets are set: 0 per cent for claims on central governments; 20 per cent for claims on other banks; 50 per cent for loans secured by residential property and 100 per cent for claims on private sector.

The Accord further reflects improvements in firms' risk management practices, for example by the introduction of the internal ratings based approach (IRB) for credit risk. The IRB approach will allow firms to rely, to a certain extent, on their own internal estimations of default probabilities and of loss given default. Risk coefficients here have the potential to be even more risk sensitive than under the standardized approach, with coefficients ranging between 3 and 600 percent, depending on the perceived riskiness of the counterparty (BIS, QIS3 Report).

Much of the debate surrounding Basel II has focused on the potential cyclicality effects that could arise from the adoption of the new framework. Since one of the primary aims of the new Accord is to create a closer link between capital requirements and risks, it is clear that these requirements will subsequently become more dependent on the business cycle. In a cyclical downturn, when counterparties are more likely to be downgraded than upgraded, the resultant effect under the standardized approach would be a significant increase in the capital requirements to account for the increased risk of the counterparty. Similarly, during an economic upturn, when rating agencies are likely to increase the number of upgrades made, the amount of capital required would be reduced. Since raising capital is costly, especially during an economic recession when profits are decreasing, banks might be forced to reduce their loan portfolio in order to meet rising capital requirements. The subsequent credit squeeze would add to the downturn and further accentuate the cycle, creating an undesired effect on bank stability.

3. Capital Buffers

Despite the safety-and-soundness benefits of capital regulation, requiring banks to hold increased levels of capital does have costs and can be argued to be a binding constraint on bank behaviour. Obliging a bank to be financed with a greater percentage of capital in effect restricts the amount of borrowing it can support with a given amount of capital, ultimately hampering its capacity to lend. Capital rules imposed on banks can thereby have broader macroeconomic effects on the availability of credit. Nevertheless, as seen in Table 1, banks tend to hold far more prudential capital than that required by the regulators.

Reasons why banks may wish to hold excess capital are diverse. (see for example Marcus, 1984; Berger et al., 1995; Jackson, 1999; Milne and Whalley, 2001; Milne, 2004) Banks generally will tend to assess their risks differently, for instance via the use of internal economic capital models. Appropriate bank-specific capital levels will therefore be set according to varying assumptions and levels of assumed risk appetites. Alternatively, banks may choose to hold excess capital in order to signal soundness to the market as a means to obtain funds quickly and at a lower rate of interest in the event of unexpected profitable investment opportunities. Buffer capital can further act as a cushion, absorbing costly unexpected shocks, particularly if the financial distress costs from low capital, and the costs of accessing new capital quickly, are high. Furthermore, banks may hold capital as a security against the violation of the regulatory minimum (Marcus, 1984; Milne and Whalley, 2001; Milne, 2004). By holding capital as a buffer, banks' essentially insure themselves against costs related to market discipline or supervisory intervention in the event of a violation of the requirements. Table 1 presents the amount of capital each country holds in excess of that required. Here, buffer capital is measured as the capital ratio held over the minimum required by the regulators. The figures presented are weighted by market share. Figure 1 further plots the evolution of our individual sub-sample capital buffers over the last eight years, highlighting slight differences that appear to exist.

3.1 Capital Buffers and the Business Cycle

In spite of the many reasons cited for banks holding buffers of capital it is generally thought that they do so to provide a cushion for absorbing negative capital shocks. For banks, the main source of such shocks relate to credit risk, or the risk arising from uncertainty relating to a counterparty's ability to meet its obligations. The term credit risk can be thought to comprise both expected as well as unexpected losses. 'Expected losses' relate to the average anticipated loss likely to be incurred over a period, while 'unexpected losses' concern the degree of uncertainty surrounding a particular event. The evolution of such risks can essentially be thought to be anticyclical in nature since during an economic downturn (upturn) the probability of default increases (decreases) with the increased volatility of asset returns while the expected loss increases (decreases). Similarly, unexpected losses also increase (decrease) during a recessionary (inflationary) period.

There are generally two distinct reasons why capital levels should change over time; the first relates the change in the riskiness of the banks portfolio and the subsequent need to provide a cushion to absorb such risks. The second relates to intertemporal arbitrage, highlighting the fact that banks raise capital so as to avoid having to do so under adverse conditions. Economic cycles essentially drive both concepts, and subsequently affect the level of capital held since capital holdings may vary over time to accommodate fluctuations in risk arising from disparities in the economic environment not captured by fixed weights attached by the regulator to assets.

3.2 Hypotheses

Our estimations therefore serve to test whether such changes can be driven by cyclical variations, by testing the null hypothesis (H_0) that under the Basel I Accord, business cycle fluctuations do not have an impact on capital buffer fluctuations.

Considering credit risk to be anti-cyclical in its nature, as outlined above, we formalise our alternative hypotheses (H_1) as follows:

$H_1(a)$ Banks tend to increase capital in business cycle expansions and reduce capital in business cycle recessions exhibiting pro-cyclical behaviour. Given the anti-cyclical behaviour of credit risk, estimated risks generally tend to be higher during an economic downturn, increasing bank capital buffers by more than average in order to account for the increasing risks. However, building reserves or raising capital from decreasing profits can prove costly and could result in the need for banks to shrink their lending activities. Hence, during recessions, when risks materialize, banks tend to feed from the buffers built up during economic upturns resulting in a pro-cyclical effect despite actually increasing (decreasing) in an economic downturn (upturn).

Alternatively, as argued in the literature (see among others Rajan, 1994; Borio et al., 2001; Crockett, 2001) risks during upturns may actually increase. Essentially, during an economic boom, lenders continue to provide large amounts of credit while imbalances that will become responsible for the following recession continue to build up, increasing the possibility of unusually large losses. Both arguments whereby banks build up capital during an economic upturn to offset the negative effects of pro-cyclical requirements would provide evidence in favour of forward-looking or prudent bank behaviour.

$H_1(b)$ During an economic upturn, when risks are less likely to materialise and banks can safely hold less capital, they tend to expand their loan portfolios without subsequently building up their capital buffers, underestimating risks. In the subsequent economic downturn when risks materialize, the deficient capital buffers are unable to absorb shocks encountered from the possible rise in the number of write-offs and provisions. Additionally, banks relying on credit ratings to gain access to capital markets may also need to raise their capital holdings to maintain their ratings during an economic downturn. Banks would therefore be expected to hold higher levels of capital during economic busts than during booms, in order to cover materializing risks.

Building up buffers during economic adversity can prove expensive and difficult since profits are likely to be decreasing, and the cost of raising fresh capital expensive. Banks would therefore have to resort to reducing their loan portfolio through either the reduction or the non-renewal of existing contracts. Essentially, such a lack of capital build-up or inability to properly account for risks during and an economic upswing can be considered as short-sighted bank behaviour.

Cyclical variables can further serve to capture economic conditions since both credit risk and losses are negatively correlated with the business cycle. Similarly, the capital required to cover for such losses increases during a downturn, implying risk-sensitive behaviour.

3.2. Empirical Specification

In order to better understand the behaviour of European bank capital buffers, we consequently consider that capital decisions are based on a trade-off between three types of costs; the cost of holding capital, the cost of failure and the cost of adjustment. The combination of the costs considered in a banks capital decisions can be organised as follows:

$$C_t = (\alpha_t - \gamma_t)K_t + (1/2)\delta_t I_t^2 \qquad (1.)$$

where K_t represents the capital level at time t, α_t denotes the cost of holding capital, γ_t, the cost of bank failure and δ_t the existence of adjustment costs. I_t^2 denotes the stock issues or repurchases plus the profits retained in period t[6]. Here, linearity concerning both the cost of holding capital and the cost of failure, as well as symmetry with regard to the cost of adjustment, are assumed for simplicity. The costs are described in greater detail below.

Cost of holding capital

The first cost relates to the cost of holding capital which is essentially proportional to the level of capital of an operating bank. This cost can relate either to the difference that exists between the costs of capital funding, and funding through other means such as through deposits or through debt. Theoretical analysis (see Myers and Majluf, 1984; Campbell, 1979) has argued that in the context of information asymmetries, equity is a more costly alternative to other bank liabilities. We include the banks return on equity (ROE) in order to capture the direct costs of remunerating excess capital. This measure reveals how much profit a company earned in comparison to the total amount of shareholder equity found on the balance sheet.

Considering that as capital ratios increase, spreads required to generate a given ROE also increase, illustrating the cost of holding excess capital. We would therefore expect to observe a negative relationship between the capital buffer and the ROE variable.

Cost of failure

Regulators constantly monitor banks' capital ratios C, ensuring that they do not fall below the regulatory minimum $C*$ thus reducing the probability of bankruptcy and

[6] Since the amount of profits retained is an unknown at the beginning of each period, capital levels can only be determined at the end of each period.

the costs associated with failure[7]. Here, when $C = C*$ the bank is faced with the option of recapitalizing or liquidating. Higher levels of capital therefore reduce the risk of non-compliance and the subsequent costs of failure which are directly proportional to absolute value of the negative net worth of the failing bank. (Milne and Whalley, 2001)

The actual cost of failure can be considered as the loss of share value times the probability of failure. Since a banks' probability of failure is dependent on its risk profile, we proxy the cost of failure by adopting various measures of risk. As a first measure, we consider the ratio of non-performing loans to total loans $(RISK)$ as per Ayuso et. al (2002). This is an *ex post* measure of the risks assumed by banks and is comparable to other measures adopted in the literature since banks with non-performing loans are obliged to make provisions for loan losses. We further include an alternative measure for risk as per Stoltz and Wedow (2005) and Lindquist (2004) whereby we consider the ratio of new net provisions over total assets $(RISK2)$[8]. If banks set their capital in line with the true riskiness of their portfolios, then we would expect the relationship here to be positive[9].

Size can have a significant impact on a banks' access to capital, and consequent target capital level. Furthermore, the size of a bank may play a role in determining the banks' risk level through its impact on investment opportunities and diversification possibilities. We include a $SIZE$ variable which is proxied by the natural log of total assets. We might expect larger banks to hold smaller capital buffers as per the 'too-big-to-fail' hypothesis since they generally expect to be 'bailed-out' if they are faced with difficulties. Small banks on the other hand, might hold larger buffers due to their relative difficulty to access the capital markets, in which case the $SIZE$ variable acts as a proxy for adjustment costs rather than the cost of failure.

Cost of adjusting capital

The final costs relate to the adjustment of capital. Considering financing under asymmetric information, costs in this sense are incurred when banks are forced to make use of external funds to add to existing internal capital (see for example Myers and Majluf, 1984). Such a cost mechanism provides motivation for holding higher levels of capital as a way of mitigating costs of remuneration. If the bank lets its internal funds fall too far, it is faced with the choice between cutting highly rewarding

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[7] So called losses of failure include the loss of charter value, reputational loss, and the legal costs of the bankruptcy process. (see Ancharya, 1996).

[8] As the results for $RISK$ are broadly in line with those obtained for $RISK2$, we present only those for $RISK2$ since more observations are available for this variable.

[9] Banks may vary significantly in their willingness to take risk. This measure therefore can be assumed to uncover information on bank type. Any further idiosyncratic time-invariant component in the banks risk profile would be captured by the μ_i component of the residual term of Equation 2.

investments or incurring high costs of external finance. In order to capture these adjustment costs, we include the lagged dependent variable BUF_{t-1}. Higher adjustment costs would result in a higher coefficient of the lagged dependent variable, signifying a lower speed of adjustment. We therefore expect the coefficient to be positively signed.

Bank capital decisions are subsequently modelled using a partial adjustment framework which can be presented as follows:

$$\Delta BUF_{it} = \varphi(BUF_{it} - BUF^{*}_{t-1}) + \varepsilon_{it} \qquad (2.)$$

where BUF_{it} is bank i's capital buffer at time t, φ is a positive adjustment parameter, ε_{it}, a random error term. In the long run, BUF converges to the optimal BUF^*, whereby φ captures the speed of the adjustment. Since BUF^* cannot be observed, it is approximated by a variety of variables that serve to capture the factors affecting the optimal capital structure[10].

Additional balance sheet variables

The size of a banks' profit can have an effect on bank capital in either a positive or a negative fashion but are considered an important source of capital financing, affecting the cost of adjustment. Since retained earnings are usually employed as a means to increase the capital cushion, a positive relationship would be evident. High profits on the other hand can similarly reflect high contract values and hence the need to consistently generate high profits. Consequently, capital buffers are increased through retained earnings implying a negative relationship between the buffer and the generation of profits (see Whalley and Milne, 2001). We therefore include post tax profits over total assets a measure of $PROFIT$ with an ambiguous anticipated sign.

Finally, we further include the level of bank loans $(NET\ LOANS)$ which acts to further reflect the risk profile of the bank since banks themselves could vary their capital buffers according to the risk profile of their loan portfolio. A larger number of loans with respect to total assets are likelier to reflect a riskier profile; the expected sign is therefore positive. We additionally incorporate annual loan growth $(\Delta LOAN)$ as a proxy for credit demand (Ayuso et al., 2004). Despite this variable being the interaction between credit supply and demand, it nevertheless serves as a proxy for credit demand since the main potential credit supply constraint (the capital requirements) is not binding in our sample. i.e. capital buffers are always positive. Moreover, since an increase in loan supply implies an increase in capital requirements, which in a context whereby the adjustment of capital (BUF_{t-1}) is costly is likely to result in an increase in capital buffers.

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[10] For a theoretical derivation and explanation of this model, see Ayuso et al. 2004 or Estrella, 2004.

Business and economic cycle variables

We further include a number of cyclical variables into the model in addition to the determinants of capital buffers in order to establish the magnitude and direction of the effect that the cycle has on the size of capital buffers held. The first indicator is the output gap, which is obtained by applying the Hoddrick-Prescott filter to the real GDP series. Furthermore, in order to ensure an in depth analysis of the relationship between the buffer and the business cycle, we additionally include the real GDP growth rate. The cycle variables are adopted at both the domestic level as well as at a broader sub-group level.

Table 3 describes each of the variables adopted in the analysis while Tables 4 and 5 provide some descriptive statistics for the balance sheet and cycle variables respectively. In our paper we present results for the output gap variables only since the difference in the relationship between the capital buffer and each of the cycle variables are diminutive. Differences that do exist lie predominantly in the degree of significance. Since the GDP growth is probably a slightly less precise measure as the average level of growth may differ across countries. Furthermore, considering that the output gap is merely a smooth curve fitted to the actual GDP data, ironing out much of the fluctuation and essentially isolating the business cycle, it is likely that results obtained for this variable are a more accurate reflection of the actual relationships that exist between the buffer and the business cycle. In this paper, we therefore focus on the output gap measure to capture the cyclical effect. Descriptive statistics for the GDP variables are presented in Table A. 1, and estimation results with the GDP series are available from the authors on request.

The correlation matrices for all the variables included in our estimations are presented in Tables A. 2 to A. 6 of Annex I, for the EU25, EU15, EA, DK,SE,UK and RAM sub-samples respectively. As expected, the cycle indicators appear to be highly positively correlated with each other in most cases. Looking at the capital buffer variables, we find that for the EU25, the EU15 and the EA samples, in all cases, the buffer variable appears to be significantly negatively correlated with both the domestic and the group output gap. These relationships may however be affected by spurious specific dynamics which are not controlled for in the simple correlation analysis. Our estimations controlling for bank-specific characteristics may shed some more light on the actual relationships between these variables.

4. Data and Estimation Approach

For the purpose of our estimations, we make use of an unbalanced panel data set consisting of eight years of annual bank balance sheet data obtained from the *Bankscope* Database. Data relating to our cycle variables were obtained from *Eurostat*. Our sample includes data for commercial, savings and cooperative banks. In total, 468 banks are included in the sample, made up of 364 euro area banks, 427 EU15 banks and 41 banks for the RAMs. All 25 European countries are represented.

The largest bank in the samples is *BNP Paribas*, with total assets of around EUR 906 bln at the end of 2004. The smallest bank, *Budapest Bank*, belonging to Hungary, has total assets amounting to just around EUR 1.5 million at the end of 2004. The distribution of banks in the sample are presented in Table 6, highlighting the dominance of countries such as France (103 banks) and Spain (70 banks) in the EU and EA samples, and Poland (10 banks) for the RAMs. In order to deal with various incidents of large fluctuations in the level of the buffers over time, we clean the data and get rid of any eccentric jumps that are not representative of the sample. Such jumps were generally due to individual bank effects rather than due to entry or exit from the sample and were identified via graphical representation of the sample[11].

Our sample is further broken down by bank type distinguishing between commercial, cooperative and savings banks. We additionally differentiate between 'small' and 'large' banks by considering the median asset size in 2004 as our cut-off point. Here we consequently regard those banks with total assets over EUR 37 billion in 2004 as large. The sample distribution by type and size of bank is presented in Table 6.

From Table 6 we can see that the RAM sample is essentially made up of small commercial banks, the only exception being a single Polish savings bank, *Powszechna Kasa Oszczednosci Bank*. On the whole, the EU25, EU15 and EA sub-samples are comprised of around 65 percent of commercial banks, 15 percent cooperative banks and around 20 percent savings banks. Sweden has the largest percentage of 'large' banks (around 50 percent), followed by Ireland (around 35 percent). The DK,SE,UK sub-sample with 19 percent of its banks being 'large', only slightly dominates the EU15 (16 percent) and the EA (16 percent) samples in terms of size.

Descriptive statistics for each variable by bank type and size respectively are presented in Tables A. 9 and A. 10 of Annex 1. Looking first at the distinctions between the types of banks, we find that for the EU25, EU15 and EA sub-samples, commercial banks appear to hold slightly higher capital buffer than savings or cooperative banks. This finding is further highlighted in Figure 2 where we plot the evolution of capital buffers per sub-sample by type and size of bank.

4.2 Estimation

Following the literature (see among others Ayuso et al., 2004; Estrella, 2004), we estimate the following equation order to analyse the determinants of capital buffers for our sub-samples:

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[11] Only cleaned data is presented in the paper, other information is available from the authors on request.

$$BUF_{ijt} = \alpha KK_{ijt} + \gamma KF_{ijt} + \delta KA_{ijt} + \beta CYCLE_t + u_{ijt} \quad (3.)$$

Where $i = 1,2\ldots N$ is the number of countries $j = 1,2\ldots.J_i$ the number of banks within a countries and $t = 1,2,\ldots, T_{j_i}$ is the number of time observation for bank j in country i. u_{ijt} is an error term that can be decomposed as the sum of two components, a random country specific component μ_i, plus a pure bank idiosyncratic component ε_{ijt}.

KK_{it}, KF_{it} and KA_{it} symbolise the cost of holding capital, the cost of failure and the cost of adjustment respectively, as outlined in detail in Section 3. The model is estimated for the EU25, EU15, EA, DK,SE,UK, and RAM sub-samples separately in order to determine whether disparities exist between different groups of countries. We transform all variables into first differences in order to obtain stationarity. Furthermore, since lagged endogenous variables are included in the estimations, we employ the two-step generalized method of moments (GMM) procedure based on the Arellano and Bond (1991) estimator. The methodology assumes no autocorrelation in the u_{ijt} and uses the entire set of lagged BUF_{it} as instruments. We additionally apply the Newey-West correction for heteroskedasticity and autocorrelation consistent covariances to further adjust the t-values for additional heteroskedasticity and autocorrelation. We also include two to four lags of $RISK$ and ROE for the lagged endogenous variables in order to avoid correlation with u_{ijt}.

5. Estimation Results

In order to extensively investigate the relationship between the capital buffer and the cycle variables for European banks, we estimate a number of variations of our baseline model as outlined below. The results for our estimations are presented in Table 7 for the EU25, EU15, EA, and Table 8 for the DK,SE,UK and RAM samples respectively.

Model 1

Model specification 1 is our baseline model whereby we regress capital buffers (BUF_{it}) on ROE, $RISK$, $SIZE$, on the lagged dependent variable (BUF_{it-1}) as well as on the cycle variables. The estimations are conducted considering the domestic and the broad cycle variable in turn. The results for the two-step GMM estimates are presented in Tables 7 and 8.

Business and economic cycle variables

For the case of the EU25, EU15, EA and DK,SE,UK samples, we uncover a negative significant relationship between the capital buffer and each of the output gap variables. These findings tend to provide support for our $H_1(a)$ hypothesis of anti-cyclical capital behaviour, indicating that banks operating in these sub-samples are generally exhibiting short-sighted, or risk-sensitive bank behaviour. The largest effect is seen for the DK,SE,UK sample, where the capital buffer decreases on average around 0.75 percentage points on a one percentage point rise in the domestic cyclical variable.

These findings are broadly in line with the literature in this field. Stoltz and Wedow (2005); Ayuso et al. (2004) and Lindqvist (2004) find a similar negative relationship between bank buffers and the cycle variables for German, Spanish and Norwegian banks respectively. These findings can additionally be compared to those of Bikker and Metzemakers who conduct a cross-country analysis of bank capital buffers for 29 OECD countries. Their OECD sample can in some respects be considered to be similar to our EU25 in that it includes both RAM and original member state countries. While they do uncover a negative relationship, they find that cyclical effects are fairly limited.

The RAM sample returns opposite results. Here we find a significant positive relationship between the buffer and the cycle variables. This finding is in line with our $H_1(b)$ hypothesis of pro-cyclicality and would tend to suggest forward-looking or prudent bank behaviour. Here we see a significant decrease in the capital buffer variable of 0.03 and 0.50 percentage points for a one percentage point rise in the domestic and the broad output gap respectively.

Cost of holding capital

Looking first at our proxy of the cost of capital, ROE. The significant negative coefficient, as expected, is visible in each of the sub-sample estimations, denoting the influence that the direct costs of remunerating capital has on the banks. The ideology essentially is that the more expensive capital is, the less of it will be held. The coefficients are essentially uniform across sub-groups, indicating that the direct effects of such costs on bank capital are similar across European countries.

Cost of failure

The $RISK2$ variable returns a highly significant positive relationship for four of the five sub-samples. The DK,SE,UK sub-sample produces and opposite result whereby we find that the coefficient is significant and negative. The positive result indicates that banks with relatively risky portfolios generally do hold more capital and that they do set their capital in line with the true riskiness of their portfolios. For the case of DK,SE,UK, the *RISK*2 coefficients are negative and significant. This counterintuitive finding is in line with some of the other literature in this field (Ayuso et al., 2004; Lindqvist, 2005) and would tend to indicate that in these countries, banks with a relatively risky portfolio do not hold more capital. From the degree of significance of these coefficients, it is possible to conclude that a shift towards a more risk-sensitive Accord, could significantly affect all banks in our sample with the effect slightly higher for Denmark, Sweden and the UK.

The *SIZE* coefficients are consistently significantly negative and in line with the 'too big to fail hypothesis' as well as with the notion that smaller banks tend to experience greater difficulty in accessing the capital markets. Furthermore, this finding could provide evidence in favour of scale economies whereby larger banks will generally enjoy a higher level of screening and monitoring than their smaller counterparts resulting in a reduction excess capital held as insurance. Moreover, the negative *SIZE* coefficient is consistent with the notion that smaller banks are less diversified than their larger counterparts and therefore hold higher levels of buffer capital. The *SIZE* coefficients are generally uniform across sub-groups with slightly larger coefficients visible for the RAM countries.

Cost of adjusting capital

Finally, the cost of adjusting capital, proxied by the lagged endogenous variable, is positive and significant in almost all cases. This finding is in line with our expectations that the cost of adjusting capital motivates the holding of higher levels of capital. The coefficients are largely uniform across sub-samples, which would indicate that the costs of adjustment are largely consistent across countries. We find that the coefficients are negative for the DK,SE,UK sub-sample, which would indicate that in these countries access to the capital markets is slightly easier. The speed of bank capital adjustment is consequently higher in Denmark, Sweden and the UK when compared to other countries of Europe.

Model 2

Under model specification 2, we extend our analysis by including all the variables from model specification 1, together with certain other variables capturing specific components of the banks balance sheet. These estimations serve as a type of robustness check of the results found above since we try to determine whether the signs and the magnitudes of the cycle variables vary with the inclusion of additional balance sheet measures. The results for Model specification 2 are presented in Tables 7 and 8.

Business and economic cycle variables

For all sub-samples, we find that the inclusion of the variables extending the model as per above has left the output gap variables largely unchanged from the findings presented above. The both the domestic and the broad output gap remains negatively related to the buffer variable in the EU25, EU15, EA and DK,SE,UK sub-samples. The effect for the DK,SE,UK sub-sample still shows the largest effect, and despite controlling for additional balance sheet variables, we find that a significant decrease in the capital buffer variable of 0.77 and 0.61 percentage points would follow a one percentage point fall in the domestic and the broad output gap respectively.

Similarly for the RAM banks, the relationship between the capital buffer and the cycle remains positive and significant. These findings confirm the robustness of the results obtained via the estimation of the baseline model above.

Cost of holding capital, cost of failure and cost of adjusting capital

The proxies for the cost of holding capital as well as for the cost of adjusting capital are broadly unchanged from those observed in Model 1. Regarding the coefficients for the cost of failure however, for all sub-samples, we find that the coefficients for the *RISK* proxies have intensified. With regards to the *SIZE* variable, interestingly for the DK,SE,UK and RAM sub-samples, under the new specification, the coefficients have become positive and significant, while those for the other sub-samples have remained negative but become insignificant.

Other balance sheet variables

The *PROFIT* variable for all sub-samples is positive and highly significant; indicating that retained earnings will generally be used as a means to increase the capital cushion. The effect is noticeably larger for the EA sample when compared to the sub-samples.An expected negative sign for the *NET LOANS* variable is found for the EU15, EA and RAM sub-samples, however the coefficients are broadly insignificant. The DK,SE,UK sample returns a highly significant positive result, this is consistent with the assumption that *NET LOANS* acts as a further reflection of the risk profile of the bank since the results returned are in line with those obtained for the *RISK* proxy in model 1. Considering the $\Delta LOAN$ variable, this time, for all sub-samples, we find the parameter to be highly significant, with a negative sign as expected. This finding suggests that a contemporaneous increase in loan demand essentially erodes the capital buffer.

Finally, we further estimate various alternatives to the models described above in order to verify our results. Evidence concerning the relationship between the buffer and the cycle variables remain largely unchanged, and hence, for brevity results are not presented here[12].

5.1 Different types/ sizes of banks

Different banking institutions manage their capital differently due to their varying institutional characteristics. Differences that exist are largely a result of variations in ownership structures and their access to the capital market. A vast body of literature has focussed on examining the impact that different types of banks may have on the risk profile of institutions (see among others, Saunders et al., 1990; Gorton and Rosen, 1995; Esty, 1997; Salas and Saurina, 2002b).

Since the major differences between the different types of banks involve how they are owned and how they manage their assets and liabilities, risk-profiles may vary accordingly and may ultimately be reflected in the level of the capital buffer held. Our sample includes information on commercial, savings and cooperative banks. Commercial banks specialize in loans to commercial and industrial businesses and are generally owned by private investors, called stockholders, or by companies called bank holding companies[13]. Savings banks, on the other hand, have no stockholders, and their assets are administered for the sole benefit of depositors. Earnings are paid to depositors after expenses are met and reserves are set aside to insure the deposits. Cooperative banks are considered associations (as a credit union) owned by and offering banking services for its members.

Bank size could additionally play a role in the management of bank capital. As explained in Section 3, the main risk facing banking institutions relates to credit risk, which encompasses both expected as well as unexpected losses. Generally, unexpected losses can be due to purely random shocks or alternatively to asymmetric information in the lender borrower relationship. In the latter case, more extensive screening and monitoring of borrowers could increase the banks understanding of the risk involved in each project. (Helwig, 1991). Screening and monitoring are costly, however, and banks probably balance the cost of (and gain from) these activities against the cost of excess capital. In the presence of scale economies in screening and monitoring, one would expect large banks to substitute relatively less of these activities with excess capital. Hence one may find a negative size effect on excess capital. This may however be due to a diversification effect as well. The argument here being that portfolio diversification will reduce the probability of experiencing a large drop in the capital ratio, and that diversification generally increases with size. A third argument relates to the 'too big to fail' hypothesis whereby large banks expect support from the government in the event of difficulties, while this is

[12] Results are available from authors on request.

[13] A holding company is a corporation that exists only to hold shares in another company.

not, to the same degree, expected by small banks. We would therefore expect large banks to hold lower capital buffers.

In Figure 2, we plot the evolution of the individual sub-samples capital buffers over time, distinguishing between bank type as well as bank size, together with the aggregate sample GDP and output gap. Here we can see distinct differences in the levels of capital held for different banking types for each of the sub-samples. We further see that generally small banks tend to hold higher capital buffers than large banks which would be in line with the 'too big to fail hypothesis' as well as with the notion that smaller banks tend to experience greater difficulty in accessing the capital markets. These simple plots additionally tend to confirm the findings in Section 5. We therefore test whether the cyclicality of capital buffers is dependent on the specific differences of the bank type and size, by separating the sample further. As seen in Table 6, the distributions of the DK,SE,UK and RAM samples are largely made up of small commercial banks, therefore an analysis by bank type or size is not feasible. The results for the EU15 sample is presented in Tables 9, while results for the EU25 and EA sub-samples are presented in Table A.6 and A.7 of Annex 1 respectively.

By type of bank

While allowing for a further analysis of the buffer-cycle relationship, our estimations by type of bank additionally allow us to compare our findings to those obtained previously in the literature. Many of the studies that have empirically estimated the relationship between bank capital and cyclical fluctuations have focussed on single country assessments, and subsequently on a panel of banks that operative within that framework. More recently however, Bikker and Metzemakers (2004) and Stoltz and Wedow (2005) either considered types of banks separately, or alternatively focussed on a single bank category of banks to obtain a homogeneity.

Business and economic cycle variables

In estimating the economic specification outlined in Equation 3 by commercial, savings and cooperative banks separately, we discover some interesting results regarding the cycle variables. Considering commercial and savings banks, we find that the cycle variable returns a negative result, while for cooperative banks, the sign is positive. Essentially, this would tend to indicate that cooperative banks are largely more prudent and foreword looking in their activity than commercial and savings banks. The results for savings banks are noticeably more significant at the ten percent level, than for commercial banks. This would further suggest the negative relationship uncovered in Section 5 appears to be driven by savings banks. This finding is in line with some of the literature in this field. Stoltz and Wedow (2005) present evidence for German banks whereby a stronger relationship between the buffer and the cycle variable is stronger for savings banks than it is for cooperatives. Bikker and Metzemakers (2004) implement a cross-country study of bank capital pro-cyclicality and find that the cyclical effects appear to be limited. This finding is in line with our results since they focus their estimations on commercial banks only. Ayuso et al. (2004) additionally include savings and commercial banks in their study and find a robustly significant negative relationship. Their study does not however analyse bank type effects separately and therefore are unable to determine the driving force behind the finding.

Cost of holding capital

The ROE variable returns very similar results to those obtained in Section 5. For all sub-samples, the coefficient is noticeably more significant for savings banks than it is for cooperative or commercial banks. This finding tends to indicate that the cost of holding excess capital appears to be most significant for cooperative banks when compared to savings and commercial banks.

Cost of failure

The $RISK$ coefficient remains positive and significant for both commercial and cooperative banks in all three sub-samples, while it is negative for savings banks. This finding is in line with the notion that commercial and cooperative banks are setting their capital in line with the true riskiness of their portfolios, while savings banks are not. The sizes of the coefficients are notably larger for cooperative banks. The $SIZE$ variables are negative and significant for cooperative banks while they are largely insignificant for the other bank types.

Cost of adjusting capital

For all three sub-samples, the BUF_{t-1} variable is positive and highly significant for commercial banks, while it is negative and significant for savings banks. As this measure proxies adjustment costs, this would tend to indicate that the existence of adjustment costs is a significant motivator for cooperative banks to hold of higher levels of capital.

By size of bank

Business and economic cycle variables

Turning to the separation by size, for all sub-samples, a positive and significant relationship appears to exist between the capital buffers of small banks and output gap variables, while the relationship is negative for large banks. These findings would tend to indicate that small banks are forward looking and more cautious than large banks.

Cost of holding capital

We further find that the *ROE* variable results for the EU25 and EU15 samples are unchanged from those obtained for the initial total sample estimations. The coefficients are negative and highly significant for both small and large banks. The only exception is for small banks in the EU25 sample where the coefficients are insignificant.

Cost of failure

The *RISK* coefficients remain positive and significant for both small and large banks, while the *SIZE* variables return varying results. Small banks remain positive and highly significant coefficients in all three samples, while the coefficients for large banks return negative and significant coefficients. Such a finding generally is in line with the notion that smaller banks face greater difficulties in accessing capital markets, while larger banks generally feel themselves protected by the government safety net as per the 'too-big-to-fail' hypothesis.

Cost of adjusting capital

The results for the cost of adjusting capital (BUF_{t-1}) are again largely unchanged by size of bank. Both big and small banks return a positive significant relationship between the proxy for adjustment costs and the capital buffer variable. This finding would tend to indicate that the cost of adjusting capital is significant in the determination of the level of capital banks hold with the effect consistently greater for large banks.

Our estimations by both size and type of bank provide evidence that for the EU25, EU15 and EA sub-samples, the capital buffers of both small and cooperative banks tend to have a positive relationship with the output gap variables, indicating that they are generally more prudent in their operations, generally using 'good' years to build up capital reserves for 'bad' years. Commercial, savings as well as large banks on the other hand appear to be more short-sighted in their operations, generally not accounting for risks during economic busts.

6. Robustness Checks

Beyond the random effect estimate in the GMM procedure, whereby specific random effects are already included in the μ_i component of the residual term, we further examine the existence of individual national effects that could arise from various country-specific characteristics relating to the legal, regulatory, structural, or tax and accounting framework. A simple way to test, and control for these conditions, is to create a country-specific dummy variable (D_i) for each country. The inclusion of these dummies transforms equation (3.) into the following:

$$BUF_{ijt} = \alpha KK_{ijt} + \gamma KF_{ijt} + \delta KA_{ijt} + CYCLE_t + \xi_1 D_{1t} + \xi_2 D_{2t} + ... + \xi_{(I-1)} D_{(I-1)t} + u_{ijt} \quad (4.)$$

Introducing the country dummy variables into our regressions, unsurprisingly, do not return any significant results, indicating that all the national effects are already captured by the residual error term of the estimation.

The inclusion of dummy variables however does not allow for dynamic analysis and therefore are restrictive in their explicative power, we re-run equation 3, this time including both the broad and the domestic cycle components among the regressors. The ideology is such that the domestic cycle could capture dynamic national effects that are not depicted by the broad cycle component. We would expect this effect to be, particularly relevant for those countries outside EMU that, in principle, are more likely to have a business cycle dynamics different from the core EMU countries. The modified equation (3.) can now be presented as:

$$BUF_{ijt} = \alpha KK_{ijt} + \gamma KF_{ijt} + \delta KA_{ijt} + \beta GPCYCLE_t + \lambda NCYCLE_{it} + u_{ijt} \quad (5.)$$

Where $GPCYCLE$ and $CNCYCLE$ denote the sub-group and the individual national cycle variables respectively. The results are interesting, since for both the DK,SE, UK and the RAM samples, we are able to detect significant effects from the domestic cycle variable, indicating that national effects beyond those captured by the individual country dummies exists. The findings are presented in Tables 10. In the case of the DK,SE,UK sample, for all of the model specifications, we find that the GDP is significant at least at the ten percent level, while the output gap is significant for three out of the four model cases. The results for the RAM sample are even more convincing, with both GDP and output gap variables for the full range of specifications. The findings highlight the fact that national effects, as captured by the individual country business cycle variables, appear to exist for the DK, SE, UK and

RAM countries. These effects appear to have a significant impact on the movements and fluctuations of capital buffers of these countries.

Conclusions

This paper serves to analyse the relationship that exists between European bank capital buffer fluctuations and business cycle variations over the last eight years. While much of the empirical literature in this field has focussed on analysing various aspects of bank capitalization in a single country framework, we centre our research on sub-sample analysis, to try to uncover whether variations exist between different groups of countries.

For the purpose of our estimations, we build up an unbalanced panel of 486 banks, using annual balance sheet data between 1998 and 2004. Controlling for various probable determinants of capital buffer movements, we analyse the remaining impact that the cycle variables appear to have. We find that for the EU25, EU15, EA and DK,SE,UK sub-samples, a significant negative relationship between the capital buffers of banks and the position of the cycle appears to exist. For the RAM banks, our findings are opposite and equally significant, where the buffer movements appear pro-cyclical in nature. These results would tend to provide evidence that RAM banks are more prudent in their operations, generally building up capital during an economic upturn to offset. It would seem that EU25, EU15, EA and DK,SE,UK banks on the other hand, behave in a more nonchalant fashion during upturns, not properly accounting for the cyclical nature of output and consequently underestimating risks during upturns.

We further break the sample down, distinguishing between both type and size of bank. Our findings indicate that capital buffers of large banks, as well as commercial and savings banks, appear to fluctuate anti-cyclically, while those of small banks and of cooperative banks move together with the cycle.

As further robustness checks, we try to control for various country specific effects that could drive buffer fluctuations by introducing a set of alternative measures. Country-specific dummy variables are unable to capture any remaining country effects, however, for the DK,SE,UK and RAM samples, the inclusion of both the broad and the national cycle in an attempt to capture dynamic country effects proves significant. This finding would tend to indicate the dynamic country specific effects captured by the domestic cycle variable exist beyond that possible to be captured by a static dummy variable.

While the results uncovered are interesting and important, they are rather limited by the restricted data available. Furthermore, from Figure 2, it becomes apparent that much of the buffer movements of the RAM banks has occurred during the first half of the sample period, therefore, with time, as data becomes available, it would be interesting to conduct further research into whether buffer decisions of the RAMs are converging to become more like the other EU members.

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Table 1: Capital Buffers by Country (weighted by total assets)

	1997	1998	1999	2000	2001	2002	2003	2004	Avg.
AT	2.8	2.5	1.8	3.4	5.2	4.4	10.0	6.5	4.6
BE	3.8	4.7	3.8	4.9	5.2	5.1	6.3	5.5	4.9
DE	2.1	2.3	2.8	3.1	2.7	3.4	4.8	5.4	3.3
ES	5.6	5.3	4.7	3.7	3.9	3.6	3.6	3.6	4.2
FI	6.6	4.4	3.7	3.5	3.7	3.4	5.7	5.3	4.5
FR	5.1	4.6	3.8	3.8	4.0	4.3	3.4	2.9	4.0
GR	2.3	2.1	9.5	7.2	3.9	2.8	6.0	5.3	4.9
IE	4.3	3.7	3.2	2.9	4.6	4.3	4.4	3.9	3.9
IT	4.3	5.8	4.4	4.5	2.5	3.0	3.0	3.7	3.9
LU	6.1	4.8	4.8	4.6	4.5	4.9	6.6	4.9	5.2
NL	7.1	8.0	5.6	5.5	6.1	6.7	7.6	7.6	6.8
PT	9.3	8.2	7.9	6.3	5.0	4.4	5.3	5.8	6.5
DK	4.4	3.4	3.3	2.7	3.0	3.7	4.9	4.2	3.7
SE	2.6	6.7	5.8	5.4	4.6	4.9	5.3	5.0	5.0
UK	13.1	10.7	12.4	10.7	9.5	10.0	11.8	8.2	10.8
CY	2.1	1.7	2.5	4.5	5.7	6.0	5.4	5.3	4.2
CZ	2.9	10.2	12.2	6.2	7.3	6.9	6.7	4.8	7.2
EE	3.1	7.7	9.1	6.2	6.3	6.2	5.3	4.3	6.0
HU	5.0	6.5	6.7	5.9	4.2	4.8	3.3	3.2	5.0
LAT	10.1	3.6	8.4	5.5	4.6	4.5	4.3	4.4	5.7
LIT	6.3	14.4	5.5	4.8	6.7	6.7	4.1	3.1	6.5
MAL	6.5	8.4	8.0	8.1	6.5	7.1	7.6	6.9	7.4
PL	1.9	3.7	5.2	4.9	5.8	4.9	4.8	7.4	4.8
SK						5.4	9.2	9.5	8.0
SL	6.3	4.6	6.7	8.1	7.6	7.6	5.7	6.3	6.6
EU25	5.15	5.75	5.91	5.28	5.13	5.16	5.80	5.32	5.4
EU15	5.29	5.14	5.17	4.82	4.56	4.58	5.90	5.18	5.1
EA	4.94	4.69	4.67	4.46	4.27	4.18	5.55	5.03	4.7
DK,SE,UK	6.70	6.95	7.14	6.28	5.68	6.18	7.32	5.81	6.5
RAM	4.92	6.77	7.15	6.03	6.07	6.02	5.64	5.52	6.0

Note: AT= Austria, BE= Belgium, DE= Germany, ES= Spain, FI= Finland, FR= France, GR= Greece, IE= Ireland, IT= Italy, LU= Luxembourg, NL= Netherlands, PT= Portugal, DK= Denmark, SE= Sweden, UK= United Kingdom,CY= Cyprus, CZ= Czech Republic, EE= Estonia, HU= Hungary,LAT=Latvia, LIT=Lithuania, MAL= Malta, PL= Poland, SK= Slovakia, SL=Slovenia.

Figure 1: Capital Buffer Development by Sub-Sample

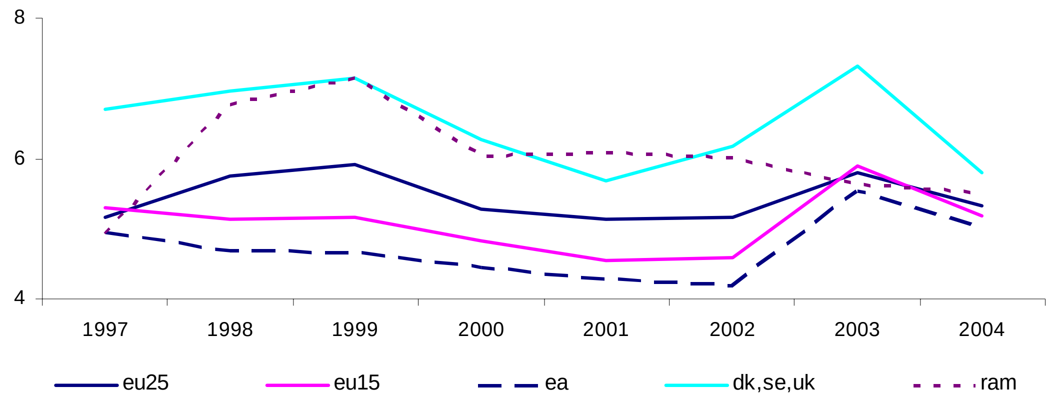


Table 2: National Tier 2 Capital Requirements

Countries Applying Ratio Above 8%			
	minimum required ratio	*year of implementation*	*reason*
UK	9%*	1979	
CY	8 %	1997	
	10 %	2001	Changes in market structure
CZ	8 %	1992	
EE	10 %	1997	Rapid growth of bank assets and a change in operating environment
HU	8 %	1991	
LAT	10 %	1997	
	8 %	2004	
LIT	10 %	1997	
	8 %	2005	
MAL	8 %	1994	
PL	8 %	1992	
SK	8 %	1997	
SL	8 %	2002	

Note: As explained in Appendix I, the FSA sets additional 'trigger' and 'higher target' ratios for UK banks resulting in higher levels of capital required by the regulators. For this reason in the study we apply a 9% requirement to UK banks active in the sample and calculate the buffer as capital above this level.*

AT= Austria, BE= Belgium, DE= Germany, ES= Spain, FI= Finland, FR= France, GR= Greece, IE= Ireland, IT= Italy, LU= Luxembourg, NL= Netherlands, PT= Portugal, DK= Denmark, SE= Sweden, UK= United Kingdom, CY= Cyprus, CZ= Czech Republic, EE= Estonia, HU= Hungary, LAT=Latvia, LIT=Lithuania, MAL= Malta, PL= Poland, SK= Slovakia, SL=Slovenia.

Table 3: Description of Variables Adopted

Variable	Description
Balance sheet variables	
buf	capital ratio-national regulatory minimum as per table 2
roe	return on equity
$risk$	ratio of non-performing loans to total loans
$risk2$	loan-loss provisions over total assets
$size$	log of total assets
$profit$	post-tax profit over total assets
$\Delta loan$	annual loan growth
$net\ loans$	loans over total assets
Business and economic cycle variables	
gdp	domestic and sub-sample GDP growth
$output\ gap$	HP filtered real GDP series

Table 4: Descriptive Statistics by Sub-Sample

	obs	mean	st dev
EU25			
buf	1776	5.11	6.22
roe	3137	10.53	15.42
$risk$	1081	0.63	0.07
$risk2$	2008	0.00	0.01
$size$	3139	3.94	0.77
$profit$	3137	0.01	0.01
$\Delta loan$	2668	-5.88	632.64
$net\ loans$	3136	54.86	21.56
EU15			
buf	1566	5.01	6.53
roe	2866	10.41	15.30
$risk$	915	0.06	0.07
$risk2$	2747	0.00	0.01
$size$	2868	3.94	0.73
$profit$	2866	0.01	0.01
$\Delta loan$	2438	-7.91	661.77
$net\ loans$	2865	55.01	22.25
EA			
buf	1297	4.49	5.67
roe	2402	10.09	16.08
$risk$	647	0.06	0.06
$risk2$	2323	0.00	0.01
$size$	2404	3.91	0.69
$profit$	2402	0.01	0.01
$\Delta loan$	2039	-11.51	723.51
$net\ loans$	2404	54.49	21.94
DK,SE,UK			
buf	269	7.51	9.27
roe	464	12.07	10.17
$risk$	241	0.03	0.09
$risk2$	424	0.00	0.01
$size$	464	4.10	0.89
$profit$	464	0.01	0.01
$\Delta loan$	399	10.46	26.72
$net\ loans$	461	57.71	23.62
RAM			
buf	210	5.80	3.02
roe	271	11.83	16.59
$risk$	166	0.11	0.74
$risk2$	261	0.01	0.01
$size$	271	3.96	1.08
$profit$	271	0.01	0.01
$\Delta loan$	230	15.71	15.16
$net\ loans$	271	53.30	12.11

Table 5: Output Gap Variables: Summary Statistics

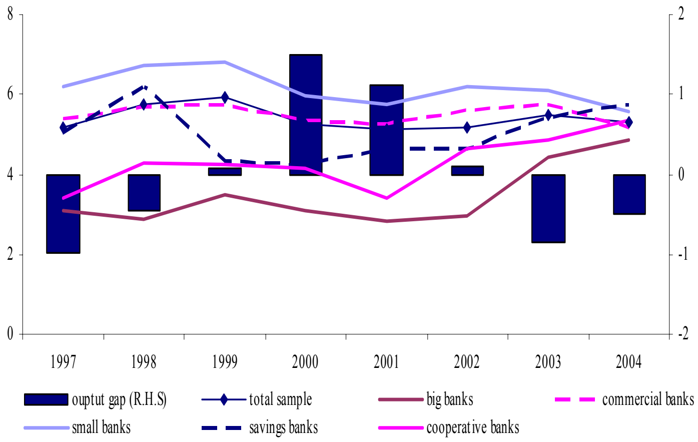
	obs	mean	st dev
EU25			
broad output gap	3736	-0.01	0.85
domestic output gap	3732	0.00	1.08
EU15			
broad output gap	3408	0.00	0.88
domestic output gap	3408	0.00	1.02
EA			
broad output gap	2912	0.00	0.99
domestic output gap	2912	0.00	1.07
DK,SE,UK			
domestic output gap	496	0.00	0.67
RAM			
domestic output gap	324	0.01	1.60

Table 6: Distribution of the Sample

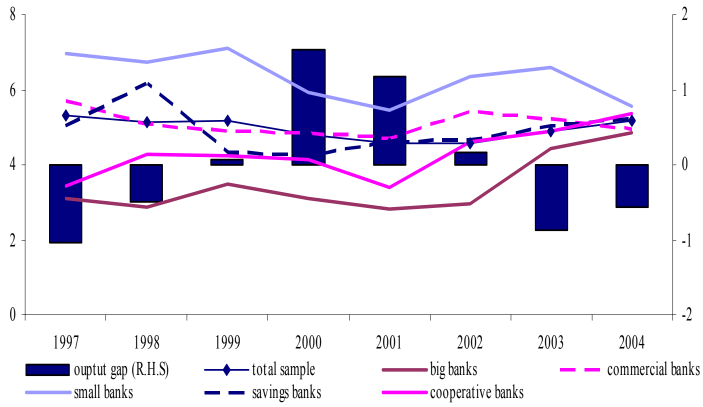
	commercial banks	cooperative banks	savings banks	big banks *(total assets> EUR37 billion in 2004)*	small banks *(total assets< EUR37 billion in 2004)*	total
AT	12	8	6	4	22	26
BE	10		2	2	10	12
ES	23	3	44	8	62	70
FI	4		1	1	4	5
FR	55	42	6	13	90	103
DE	24	8	2	7	27	34
GR	12			1	11	12
IE	11			4	7	11
IT	30	13	11	10	44	54
LU	7			1	6	7
NL	18	1		5	14	19
PT	8	1	2	3	8	11
DK	13		2		15	15
SE	3	1	2	3	3	6
UK	41		1	9	33	42
CY			5		5	5
CZ	3				3	3
EE	2				2	2
HU	6				6	6
LAT	4				4	4
LIT	2				2	2
MAL	2				2	2
PL	9		1		10	10
SK	2				2	2
SLOV	5				5	5
EU25	306	77	85	71	397	468
EU15	271	77	79	71	356	427
EA	214	76	74	59	305	364
DK,SE,UK	57	1	5	12	51	63
RAM	35	0	6	0	41	41

Figure 2: Capital Buffers by Bank Type and Size (Weighted by Total Assets)

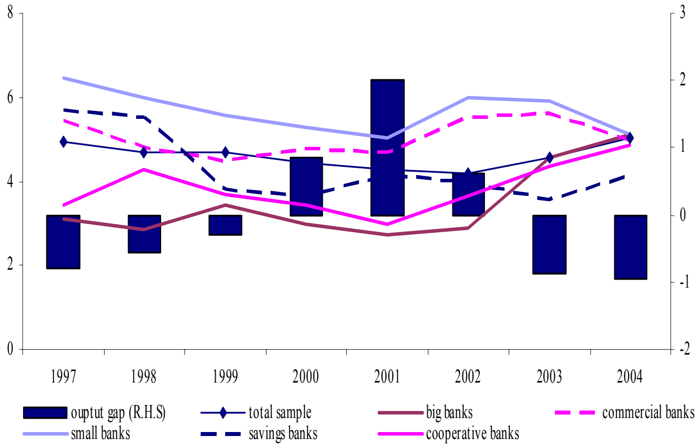
EU25



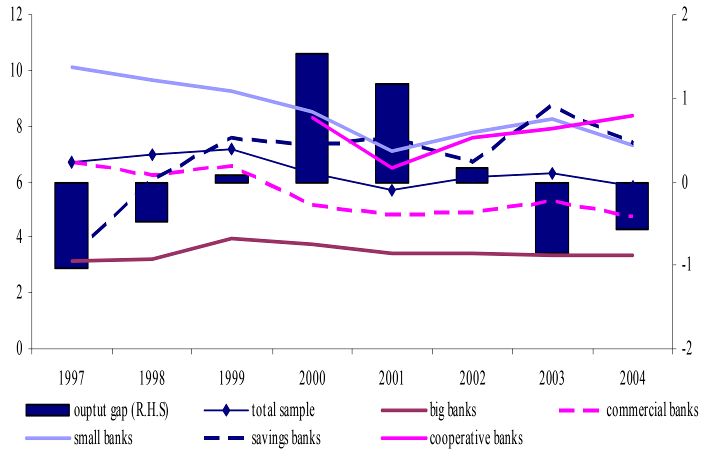
EU15



EA



DK,SE,UK



RAM

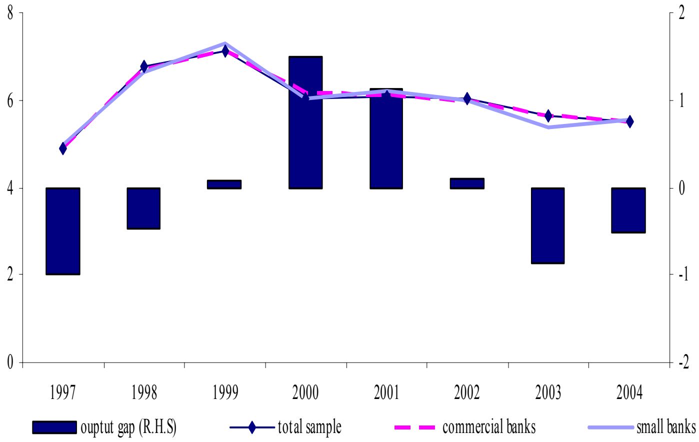


Table 7: Two-Step GMM Estimates

	EU25				EU15				EA			
	Model Specification 1		*Model Specification 2*		*Model Specification 1*		*Model Specification 2*		*Model Specification 1*		*Model Specification 2*	
Cycle variable:	domestic output gap	EU25 output gap	domestic output gap	EU25 output gap	domestic output gap	EU 15 output gap	domestic output gap	EU 15 output gap	domestic output gap	EA output gap	domestic output gap	EA output gap
buf_{t-1}	0.38	0.33	0.41	0.36	0.41	0.38	0.34	0.33	0.47	0.42	0.33	0.31
	*(3.22)****	*(3.49)****	*(3.54)****	*(4.56)****	*(4.91)****	*(4.88)****	*(4.71)****	*(4.81)****	*(4.65)****	*(3.93)****	*(3.82)****	*(3.47)****
roe	-0.05	-0.05	-0.04	-0.05	-0.06	-0.05	-0.08	-0.07	-0.05	-0.05	-0.12	-0.12
	*(1.79)**	*(1.90)**	*(1.81)***	*(1.31)**	*(5.61)****	*(5.58)****	*(1.36)**	*(2.29)***	*(1.62)***	*(1.31)**	*(1.23)*	*(1.23)*
$risk$	58.58	50.86	77.85	52.28	38.21	31.14	59.65	56.26	37.38	35.12	78.58	80.37
	*(3.20)****	*(2.50)****	*(3.54)****	*(3.17)****	*(2.62)****	*(2.27)***	*(3.99)****	*(3.54)****	*(2.37)****	*(2.17)***	*(5.38)****	*(5.38)****
$size$	-6.67	-6.39	1.31	-0.21	-6.17	-6.25	-0.54	-1.36	-6.11	-6.55	0.59	-0.37
	*(4.24)****	*(3.85)****	*(0.66)*	*(0.13)*	*(3.72)****	*(4.05)****	*(0.22)*	*(0.56)*	*(3.18)****	*(3.41)****	*(0.22)*	*(0.14)*
$profit$			177.09	165.09			243.18	236.96			319.37	323.67
			*(4.10)****	*(3.77)****			*(4.64)****	*(4.42)****			*(5.30)****	*(5.71)****
$cycle$	-0.74	-0.24	-0.52	-0.28	-0.33	-0.43	-0.26	-0.37	-0.25	-0.03	-0.13	-0.06
	*(4.66)****	*(2.01)***	*(4.74)****	*(2.50)****	*(4.86)****	*(3.90)****	*(3.72)****	*(4.62)****	*(3.47)****	*(4.21)****	*(1.71)****	*(3.16)****
$\Delta loan$			-0.03	-0.03			-0.02	-0.01			-0.02	-0.02
			*(3.25)****	*(4.60)****			*(2.60)****	*(2.30)***			*(2.19)***	*(2.01)***
$net\ loans$			0.00	0.00			-0.02	-0.04			-0.05	0.07
			(1.72)	*(1.45)*			*(0.92)*	*(0.46)*			*(0.96)*	*(1.06)*
sargan	24.90 *(0.89)*	25.29 *(0.88)*	25.19 *(0.88)*	24.79 *(0.90)*	22.76 *(0.75)*	23.52 *(0.53)*	29.09 *(0.69)*	27.18 *(0.69)*	24.13 *(0.64)*	27.58 *(0.23)*	22.20*(0.58)*	23.81*(0.61)*
$a(1)$	-2.67 *(0.00)*	-2.22 *(0.00)*	-2.94 *(0.00)*	-2.73 *(0.00)*	-2.08 *(0.00)*	-2.04*(0.00)*	-2.16 *(0.00)*	-2.18 *(0.00)*	-2.28 *(0.00)*	-2.25 *(0.00)*	-2.12 *(0.00)*	-2.09 *(0.00)*
$a(2)$	-0.85 *(0.69)*	-0.99 *(0.32)*	-1.04 *(0.30)*	-0.17 *(0.86)*	-1.30 *(0.39)*	-1.29 *(0.69)*	-1.25 *(0.45)*	-1.29 *(0.65)*	-1.65 *(0.56)*	-0.80 *(0.45)*	-1.04 *(0.67)*	-1.57 *(0.56)*

Note: Dependent variable is BUF_{it}. *Other variables as defined in Table 3.*

T-values presented in parentheses. $a(1)$ *and* $a(2)$ *represent first and second order residual tests.*

*, **, *** *denote significance at the ten, five and one percent levels of significance respectively.*

Table 8: Two-Step GMM Estimates

	DK,SE,UK				RAM			
	Model Specification 1		*Model Specification 2*		*Model Specification 1*		*Model Specification 2*	
Cycle variable:	domestic output gap	eu25 output gap	domestic output gap	eu25 output gap	domestic output gap	eu25 output gap	domestic output gap	eu25 out-put gap
buf_{t-1}	-0.70 *(2.59)****	-0.09 *(3.87)****	-0.13 *(5.33)****	-0.23 *(13.55)****	0.32 *(10.90)****	0.34 *(16.94)****	0.09 *(2.81)****	0.15 *(5.99)****
roe	-0.04 *(1.98)***	-0.01 *(1.14)*	-0.02 *(0.82)*	-0.08 *(4.92)****	-0.04 *(1.33)**	-0.04 *(3.38)****	-0.15 *(0.52)*	-0.01 *(0.04)*
$risk$	-60.25 *(3.41)****	-89.77 *(7.44)****	-56.37 *(3.40)****	-67.61 *(3.34)****	41.39 *(1.38)**	44.39 *(1.64)***	107.72 *(2.96)****	150.57 *(5.17)****
$size$	-5.61 *(5.21)****	-7.06 *(7.75)****	7.34 *(3.77)****	8.70 *(4.42)****	-9.34 *(12.10)****	-10.45 *(9.21)****	11.42 *(1.70)**	12.23 *(2.31)***
$profit$			78.38 *(3.30)****	151.82 *(5.78)****			85.44 *(3.46)****	131.02 *(3.95)****
$cycle$	-0.75 *(8.61)****	-0.57 *(14.81)****	-0.77 *(11.35)****	-0.61 *(8.99)****	0.03 *(1.92)***	0.52 *(4.65)****	0.12 *(2.48)***	0.14 *(2.78)****
$\Delta loan$			-0.00 *(3.37)****	-0.08 *(8.28)****			-0.10 *(2.76)****	-0.11 *(3.69)****
$net\ loans$			0.07 *(2.65)****	0.08 *(3.45)****			-0.01 *(0.04)*	-0.02 *(0.37)*
sargan	30.38 *(0.87)*	30.97 *(0.42)*	24.81 *(0.36)*	26.57 *(0.64)*	22.75 *(0.65)*	20.65 *(0.86)*	21.09 *(0.57)*	27.53 *(0.78)*
$a(1)$	-1.25 *(0.00)*	-1.29 *(0.00)*	-0.89 *(0.00)*	-0.89 *(0.00)*	-1.91 *(0.00)*	-1.86 *(0.28)*	-1.78 *(0.00)*	1.70 *(0.00)*
$a(2)$	-1.29 *(0.26)*	-1.32 *(0.71)*	-1.53 *(0.82)*	-1.57 *(0.75)*	0.74 *(0.65)*	-0.98 *(0.42)*	-0.85 *(0.76)*	0.86 *(0.66)*

Note: Dependent variable is BUF_{it}*. Other variables as defined in Table 3.*

T-values presented in parentheses. $a(1)$ *and* $a(2)$ *represent first and second order residual tests.*

, **, * denote significance at the ten, five and one percent levels of significance respectively.*

Table 9: EU15 Two-Step GMM Estimates by Type and Size of Bank

	Commercial banks		***Cooperative banks***		***Savings banks***		***Big banks***		***Small banks***	
Cycle variable:	domestic output gap	eu25 output gap	domestic output gap	eu25 output gap	domestic output gap	eu25 output gap	domestic output gap	eu25 output gap	domestic output gap	eu25 output gap
buf_{t-1}	0.30	0.31	-0.01	0.01	-0.04	-0.07	0.53	0.55	0.15	0.11
	*(3.90)****	*(4.27)****	*(0.30)*	*(0.43)*	*(1.50)**	*(2.99)****	*(7.88)****	*(7.67)****	*(2.56)****	*(2.72)****
roe	-0.03	-0.03	-0.02	-0.06	-0.22	-0.20	-0.11	-0.11	-0.08	-0.08
	*(1.48)**	*(1.35)**	*(0.60)*	*(1.41)**	*(5.37)****	*(4.99)****	*(3.71)****	*(3.42)****	*(1.91)***	*(1.85)**
$risk$	27.34	26.93	149.11	207.13	-59.21	-71.92	71.46	78.40	40.57	41.89
	*(2.03)***	*(2.08)***	*(3.17)****	*(2.59)****	*(2.33)****	*(2.62)****	*(2.44)***	*(2.73)****	*(2.11)***	*(2.18)***
$size$	2.16	0.47	-47.16	-47.52	-12.96	8.35	-10.56	-9.85	12.91	7.72
	(1.00)	*(0.22)*	*(12.85)****	*(5.70)****	*(0.81)*	*(0.63)*	*(5.03)****	*(4.59)****	*(7.52)****	*(2.02)***
$profit$	151.69	149.24	157.41	105.86	432.59	378.29	275.46	268.66	233.53	-0.00
	*(3.55)****	*(3.32)****	*(6.00)****	*(1.93)***	*(6.16)****	*(5.52)****	*(4.45)****	*(4.19)****	*(3.33)****	*(3.32)****
$cycle$	-0.37	-0.48	0.18	0.17	-0.03	-0.30	-0.13	-0.14	0.34	0.40
	*(1.33)**	*(2.64)***	*(2.18)***	*(0.79)*	*(3.26)****	*(3.60)****	*(2.14)***	*(1.65)**	*(3.57)****	*(2.67)****
$\Delta loan$	-0.03	-0.02	0.14	0.14	0.11	-0.01	-0.04	-0.04	0.00	-0.00
	*(5.23)****	*(4.05)****	*(7.95)****	*(3.41)****	*(1.25)*	*(0.14)*	*(10.70)****	*(10.65)****	*(0.07)*	*(0.16)*
$net\ loans$	0.02	0.00	-0.36	-0.37	-0.24	-0.08	0.05	0.04	-0.06	-0.07
	(1.00)	*(0.06)*	*(8.53)****	*(5.72)****	*(1.97)**	*(0.70)*	*(2.97)****	*(2.45)****	*(1.60)**	*(1.82)**
sargan	32.34 *(0.94)*	32.98 *(0.85)*	25.67 *(0.86)*	26.97 *(0.81)*	30.37 *(0.94)*	28.78 *(0.85)*	24.93 *(0.89)*	27.16 *(0.80)*	29.73 *(0.65)*	23.56 *(0.66)*
$a(1)$	-1.98 *(0.00)*	-2.03 *(0.00)*	-1.70 *(0.00)*	-1.89 *(0.00)*	-1.67 *(0.00)*	1.29 *(0.00)*	-2.15 *(0.00)*	-3.26 *(0.00)*	-1.29 *(0.00)*	-1.39 *(0.00)*
$a(2)$	-1.19 *(0.74)*	-1.22 *(0.90)*	-1.69 *(0.96)*	-1.26 *(0.76)*	-1.46 *(0.83)*	-1.42 *(0.98)*	-1.96 *(0.80)*	1.03 *(0.76)*	-1.52 *(0.86)*	-1.55 *(0.76)*

Note: Dependent variable is BUF_{it}*. Other variables as defined in Table 3.*

T-values presented in parentheses. $a(1)$ *and* $a(2)$ *represent first and second order residual tests.*

, **, * denote significance at the ten, five and one percent levels of significance respectively.*

Table 10: Robustness Checks: Country Effects

	EU25	EU15	EA	DK,SE,UK	RAM
buf_{t-1}	0.25 *(2.73)****	0.26 *(2.81)****	0.22 *(2.47)***	-0.21 *(2.65)****	0.10 *(2.59)****
roe	-0.03 *(1.21)*	-0.04 *(1.29)**	-0.06 *(1.29)**	-0.05 *(1.78)**	-0.04 *(0.82)*
$risk$	50.13 *(2.67)****	52.11 *(2.62)****	62.21 *(3.12)****	114.64 *(6.22)****	96.54 *(2.32)****
$size$	-0.15 *(0.96)*	-1.22 *(0.42)*	-0.75 *(0.85)*	6.97 *(1.99)***	7.11 *(1.45)**
$profit$	76.29 *(2.89.)****	156.21 *(3.22)****	168.57 *(2.99)****	124.06 *(3.02)****	85.12 *(2.93)****
$cycle: broad$	-0.16 *(1.28)**	-0.37 *(1.62)**	-0.21 *(2.16)***	0.10 *(2.04)***	0.13 *(2.62)****
$cycle: domestic$	-0.05 *(0.72)*	-0.11 *(0.96)*	-0.25 *(1.06)*	0.15 *(2.55)***	0.05 *(1.96)***
$\Delta loan$	-0.03 *(4.60)****	-0.01 *(2.30)***	-0.05 *(1.98)***	-0.06 *(1.99)***	-0.08 *(3.69)****
$net\ loans$	0.00 *(1.45)*	-0.04 *(0.46)*	0.02 *(1.00)*	-0.01 *(0.55)*	-0.02 *(0.37)*
sargan	25.56 *(0.68)*	21.45 *(0.85)*	22.63 *(0.92)*	25.66 *(0.67)*	1.70 *(0.00)*
$a(1)$	-1.46 *(0.00)*	-1.22 *(0.00)*	-1.01 *(0.00)*	-1.47 *(0.00)*	0.86 *(0.66)*
$a(2)$	-1.04 *(0.72)*	1.03 *(0.96)*	-0.96 *(0.63)*	2.14 *(0.74)*	1.15 *(0.99)*

Note: Dependent variable is BUF_{it}. *Other variables as defined in Table 3.*

T-values presented in parentheses. $a(1)$ *and* $a(2)$ *represent first and second order residual tests.*

, **, * denote significance at the ten, five and one percent levels of significance respectively.*

Table A. 1: GDP Variables: Summary Statistics

	obs	mean	st dev
EU25			
broad output gap	3736	2.33	0.87
domestic output gap	3732	2.818	1.726
EU15			
broad output gap	3408	2.275	0.894
domestic output gap	3408	2.69	1.62
EA			
broad output gap	2912	2.16	0.935
domestic output gap	2912	2.68	1.717
DK,SE,UK			
domestic output gap	496	2.697	0.864
RAM			
domestic output gap	324	4.16	2.178

Annex 1

Table A. 1: EU25 Correlation Matrix

	buf	*roe*	*size*	*risk*	*profit*	*Δloan*	*net loans*	*domestic gdp*	*domestic output gap*	*EU25 gdp*	*EU25 output gap*
buf	1										
roe	-0.06*	1									
size	-0.28***	-0.15***	1								
risk	0.51***	0.02	-0.18***	1							
profit	-0.04*	-0.15***	0.49***	-0.15***	1						
Δloan	-0.00	0.02	0.02	-0.13***	0.01	1					
net loans	-0.34***	0.01	0.03	-0.26***	-0.02	-0.07***	1				
domestic gdp	0.03	0.13***	-0.06***	-0.07*	0.04**	-0.01	-0.03*	1			
domestic output gap	-0.04**	0.05***	0.02	-0.08***	0.03	0.04**	-0.02	0.17***	1		
EU25 gdp	0.02	0.08***	-0.04	-0.00	-0.00	0.00	-0.07**	0.50***	0.21***	1	
EU25 output gap	-0.04**	0.06***	0.02	-0.04	0.02	0.02	-0.01	0.11***	0.71***	0.29***	1

*Note: *, **, *** denote significance at the ten, five and one percent levels of significance respectively.*

Table A. 2: EU15 Correlation Matrix

	buf	*roe*	*size*	*risk*	*profit*	*Δloan*	*net loans*	*domestic gdp*	*domestic output gap*	*EU15 gdp*	*EU15 output gap*
buf	1										
roe	-0.09***	1									
size	-0.34***	0.06***	1								
risk	0.56***	-0.12***	-0.25***	1							
profit	-0.10***	0.13***	0.55***	0.16***	1						
Δloan	-0.11***	0.02	0.02	-0.14***	0.01	1					
net loans	-0.35***	0.03	-0.01	-0.26***	0.00	0.07***	1				
domestic gdp	0.03	0.12***	-0.04*	-0.12***	0.02	-0.02	-0.04**	1			
domestic output gap	-0.06**	0.05**	0.02	-0.05	0.03	0.04**	0.01	0.14***	1		
EU15 gdp	0.02	0.08***	-0.04*	0.03	0.02	0.00	-0.07***	0.56***	0.25***	1	
EU15 output gap	-0.05**	0.06***	0.02	-0.05	0.03*	0.02	-0.00	0.14***	0.84***	0.31***	1

*Note: *, **, *** denote significance at the ten, five and one percent levels of significance respectively.*

Table A. 3: EA Correlation Matrix

	buf	*roe*	*size*	*risk*	*profit*	*∆loan*	*net loans*	*domestic gdp*	*domestic output gap*	*EA gdp*	*EA output gap*
buf	1										
roe	-0.04	1									
size	-0.27***	0.03	1								
risk	0.29***	-0.01*	-0.21***	1							
profit	-0.07**	0.14***	0.53***	0.14***	1						
∆loan	-0.12***	0.02	0.02	-0.14***	0.01	1					
net loans	-0.36***	-0.00	-0.07***	-0.17***	-0.06***	0.07***	1				
domestic gdp	0.01	0.12***	-0.03	-0.17***	0.04*	-0.02	-0.04**	1			
domestic output gap	-0.07***	0.05**	0.02	-0.05**	0.04*	0.04**	0.01	0.13***	1		
EA gdp	0.08	0.09***	-0.04*	0.02	0.04**	0.01	-0.08***	0.55***	0.25***	1	
EA output gap	-0.05**	0.03*	0.02	-0.05	0.02	0.03	-0.00	-0.02	0.76***	0.02	1

*Note: *, **, *** denote significance at the ten, five and one percent levels of significance respectively.*

Table A. 4: DK,SE,UK Correlation Matrix

	buf	*roe*	*size*	*risk*	*profit*	*Δloan*	*net loans*	*domestic gdp*	*domestic output gap*	*EU25 gdp*	*EU25 output gap*
buf	1										
roe	-0.25***	1									
size	-0.56***	0.25***	1								
risk	0.89***	-0.29***	-0.29***	1							
profit	-0.24***	0.22***	0.71***	-0.12*	1						
Δloan	-0.16**	0.22***	0.02	-0.15*	-0.02	1					
net loans	-0.39***	0.25***	0.20***	-0.41***	0.06	0.11**	1				
domestic gdp	0.21***	0.04	-0.15***	0.11*	-0.05	0.06	-0.02	1			
domestic output gap	-0.01***	0.04	0.03	-0.04	0.04	0.03	0.02	0.31***	1		
EU25 gdp	0.04	0.04	-0.05	0.07	-0.02	0.04	0.04	0.76***	0.49***	1	
EU25 output gap	-0.03*	0.06	0.04	-0.05	0.02	-0.02	0.01	0.06	0.83***	0.31***	1

*Note: *, **, *** denote significance at the ten, five and one percent levels of significance respectively.*

Table A. 5: RAM Correlation Matrix

	buf	*roe*	*size*	*risk*	*profit*	*Δloan*	*net loans*	*domestic gdp*	*domestic output gap*	*EU25 gdp*	*EU25 output gap*
buf	1										
roe	0.17**	1									
size	0.15**	-0.11*	1								
risk	0.01	-0.38***	0.28***	1							
profit	0.17**	0.26***	0.51***	0.16*	1						
Δloan	-0.17**	0.27***	-0.23***	-0.53***	0.12	1					
net loans	-0.21***	-0.13**	-0.25***	-0.21***	-0.16***	0.26***	1				
domestic gdp	-0.08	0.23***	-0.19***	-0.42***	-0.03	0.32***	-0.10*	1			
domestic output gap	0.05***	0.08	0.04	-0.13*	0.04	0.13**	0.08	0.32***	1		
EU25 gdp	0.06	0.10*	-0.04	-0.25***	-0.08	-0.02	-0.14**	0.20***	0.17***	1	
EU25 output gap	0.11**	0.02	-0.02	-0.05	-0.02	-0.01	0.12**	-0.09*	-0.14**	0.29***	1

*Note: *, **, *** denote significance at the ten, five and one percent levels of significance respectively.*

Table A. 6: EU25 Two-Step GMM Estimates by Type and Size of Bank

	Commercial banks		***Cooperative banks***		***Savings banks***		***Big banks***		***Small banks***	
Cycle variable:	domestic output gap	eu25 output gap	domestic output gap	eu25 output gap	domestic output gap	eu25 output gap	domestic output gap	eu25 output gap	domestic output gap	eu25 output gap
buf_{t-1}	0.38	0.37	-0.01	0.01	-0.04	-0.07	0.53	0.55	0.32	0.26
	*(4.97)****	*(5.26)****	*(0.30)*	*(0.28)*	*(1.50)**	*(2.80)****	*(7.88)****	*(7.67)****	*(4.64)*	*(4.31)****
roe	-0.04	-0.03	-0.01	-0.05	-0.22	-0.21	-0.11	-0.11	-0.04	-0.03
	*(1.66)**	*(1.27)*	*(0.60)*	*(1.18)*	*(5.27)****	*(4.89)****	*(3.71)****	*(3.40)****	*(1.24)*	*(1.10)*
$risk$	68.39	70.49	149.11	193.89	-5.21	-70.36	71.46	77.86	82.37	74.95
	*(3.60)***	*(3.66)****	*(3.17)****	*(2.18)**	*(2.33)***	*(2.60)****	*(2.44)****	*(2.71)****	*(3.45)****	*(3.06)****
$size$	-1.21	-2.78	-47.16	-45.24	-12.96	6.87	-10.56	-9.78	7.74	7.24
	(0.53)	*(1.31)**	*(12.85)***	*(5.63)****	*(0.81)*	*(0.51)*	*(5.03)****	*(4.61)****	*(1.83)****	*(6.46)****
$profit$	160.35	146.70	157.41	120.05	432.59	374.85	275.46	267.61	169.08	159.57
	*(4.09)****	*(3.76)****	*(6.00)****	*(2.23)***	*(6.16)****	*(5.44)****	*(4.45)****	*(4.17)****	*(3.32)****	*(3.10)****
$cycle$	-0.07	-0.27	0.18	0.09	-0.03	-0.28	-0.13	-0.13	0.02	0.32
	*(1.29)**	*(2.10)***	*(2.18)***	*(2.45)****	*(3.26)****	*(3.40)****	*(2.14)***	*(1.56)**	(1.28)*	*(2.18)***
$\Delta loan$	-0.02	-0.01	0.14	0.13	0.11	-0.00	-0.04	0.00	-0.01	-0.03
	*(3.35)****	*(2.81)****	*(7.95)****	*(2.72)****	*(1.25)*	*(0.03)*	*(10.70)****	*(1.56)**	*(0.27)*	*(2.55)****
$net\ loans$	-0.04	-0.06	-0.07	-0.36	-2.38	-0.08	0.05	0.04	-0.09	-0.09
	*(1.97)***	*(2.82)****	*(4.49)****	*(5.28)****	*(1.97)***	*(0.80)*	*(2.97)****	*(2.46)****	*(2.37)***	*(2.37)****
sargan	24.86 *(0.89)*	25.29 *(0.88)*	25.67 *(0.86)*	27.46 *(0.89)*	30.37 *(0.68)*	29.10 *(0.84)*	24.93 *(0.89)*	27.04 *(0.76)*	23.63 *(0.42)*	21.07 *(0.98)*
$a(1)$	-2.63 *(0.00)*	-2.64 *(0.00)*	-1.70 *(0.00)*	-2.05 *(0.00)*	1.12 *(0.00)*	1.30 *(0.00)*	-3.18 *(0.00)*	-2.26 *(0.00)*	-2.28 *(0.00)*	-2.35 *(0.00)*
$a(2)$	-1.90 *(0.36)*	-1.92*(0.74)*	-1.69*(0.96)*	-1.57 *(0.70)*	-1.43 *(0.62)*	-1.39 *(0.67)*	1.96 *(0.58)*	-1.02 *(0.43)*	-1.32 *(0.48)*	-1.34 *(0.90)*

Note: Dependent variable is BUF_{it}. *Other variables as defined in Table 3.*

T-values presented in parentheses. $a(1)$ *and* $a(2)$ *represent first and second order residual tests.*

*, **, *** *denote significance at the ten, five and one percent levels of significance respectively.*

Table A. 7: EA Two-Step GMM Estimates by Type and Size of Bank

	Commercial banks		***Cooperative banks***		***Savings banks***		***Big banks***		***Small banks***	
Cycle variable:	domestic output gap	eu25 output gap	domestic output gap	eu25 output gap	domestic output gap	eu25 output gap	domestic output gap	eu25 output gap	domestic output gap	eu25 output gap
buf_{t-1}	0.34	0.30	-0.01	-0.03	-0.06	-0.15	0.49	0.48	0.17	0.15
	*(3.84)****	*(3.33)****	*(0.30)*	*(0.92)*	*(2.50)****	*(11.65)****	*(7.25)****	*(6.57)****	*(2.07)***	*(1.72)**
roe	-0.05	-0.06	-0.02	-0.01	-0.27	-0.33	-0.09	-0.01	-0.18	-0.18
	*(1.76)**	*(2.42)****	*(0.60)*	*(0.66)*	*(5.92)****	*(7.62)****	*(3.83)****	*(3.71)****	*(5.52)****	*(5.67)****
$risk$	47.39	52.22	149.11	107.88	-169.20	-192.14	52.77	70.86	79.30	82.70
	*(4.37)****	*(4.75)****	*(3.17)****	*(2.41)***	*(4.56)****	*(6.24)****	*(1.83)**	*(2.46)***	*(3.95)****	*(4.21)****
$size$	0.15	-0.82	-47.16	-42.58	8.75	46.07	-10.37	-10.34	5.25	5.81
	(0.09)	*(0.50)*	*(12.85)****	*(9.00)****	*(0.63)*	*(3.37)****	*(5.90)****	*(5.90)****	*(1.42)**	*(1.65)**
$profit$	177.68	206.90	157.41	151.36	-0.02	540.39	223.53	246.05	420.95	423.68
	*(3.98)****	*(4.42)*	*(6.00)****	*(6.09)****	*(1.58)**	*(7.07)****	*(4.40)****	*(4.24)****	*(7.75)****	*(7.73)****
$cycle$	-0.07	-0.07	0.19	0.02	-0.13	-0.21	0.12	0.05	0.13	0.07
	*(1.46)**	*(1.32)**	*(2.18)***	*(0.35)*	*(4.00)****	*(4.95)****	*(2.17)***	*(1.95)**	*(1.34)**	*(1.04)*
$\Delta loan$	-0.03	-0.02	0.14	0.11	-0.01	-0.22	-0.05	-0.04	-0.02	-0.03
	*(4.94)****	*(4.40)****	*(7.95)****	*(6.50)****	*(0.07)*	*(3.11)****	*(14.37)****	*(13.36)****	*(1.38)**	*(1.54)**
$net\ loans$	0.02	-0.01	-0.36	-0.31	-0.09	0.17	0.07	0.06	-0.10	-0.11
	(0.48)	*(0.27)*	*(8.53)****	*(9.32)****	*(0.87)*	*(1.57)**	*(5.08)****	*(4.21)****	*(2.40)***	*(2.58)****
sargan	28.59 *(0.92)*	24.43 *(0.86)*	28.37 *(0.99)*	29.63 *(0.99)*	23.64 *(0.87)*	23.65 *(0.87)*	19.61 *(0.66)*	18.88 *(0.70)*	18.98 *(0.70)*	20.18 *(0.63)*
$a(1)$	-1.96 *(0.00)*	-1.93 *(0.00)*	-2.19 *(0.00)*	-1.57 *(0.00)*	-1.71 *(0.00)*	1.64 *(0.00)*	-2.13 *(0.00)*	-2.09 *(0.00)*	-1.40 *(0.00)*	-1.09 *(0.00)*
$a(2)$	-1.24 *(0.75)*	-1.59 *(0.65)*	-1.19 *(0.23)*	-1.20 *(0.23)*	-1.03 *(0.90)*	-1.65 *(0.51)*	-1.47 *(0.14)*	-1.60 *(0.25)*	-1.32 *(0.69)*	-1.03 *(0.76)*

Note: Dependent variable is BUF_{it}*. Other variables as defined in Table 3.*

T-values presented in parentheses. $a(1)$ *and* $a(2)$ *represent first and second order residual tests.*

, **, * denote significance at the ten, five and one percent levels of significance respectively.*

Table A. 8: Descriptive Statistics by Bank Type

	Commercial banks			Cooperative banks			Savings banks		
	obs	***mean***	***st dev***	***obs***	***mean***	***st dev***	***obs***	***mean***	***st dev***
EU25									
buf	1267	5.23	6.84	210	4.47	5.53	299	4.64	3.12
roe	2177	10.75	18.08	481	8.39	6.34	479	11.67	4.89
risk	878	0.06	0.78	138	0.07	0.05	65	0.04	0.04
risk2	2062	0.00	0.01	467	0.00	0.01	479	0.00	0.00
size	2178	3.97	0.85	482	3.87	0.56	479	3.86	0.52
profit	2177	0.01	0.01	482	0.01	0.00	479	0.01	0.00
$\Delta loan$	1865	-13.07	756.57	400	9.06	16.82	403	12.61	11.41
net loans	2175	51.72	22.72	482	62.38	18.56	479	61.52	14.48
EU15									
buf	1059	5.23	7.36	210	4.47	5.53	297	4.61	3.12
roe	1908	10.61	18.27	481	8.39	6.34	477	11.64	4.87
risk	712	0.05	0.76	138	0.07	0.05	65	0.04	0.04
risk2	1803	0.00	0.01	467	0.00	0.01	477	0.03	0.00
size	1909	3.97	0.81	482	3.87	0.56	477	3.85	0.51
profit	1908	0.01	0.01	481	0.01	0.00	477	0.01	0.00
$\Delta loan$	1636	-17.11	807.71	400	9.06	16.81	402	12.62	11.42
net loans	1906	51.49	23.83	482	62.38	18.56	477	61.58	14.48
EA									
buf	817	4.62	6.64	204	4.10	4.01	276	4.40	2.91
roe	1480	10.14	19.97	473	8.41	6.39	449	11.69	4.59
risk	489	0.06	0.07	138	0.07	0.05	47	0.05	0.04
risk2	1407	0.00	0.01	467	0.00	0.01	449	0.00	0.00
size	1481	3.95	0.78	474	3.86	0.56	449	3.18	0.44
profit	1481	0.01	0.01	474	0.01	0.00	449	0.01	0.00
$\Delta loan$	1267	-25.17	917.63	393	9.03	16.95	379	12.88	11.61
net loans	1480	50.17	23.69	473	62.01	18.48	449	60.76	14.37
DK,SE,UK									
buf	242	7.28	9.09	6	17.01	20.83	21	7.43	4.33
roe	428	12.25	10.35	8	6.81	1.78	28	10.78	8.27
risk	223	0.03	0.08				18	0.01	0.01
risk2	396	0.00	0.01	8	0.00	0.01	28	0.01	8.27
size	428	4.07	0.88	8	4.61	0.16	28	4.44	0.97
profit	426	0.28	0.24	8	0.00	0.00	28	0.01	0.00
$\Delta loan$	369	10.58	27.73	7	10.7	4.77	23	8.33	6.19
net loans	428	56.08	23.74	8	84.90	7.29	28	74.71	9.02
RAM									
buf	208	5.77	3.02				2	8.55	0.21
roe	269	11.77	16.64				2	19.75	1.56
risk	166	0.11	0.07						
risk2	259	0.01	0.01				2	0.00	0.00
size	269	3.95	1.07				2	19.75	1.56
profit	269	0.01	0.01				2	0.01	0.00
$\Delta loan$	229	15.75	15.19				1	8.52	
net loans	269	53.34	12.13				2	46.50	1.33

Table A. 9: Descriptive Statistics by Bank Size

	large banks			small banks		
	obs	*mean*	*st dev*	*obs*	*mean*	*st dev*
EU25						
buf	447	3.05	1.88	1329	5.71	6.99
roe	532	12.20	8.36	2605	10.19	16.47
risk	284	0.05	0.04	797	0.07	0.08
risk2	524	0.00	0.00	2484	0.00	0.01
size	532	5.07	0.45	2607	3.71	0.59
profit	532	0.01	0.00	2605	0.01	0.00
$\Delta loan$	462	7.62	21.26	2206	-8.70	695.67
net loans	532	52.03	17.43	2605	55.43	22.27
EU15						
buf	447	3.04	1.88	1119	5.80	7.49
roe	532	12.20	8.36	2334	10.00	16.45
risk	284	0.05	0.04	631	0.05	0.08
risk2	524	0.00	0.00	2223	0.00	0.01
size	532	5.07	0.46	2336	3.68	0.54
profit	532	0.01	0.00	2334	0.01	0.01
$\Delta loan$	462	7.61	21.25	1976	-11.54	734.99
net loans	532	52.03	17.43	2334	55.68	23.15
EA						
buf	388	2.95	1.9	909	5.15	6.55
roe	439	11.34	8.36	1963	9.81	17.35
risk	225	0.05	0.04	449	0.07	0.07
risk2	436	0.00	0.00	1887	0.00	0.01
size	439	5.03	0.43	1965	3.65	0.45
profit	439	0.01	0.00	1965	0.01	0.01
$\Delta loan$	381	7.05	22.8	1658	-15.77	802.77
net loans	439	736.83	1084.57	1963	44.28	76.38
DK,SE,UK						
buf	59	3.63	1.64	210	8.60	10.20
roe	93	16.27	7.11	371	11.01	10.55
risk	59	0.01	0.01	182	0.04	0.09
risk2	88	0.00	0.00	336	0.01	0.01
size	93	5.21	0.55	371	3.82	0.72
profit	93	0.01	0.00	369	0.01	0.00
$\Delta loan$	81	10.28	11.19	318	10.50	29.40
net loans	93	62.44	20.24	371	65.52	24.28
RAM						
buf				210	5.79	3.01
roe				271	11.83	16.59
risk				166	0.11	0.07
risk2				261	0.01	0.01
size				271	3.96	1.01
profit				271	0.01	0.01
$\Delta loan$				230	15.71	15.16
net loans				271	53.29	12.11

*Note: *, **, *** denote significance at the ten, five and one percent levels of significance respectively.*

Table A. 10: Buffer and Cycle Correlations by Type and Size of Bank

	total sample	cooperative banks	savings banks	commercial banks	large banks	small banks
EU25						
domestic gdp	0.03	0.11*	0.06	-0.00	0.15***	-0.00
domestic output gap	-0.04*	-0.04	-0.12**	-0.04	-0.14***	-0.04
eu25gdp	0.02	0.05	0.08	0.01	-0.06	0.03
eu25 output gap	-0.04*	-0.08	-0.11**	-0.02	-0.15***	-0.04
EU15						
domestic gdp	0.03	0.11*	0.06	0.02	0.15***	0.03
domestic output gap	-0.06**	-0.04	-0.12**	-0.06**	-0.14***	-0.06**
eu15gdp	0.02	0.05	0.08	0.01	-0.07	0.03
eu15 output gap	-0.05**	-0.08	-0.11**	-0.04	-0.14***	-0.05*
EA						
domestic gdp	0.01	0.01	0.11**	-0.01	0.15***	-0.01
domestic output gap	-0.07***	-0.09	-0.12**	-0.06**	-0.16***	-0.07**
eagdp	0.08	0.03	0.12**	-0.01	-0.11**	0.02
ea output gap	-0.05*	-0.12*	-0.11*	-0.04	-0.18***	-0.04
DK,SE,UK						
domestic gdp	0.21***	0.57	-0.05	0.19***	0.09	0.28***
domestic output gap	-0.01	0.17	-0.03	-0.04	0.08	-0.02
eu15gdp	0.04	0.33	-0.05	0.03	0.08	0.04
eu15 output gap	-0.03	-0.11	0.02	-0.04	0.13	-0.05
RAM						
domestic gdp	-0.08			-0.08		-0.08
domestic output gap	0.05			0.05		0.05
eu25 gdp	0.06			0.06		0.06
eu25 output gap	0.11*			0.12*		0.11*

*Note: *, **, *** denote significance at the ten, five and one percent levels of significance respectively.*

Additional Country-Specific Regulatory Measures

EU15

All of the countries in the EU15 sample have chosen to implement the BIS minimum of eight per cent as the requirement for internationally active banks. However, in addition to this, as discussed below, several countries have supplemented these rules with alternative measures to ensure soundness and stability.

Spain

In Spain, due to the concern of the Banco de Espaňa regarding the ability of Spanish banks to keep up with potential credit losses latent in the expansion of lending activity, capital requirement regulations were supplemented in June 2000 by a 'dynamic provisioning' system. The idea of the provisioning was based on the notion that funds are set against loans outstanding in each accounting time period, in line with and estimate of expected long-run losses. Essentially, the idea is to build up a provision during good times which is subsequently drawn from during bad times. The provision will increase when actual losses for one year are lower than expected, and is used against specific provisions in years when losses are higher than expected. The provisioning system therefore acts to smooth out cyclicality impacts of specific provisions on the profit and loss account.

The statistical provision is calculated using a bank's own internal method[14], or alternatively, via a standard method recommended by the Banco de Espaňa. The standard method classifies exposures into six different categories, depending on their degree of riskiness, and each category is allocated a weight coefficient[15]. The total provision is then equal to the sum of the requirements for all six categories. It is therefore unsurprising, as seen in Table 1, that the capital buffers of Spanish banks have remain relatively unchanged (around 3.6 per cent) since the implementation of the dynamic provisioning in June 2000.

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[14] The regulator must verify that the model adopted characterizes a suitable means to measure and manage credit risk.

[15] The coefficients range from 0 for zero risk exposures to 1.5 for high risk exposures.

United Kingdom

In addition to the basic requirements set out by the Basel Accord, the UK Financial Services Authority (FSA) various additional requirements are implemented to assure the safety and soundness of the banking sector. First, sets two separate requirements for each bank: a 'trigger ratio' and a 'higher target ratio'. The 'trigger ratio' serves as a minimum ratio which will generate regulatory intervention if infringed. The 'target ratio' serves as a warning signal and as a cushion of capital acting to prevent the accidental breach of the 'trigger ratio'. The gap between the 'target' and the 'trigger' ratio acts as a buffer in that regulatory pressure is exerted when the capital ratio falls below the 'target' but drastic regulatory action is only enforced in the event of a violation of the 'trigger ratio'. These ratios are bank specific and are based on the supervisors perception of the degree of riskiness of the banking institution. Banks deemed by the supervisor to be more (less) risky is required to hold higher (lower) levels of capital. Consequently, most UK banks are required to hold capital in excess of those specified by the EU directive. For the purpose of our estimations, we calculate the capital buffer for UK banks based on an assumed nine per cent minimum, since we are unable to obtain individual bank-specific requirement data.

RAMS

Banking policy for developing or transition economies generally tends to differ from that adopted for more developed markets. Since a stable financial system is vital for economic growth, the key questions for policy-makers in this context relate to the specific methods of bank regulation and supervision that can strengthen financial system regulation and supervision in order to promote more efficient and robust financial systems. Considering the largely varying degrees of development as well as the distinct differences that exist between the ram economies in terms of banking sector structures, it is unsurprising that the minimum capital adequacy ratio required of financial market operatives has varied across countries throughout our sample period.

Table 1 highlights the minimum ratios adopted in each of the ram countries. In Estonia and Cyprus, regulatory capital ratios have recently been tightened from eight to ten per cent of risk weighted assets to account for changes in market structure. In 1997, the Estonian authorities cited rapid growth of banks assets and changes in their operational environment as the main reasons for its higher regulatory ratio. In 2001, Cyprus raised its capital adequacy ratio to account for the increase in securities market activity. Latvia and Lithuania on the other hand both recently reduced their required ratios from ten to eight per cent effective from January 2005[16].

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[16] The ten per cent regulatory minimum continues to be effective for AB VB Mortgage Bank in Lithuania.

In Poland, while banks are required to hold no more than the eight per cent regulatory minimum, 15 per cent is the requisite ratio for banks in their first year of operation, and 12.5 per cent in the second year.