# Do profitable banks with a solid capital base have a higher ratio of capital buffer?

- Reviewing the impact of regulation, the previous financial crisis and banks own incentives of having excess capital

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KTH Industrial Engineering
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## Abstract

The financial crisis starting in mid-2007 is still affecting us, and with increased regulation banks and institutions are supposed to get more solvent and the industry to become more stable. The Basel Committee is working towards more unified regulation across countries, but the question is how the increased regulation is affecting banks financials. Do profitable banks with a solid capital base have a higher ratio of capital buffer? Looking at banks in 16 OECD countries during the period 1993-2009, with country-level panel-data displayed in two simultaneous equation estimations illustrating how profit and capital buffer has changed during these years, and the relation between them. To get an understanding of how the crisis affected these variables the regressions are also done for a pre-crisis period of 1993-2006. Internal funding variables and other economic control variables are explanatory variables and results show the internal funding variables have a large effect on profit and for capital buffer profit have the largest impact. Results imply that profitable banks with a solid capital base do have a higher ratio of capital buffer. The results coincide with the franchise value theory which is applied in the paper.

## Key-words

Capital buffer, profit, internal funding, financial regulation, franchise value theory, the Basel Accords.

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# 1. Introduction

## 1.1 Background and motivation

During the past two decades there have been several financial crises. The economy is still recovering from the previous one starting in mid-2007, and financial markets are still struggling. What defined this crisis are the many bailouts of banks by their governments, having a direct effect on taxpayers. In many cases large banks become imperative for not just the financial industry but for the whole economy, meaning they are "too big to fail". A bankruptcy of that caliber would be a disaster on many levels; the failure of Lehman Brothers is an example of that. Therefore there is an ongoing debate about how and if the financial industry should be regulated.

What a century ago was not a problem, is a problem today with banks and institutions not just pursuing traditional banking business but is rather diversified in their activities. Business today is far beyond what it used to be and only during the past decade the financial industry has developed substantially and today consists of a wide range of products and services. Edwards and Mishkin (1995) studies how the industry has gone from traditional banking to more risky activities that decrease the industry stability. Customer deposits are not the only source of capital anymore; on the contrary other more risky activities bringing higher returns are more common. The financial instruments are becoming more and more complex, and there is a demand for new innovative products. This is one of the reasons why it is difficult for authorities to effectively regulate the industry, it constantly evolves and bank activities become more and more diversified. These new more diversified banks are hard to monitor and therefore it is difficult getting to know the core of how to stabilize the industry. The economic climate is proven to be cyclical and it might be unrealistic to presume a world without any economic downturns, but with effective regulation the up- and downturns could be much smoother.

New regulations and stricter capital requirements are presented by the Basel Committee, called Basel III, with aims of decreasing the number of banks and institutions in need of government help during crises. These new requirements are being implemented from 2013, progressing until final implementation in 2019. With new regulations banks are, amongst several guidelines, held to a higher standard in terms of reducing risk and increasing their capital buffer. Capital buffer is the capital to asset ratio and is vital during times of stress to

ensure banks have sufficient capital, and to also make sure there is no extensive credit growth. What became clear during the previous crisis was that the earlier accords of Basel (first and second) were not enough to prevent such a deep crisis. However, it is not only the Basel Committee that set the rules of financial regulation, it is up to each country to implement these guidelines given they want to implement it, and if so making it work with current law and regulation.

During times of economic uncertainty, it becomes more important for banks to have a high level of buffer capital. Uncertain climate increases the risk of larger, unexpected losses and it is therefore crucial for banks to have fast access to more capital, and to hold a sufficient buffer. It is both more expensive to raise capital via the capital market, and also during economic crises it is more difficult to get credit. However, it is more costly to hold excess capital rather than debt, and it is important to remember the consequences of not having the adequate level of capital buffer. It becomes a tradeoff for banks, and it is more costly when building an appropriate buffer compared to keeping it at a constant level. Buffer capital can be seen as insurance against sudden capital losses and the cost of raising new capital. For a bank with a small capital buffer an unexpected loss can be devastating and when there is no direct access to internal capital debt is likely to increase. Often banks' have a buffer ratio which to keep constant, and it will be costly if it is needed to be increased or rebuilt after a loss. Most banks hold a buffer above the required level set by the Basel Committee. Often an internal minimum level it set that is higher than the required level, and this because banks' want to minimize the risk of supervisory intervention if their capital ratio would fall below the minimum required level at some point.

Besides having an adequate buffer it is also important to have a good allocation of internal capital. Having sufficient internal funds is vital, and even if internal capital only is a part of banks' financial resources, it states the long-term financing of a bank and for credibility it is important to have good solvency. It is the internal funds that determine the leverage ratio, and also states the probability of default. This is a measure of risk and the chosen level of capital also indirect sets the level of risk for the bank. The financial stress during economic downturns puts pressure on banks, and at that time it is essential to have access to extra capital if needed, and therefore both capital buffer and internal funds are important.

To make the financial industry more stable banks need an adequate level of buffer capital, a healthy approach to risk-taking via a diversified loan portfolio and putting more focus on their internal funds. It is also a question about solvency and public credibility amongst customers, which is very sensitive in the financial industry. With increased monitoring and capital requirements being strengthened, it could take time for banks to build a sufficient capital buffer if they do not have the required level yet.

The aim of this paper is to look at the development of banks' profit and capital buffer during a time of increased regulation, and also a worldwide financial crisis. What, besides regulation, will increase banks' capital buffers? Given the increased importance of internal funding, it is interesting to see how it's affecting profit and capital buffer. The theory of franchise value will be applied which explain banks' capital decision, and shows the positive relation between capital and profit. Expectations are that profit and capital buffer positively affects each other in both directions. How each explanatory variable is expected to affect profit and capital buffer will be explained in section 3. The theory also involves risk-taking, but it will not be taken into consideration in this paper.

The question for this paper is the following; do profitable banks with a solid capital base have a higher ratio of capital buffer? The data covers the time period of 1993-2009. What effect has internal funding on capital buffer and profit? The relation between capital buffer and profit will be looked at and a simultaneous equation system will show whether there is such a relation. Explanatory variables will be banks' internal capital in both regressions, making the two models a simultaneous system. To get an understanding of how the crisis affected these variables the regressions are also done for a pre-crisis period of 1993-2006. To my knowledge the approach with the relation between capital buffer, profit and internal capital has not been looked at before. However, the topic of capital buffer and its relation to profit, regulation, risk etc. has been explored with different data and different approaches and will be discussed further in section 2.3.

Research of bank behavior is important because of the increased worldwide economic uncertainty and with the growing number of multinational firms and banks crises are not just isolated to one country anymore. It is important for regulatory institutions, policy makers and for the overall financial system so that crisis like the previous one does not occur again. What

factors have a positive impact on banks behavior to become more solvent and less risk-taking is crucial to identify.

In this paper the capital buffer will be defined as tier one capital in relation to risk-weighted assets. No variable in the regressions will control for regulation explicitly but rather the time period chosen represents when the regulation from the Basel Committee was implemented and onward. To check whether the variables in the models are affected by the crisis starting in 2007, a regression will also be done for the time period of 1993-2006. This will answer if the explanatory variables have different effects on profit and capital buffer whether there is a crisis or not.

The paper is organized as follows. Section two reviews the history of the Basel Committee, explains the theory used and reviews previous studies. Section three describes the model and the variables, and section four reviews the data and empirical results. Finally section five provides the conclusion and suggestions of future studies.

## 2. Facts and theory

### 2.1 History of the Basel Commitee

The Basel committee was founded in 1974, by the Central Bank Governors of the Group of Ten Countries (G-10). Today it has 28 member countries and all countries have representatives from their country's central bank in the committee. The committee is neither an authority nor possesses any legal force, but is rather formulating guidelines and standards with the aim of countries moving towards having similar banking regulations. It is up to authorities in every country to implement the proposed standards, making it work with their current financial regulation. Any country can choose to follow the guidelines of Basel, and it is not only members who set their financial framework after Basel standards but rather most countries with international active banks do. In 1988 the first Basel accord was presented, and it included a new measurement of sound credit risk. The committee recommended a minimum of 8 % capital standard, which was to be implemented by the end of 1992. In 2004, a revised proposal was presented, also known as Basel II. This second accord was more extensive, and focus was to set a standard to protect the industry; a minimum level of capital buffer and minimized risk-taking was amongst several new guidelines. The accord consists of three pillars; risk coverage and containing coverage, risk management and supervision and thirdly market discipline.

Despite that many countries implemented the Basel recommendations and regulations were increased, a financial crisis struck the world economy in mid-2007. The crisis revealed flaws of the regulation in many countries, and due to the excessive risk-taking and the lack of capital buffer many governments had no choice but to step in and guarantee capital injections to prevent banks from failing. In response to this the committee wanted to further strengthen financial regulation and supervision, and the third Basel accord was a fact. The third accord was an extension of the three pillars of Basel II, with focus on improving the banks' ability to stand against losses and improving the quality and quantity of their capital base. The Tier 1 Capital must be 6 % of the risk-weighted assets and the total capital (tier 1 and tier 2) must be 8 % of the risk-weighted assets. The overall goal of the Basel Committee is to work towards making financial regulation and standards more unified across countries, to enable international active banks to work with the same premises everywhere, and thereby making the financial industry more stable and solvent.

## 2.2 Theory

The franchise value theory helps explaining banks' capital decision. The franchise value is the present value of expected future earnings, that could be lost in the case of bankruptcy, and the threat of it reduces banks' incentives for risk-taking and increases the savings of buffer capital. The analysis of Milne and Whalley (2001) added further insights of the franchise value theory. Evidence was found that banks with low franchise value have fewer incentives to maintain adequate capital, and such banks also have higher probability of failure since future earnings are expected to be low. Inversely, banks with high franchise value keep a substantial capital buffer, with expected future profits being high. So the better a bank's expected future financials are, the more reason they have to keep a sufficient capital buffer and reduce risk-taking to insure high future profits. Demsetz et al (1996) also found similar results, looking at the relation between franchise value and risk-taking. Looking at 958 U.S banks 1986-1994, evidence was found that banks with higher franchise value holds more capital and less asset risk, compared to banks with lower franchise value. So banks with high franchise value will be more solvent, keeping a higher level of buffer capital and will have a more diversified loan portfolio. What is important is for banks to have some franchise value to achieve soundness and stability, while having a lot of franchise value matters less. It is optimal for the financial industry in terms of stability, and the theory implies that banks should reduce risk-taking and increase capital buffer by their own due to the threat of losing future profits.

The relation therefore between capital buffer and profit is according to the theory positive, and for a bank with high profits (and future expected profits) it should result in a higher level of capital buffer. This especially when there is a financial upswing and there is room to increase the buffer, compared to a financial downturn when the capital buffer decreases since that extra capital is needed. If a bank has strong and balanced internal funding it should have a positive effect on the capital buffer since the more access a bank has to capital, the easier and less costly it is to build and increase the capital buffer. The same with profit, retained earnings is less costly to use to build a capital buffer rather than using external capital. The goal of the Basel Committee is for banks to increase their buffer in good financial times and to use the excess capital when the economy is in downturn, and by that creating a more stable financial industry.

The franchise value model also addresses the moral hazard problem that can arise in the presence of regulation and government safety net. When governments had to ensure loan guarantees to banks during the previous crisis, banks did not have the same incentives to reduce excessive risk-taking as they would otherwise. For banks to keep a high level of franchise value, they make sure to keep sound financials on their own, and by that ensuring their future profits.

## 2.3 Previous studies

Focus in this section is to understand banks behavior and internal decisions regarding their capital buffer, and how that decision is affected by financial regulation and other factors. As mentioned earlier, to my knowledge there are no papers examining how a banks internal capital affects their capital buffer and profit, which is why focus here is mainly on banks decision regarding their buffer capital and bank behavior in response to increased capital requirements.

There are many papers investigating how financial regulation and capital requirements have affected bank behavior in response to the Basel accords for the past two decades. All have different approaches but numerous papers focus on capital buffer, risk and how banks have adjusted this due to regulation. A bank's behavior regarding capital buffer can differ depending on for example their internal policy and Lindquist (2004) uses an example of Norwegian banks and creates two sub-groups; commercial banks and savings banks. Lindquist looks at the relation between banks credit risk and capital buffer and panel-data is used to investigate, besides credit risk, what other variables determines the capital buffer.

$$buf_{it} = \alpha_{0i} + \alpha_1 risk_{it} + \alpha_2 pec_{i,t-1} + \alpha_3 vprof_{i,t-1} + \alpha_4 cbuf_{t-1} + \alpha_5 sup_t + \alpha_6 gdpg_t + \alpha_7 size_{it} + \alpha_8 uslp_{i,t-1} + \alpha_9 trend_t + \alpha_{10} Q2 + \alpha_{11} Q3 + \alpha_{12} Q4 + u_{it}$$

| | |
|---|---|
| *buf* | The capital buffer as dependent variable, defined as the excess capital to risk-weighted assets. |
| *risk* | The bank's credit risk. |
| *pec* | The price of excess capital |
| *vprof* | Each bank's profit variance |
| *cbuf* | The competitors capital buffer |
| *sup* | Supervisory scrutiny |
| *gdpg* | The growth rate of GDP |
| *size* | The bank's total financial assets |
| *uslp* | The stock of unspecified loan loss provisions relative to risk-weighted assets |
| *trend* | A deterministic trend variable |
| *Q2-4* | A dummy variable to capture quarterly season effects |

What differ this model compared to the model used in the present paper is the explanatory approach and Lindquist's model includes several explanations; measures of the bank's credit risk, an explicit variable to check for supervisory monitoring, the competitor's choice of capital buffer, and the model also takes into account the relative closeness of the bank's capital buffer to the required level. In common with the model used in this paper is the impact of profit and GDP growth, however the use of variance of profit is more of a risk measure. The inclusion of profit in this paper is rather a direct measure of the effect of income on the buffer capital. The model in this paper focuses on the impact of a bank's choice of internal capital and how it affects capital buffer, and also the effect of regulation and monitoring is implicitly included in the way that the years chosen is when the regulation first was

implemented. Lindquist motivates the inclusion of the variance of profit; "since banks can use retained profits to increase their buffer capital, a high variance implies that this option is highly uncertain". In the results it is found that the variance of the profit (vprof) has a significant and negative impact on the capital buffer, implying that banks with a high variance in their profit will also have a smaller buffer. This coincides with the franchise value theory that banks with higher profits will have a higher level of buffer capital, and the higher variance of the profit, the more difficult it is to plan how to build the capital buffer with retained earnings.

The results differ for the two groups. For savings banks, the effect of credit risk is not significant on capital buffer but the variance of the previous year's profit has a negative effect, which is interpreted as a risk measure. This implies a negative relation between risk and buffer capital. Looking at the price effect (price of excess capital) of the buffer, it has a negative effect, which implies banks use the capital buffer as insurance against cost of supervisory intervention if their buffer is near or below the regulatory minimum. A negative relation between economic growth and capital buffer illustrates the buffer is used for investment opportunities, and looking at size larger banks seems to be holding a smaller capital buffer than small banks do. For commercial banks the result is slightly different, and the result is not as significant and clear-cut as for savings banks. However, credit risk seems to have a negative impact on their buffer and increased supervision has a positive effect. Commercial banks show a tendency of keeping a quite stable buffer, and are rebuilding it after experiencing losses.

Looking at banks' capital and risk is rather interesting since it displays bank behavior. Especially banks behavior affected by financial regulation, and Shrieves and Dahl (1992) investigates the relation and between changes in capital and risk and finds a positive relation. The sample consists of 1800 FDIC-insured independent and holding companies affiliated to commercial banks. Using simultaneous equation estimation, this finding still holds for banks having capital in excess of the minimum level, supporting the franchise value theory of banks having their own incentives of limiting risk and having an adequate level of capital buffer. When also looking at regulation it was found that regulatory settings are partly working, and in the end capital decisions was based on risk. Also using the same estimated model by Shrieves and Dahl (1992), Bertrand (2000) looked at Swiss bank behavior in response to capital requirements 1989-1995. Conclusion was that regulatory pressure affects banks to

increase their capital. The Basel accords are used as the measure of regulation, and how banks adjust their capital and risk given new regulatory standards. The model presumes the decision of capital and risk were taken simultaneously. Two definitions of capital is used; the ratio of capital to total assets and the ratio of capital to risk-weighted assets, and the definition of risk is the ratio of risk-weighted assets to total assets. It was concluded that banks with capital ratios close to the regulatory minimum level tend to increase their capital to risk-weighted assets as well as capital to total assets, implying these capital requirements works and give banks more stability. However, there was no evidence of a positive impact on banks' risk behavior. This is because increasing capital via profits or equity issues is less costly than decreasing the portfolio risk, which explains banks' unwillingness to reduce risk, it is too costly. Like the predictions in the present paper, profit was found to have a positive effect on capital, with the conclusion that "profitable banks can more easily improve their capitalization through retained earnings". This coincides with the franchise value theory.

Looking at German banks and using the capital buffer theory, Heid et al (2004) also assess in their paper how banks adjust their risk and capital under financial regulation. The capital buffer theory implicates that banks' with a high level of capital buffer tries to restore it and banks with a smaller capital buffer will try to increase it to a suitable level. It is found that the coordination between risk and capital buffer depends on how much in excess of the requirement a bank hold in buffer. This implies that a bank with a small capital buffer will increase their capital with low risk, while a bank with sufficient capital buffer will try to restore the buffer by increasing risk when raising capital. However, no evidence was found that banks with a small buffer made adjustments of capital faster in response to changes in regulation, compared to banks with a larger buffer. Their findings support the capital buffer theory and even if it is a different theory compared to the one used in this paper, it gives insights to bank behavior when banks have different levels of capital buffer, especially illustrating how banks increase or adjust their capital buffer.

Blum's (1999) article discloses how potential profits and risk often can be two sides of the same coin, given the franchise value theory. Looking at how a bank would act if stricter capital rules were implemented, creating two scenarios; in the case the bank was regulated versus unregulated. Blum concluded that capital requirements have two effects; future profits are expected to be reduced and the marginal cost of risk changes. To keep future profits from being reduced risk will have to be increased today to increase income tomorrow. The

marginal cost of risk changes if new capital restrictions are permanent and the bank has to increase equity to fulfill the new standard. This means if the bank is having difficulty raising new capital, the only way to increase equity tomorrow is by increasing risk today. The problem for banks is the restriction of how they can create business value and in the end income. Banks activities cannot be as diversified anymore, and while more risk increases volatility and thereby the risk of default it also often increases profit. The main differences comparing when the bank is regulated versus unregulated is that for the regulated bank equity is more valuable due to the "leverage effect", and for the unregulated bank it is more likely to take excessive risk. These findings does not comply with the franchise value in terms of reducing risk to ensure future profits, and rather points to the contrary of increased risk to create higher future profits. However, the results state how to increase future profits when they are not expected to be as high as wanted due to new capital requirements, and the franchise value states how to preserve and insure if future profits are expected to be high. But with high expected future profits there is more that could be lost if unnecessary risk is taken in contrast to the necessity of increasing risk to avoid lowered future profits.

## 3. The models

The regression models are a simultaneous system and since the statistical method used is Arellano-Bond (1991) they can be done separately. This is because in each equation there is an instrument variable estimation done. Banks internal capital is here constituted by customer deposits, bonds and interbank deposits. Due to the high correlation (table A1 and A2) between customer deposits and bonds, they needed to be separated into two equations, which is why there is four equations out of the two regression models.

*Equation 1A:*

$$\text{Capital buffer} = \alpha + \beta_1 \times \text{profit} + \beta_2 \times \text{intrate} + \beta_3 \times \text{cusdep} + \beta_4 \times \text{intdep} + \beta_5 \times \text{inst} + \beta_6 \times \text{rgdpg} + \beta_7 \times \text{year} + \varepsilon$$

*Equation 1B:*

$$\text{Capital buffer} = \alpha + \beta_1 \times \text{profit} + \beta_2 \times \text{intrate} + \beta_3 \times \text{bonds} + \beta_4 \times \text{intdep} + \beta_5 \times \text{inst} + \beta_6 \times \text{rgdpg} + \beta_7 \times \text{year} + \varepsilon$$

*Equation 2A:*

$$\text{Profit} = \alpha + \beta_1 \times \text{capbuf} + \beta_2 \times \text{intrate} + \beta_3 \times \text{cusdep} + \beta_4 \times \text{intdep} + \beta_5 \times \text{inst} + \beta_6 \times \text{rgdpg} + \beta_7 \times \text{year} + \varepsilon$$

*Equation 2B:*

$$\text{Profit} = \alpha + \beta_1 \times \text{capbuf} + \beta_2 \times \text{intrate} + \beta_3 \times \text{bonds} + \beta_4 \times \text{intdep} + \beta_5 \times \text{inst} + \beta_6 \times \text{rgdpg} + \beta_7 \times \text{year} + \varepsilon$$

### 3.1 Variabels

*Capital buffer* — The excess capital that the bank holds in excess of required level, calculated as tier one capital divided by risk-weighted assets and expressed in percentage. Tier one capital defined as core capital, mainly consisting of equity capital and disclosed reserves. In the second equation capital buffer is expected to have a positive impact on profit, according to the franchise value theory.

*Profit* — Defined as income after tax for each bank in every country, expressed in thousands. The variable is logged due to high values. Profit is assumed to have a positive effect on capital buffer, since retained earnings is a common way to increase the capital buffer.

*Interest rate* — A macroeconomic control variable, and is included because it highly influences the economy in each country. The interest rate is determining the price of capital, which directly affects the market. With a lower interest rate there will be more borrowing, vice versa. This has a direct effect on profit in the second equation since the more consumer lending the more income for banks. For the same reason interest rate is also expected to have a positive impact on capital buffer.

*Customer deposits* — One of the variables displaying a banks internal capital. It is the share of a bank's internal funding that comes from customers depositing their funds. Customer deposit constitutes the largest part of internal capital (Figure 2), and is assumed to have a positive impact on both capital buffer and profit. A positive effect on capital buffer because the more customer deposits, the more capital available and a positive effect on profit since more customers means more income and profit. Expressed in thousands and logged due to high values.

| | |
|---|---|
| *Bonds* | One of the variables displaying a banks internal capital, which can be described as a fixed-income security. There are several types of bonds such as corporate and government bonds, and all bonds have different risk and coupon rates. Banks generally have a differentiated portfolio of bonds. It is difficult to foresee what effect bonds will have on capital buffer and profit, but a stable internal funding should result in a positive impact on both profit and capital buffer. Expressed in thousands and logged due to high values. |
| *Interbank deposits* | One of the variables displaying a banks internal capital. Banks hold deposits for another bank, which in turn hold deposits for the first bank. This in turn generates rates of interest. It is difficult to say what kind of effect interbank deposits will have on profit and capital buffer, since it is more about holding and borrowing capital and not something that should affect profit and capital buffer. Expressed in thousands and logged due to high values. |
| *Institutions* | A variable demonstrating how many banks and institutions there are in every country, for each year. It's a control variable since the profit and capital buffer for each country is an aggregated value. |
| *Real GDP growth* | This variable is included to capture economic growth, which will have an impact on banks profit caused by factors other than the variables included. The expected effect on both profit and capital buffer is positive. Expressed in percentage. |
| *Year* | A dummy variable included to capture yearly effects. |

# 4. Data and empirical results

## 4.1 The data

To estimate the regressions a country-level panel-data set for 16 OECD countries (Figure A1) is used. Why not all OECD countries are included is because not all countries have complete data set and were therefore removed from the selection. The source is the OECD database, and the data is reported from each country's central bank to OECD and stretches over the period 1993-2009. The first Basel accord was implemented in 1992, and to capture the effect of the regulation the regressions start in 1993 continuing until 2009 which is the latest data available. All data is adjusted for inflation.

The statistic method used is Arellano-Bond's (1991) generalized method of moments (GMM) estimator. It is a dynamic model used when panel data consists of many panels and few time periods, and is good to use when the panels may contain fixed effects. The method allows for the use of more instruments without increasing autocorrelation. The instruments contain unobserved panel-level effects and to remove them a first-difference transformation of all variables is used. Lags of the dependent variable are used as instruments, which often increases the efficiency of the regression. There are several variations of GMM, and here one-step GMM will be used. "Xtabond2" is the command in Stata (statistical program) used when there is cross-section time-series data, and is the augmented version. Here there is an additional assumption (compared to the earlier version "Xtabond"), which is that the first differences of instrument variables are not correlated with the fixed effects. Because of this more instruments can be used which improves efficiency.

If other methods would have been used for the regressions several problems could arise which are not present when using Arellano-Bond. For example, problems with fixed effects and causality indicating the explanatory variables are correlated with the error term. Normally a two-stage least squares (2SLS) would be used for this type of regression. To deal with the fixed effects problem one would need to include exogenous instruments, but if these instruments are weak then the instruments could be biased which would affect the results. When using Arellano-Bond, instead of including exogenous variables as instruments lagged levels of the endogenous variables are included, which are not correlated with the error term. Tests controlling for autocorrelation of the first-difference errors and whether the instruments as a group are exogenous are also included for the Arellano-Bond method.

For the equation with capital buffer as dependent variable (eq. 1) difference GMM estimator is used and for the equation with profit as dependent variable (eq. 2) system GMM estimator is used. The system GMM is the augmented version of difference GMM and is used when the lagged levels of the dependent variable are poor instruments for the first-difference variables. This is also the reason why system GMM was used for the second equation with profit as dependent variable, the lagged levels of profit was poor instruments. One possible explanation to this is if the dependent variable is close to a random walk, then difference GMM does not work well since past levels contain little information about future changes. The system GMM uses levels equations to obtain in total two equations; one differenced and one in levels. When only first difference is used information about variances in the levels of the variables are lost,

especially if the variance is quite constant over time. This would not appear in the results if difference GMM is used, and explains why system GMM sometimes suits better.

To make sure there are no over identifying restrictions, a Sargan test is included or a Hansen test if the estimation is robust which it is in this paper, with a null hypothesis of "the instruments as a group are exogenous". A test of autocorrelation is also included to control for zero autocorrelation in first-difference errors which implies that lags of the dependent variables are endogenous, called Arellano-Bond test (AR2), with a null hypothesis of "no autocorrelation" (Mileva 2007).

*Table 1: Descriptive statistics*

| **Variable** | **Mean** | **Std. dev.** | **Minimum** | **Maximum** |
|---|---|---|---|---|
| *Capital buffer%* | 12,02 | 10,6 | 6,13 | 160,9 |
| *Profit* | 223671,4 | 1860790 | -1,35e+07 | 1,40e+07 |
| *Interest rate %* | 5,398 | 1,750 | 2,095 | 12,205 |
| *Customer deposit* | 3,52e+07 | 1,46e+08 | 37,28 | 1,05e+09 |
| *Bonds* | 5615579 | 2,81e+07 | 0,003 | 2,39e+08 |
| *Interbank deposit* | 373046 | 474148,4 | 0,384 | 3251759 |
| *GDP growth%* | 3,177 | 3,223 | -14,257 | 11,736 |

Table 1 summarizes the main features of the data. The mean value of capital buffer is high, 11,5 %, however the standard deviation is also high, 10,6 %. The reason the maximum value of capital buffer is over 100 % (160,9 %) is an outlier observation of Estonia from 2009. In Estonia between 1997 and 2009 the risk-weighted assets were zero and then 2008 and 2009 the values were higher but still low compared to the tier one capital, which explains why the capital buffer is so high. Profits range as expected from a negative to a positive value, with negative profits mostly occurring in 2007-2009 during the crisis. Generally profits have increased the years up until the crisis starting in 2007, which indicates the increased regulation have not had a large negative effect on profits. The mean value of the interest rate is quite high, 5 %. Interest rates were mostly high in the nineties, and substantially lower closer to 2009. As expected all the three forms of internal funding are ranging from zero up,

with customer deposits ranging the highest. The real GDP growth varies substantially between the countries, and has fluctuated much due to the financial up- and downturns during these years. The negative growth of -14,257 % belongs to Estonia in 2009. In fact, all countries except Korea, New Zealand and Poland had a negative GDP growth in 2009. Also the very high GDP growth of 11,74 % belongs to Estonia, from 1997. These two outliers are extremes, and the mean value of 3 % is a more expected growth rate.

As stated earlier the required minimum level of Tier 1 Capital is 6 % of the risk-weighted assets. The figure (Figure 1) illustrates the mean of capital buffer for all banks in the 16 countries, an average for each year. The 6 % level all banks are well above during the entire time period, and in 1998 there was a drop of the capital buffer ratio from over 10 % to 7 %. In 2003-2004 the ratio increased again, but it was not a full recovery. The ratio level staying constant in 2005-2008, and then an increase followed again in 2009.

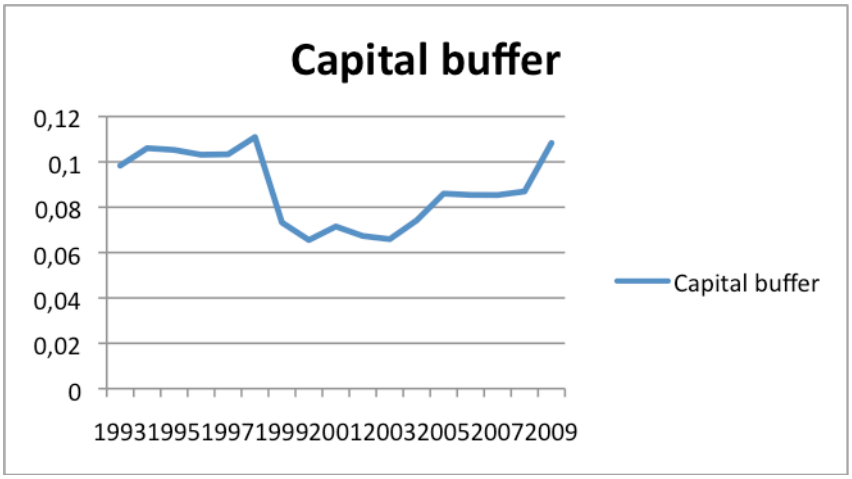


*Figure 1: Capital buffer 1993-2009*

What is clear is that banks choose to have a ratio well above the required level, and did so also in times of crisis. 1999-2004 banks' buffers' stayed around 7 %, which is the lowest level in the time period and could imply that banks used the extra capital after substantial capital losses during the nineties. Several studies have reached the conclusion that capital buffers of Western banks tend to vary counter-cyclical over the business cycle (Jokipii and Milne, 2008 and Lindquist, 2004). Results show that during economic upswings banks tend to expand their loan portfolio without increasing their capital buffer accordingly to the increased risk. So then when the economy is in decline the buffer is not enough and cannot cover the increased risk,

giving banks no choice but to reduce their lending. This is not how the Basel Committee wants banks to act, and it is important for banks to increase their capital buffer when for example lending is increased.

In 2004 the second Basel Accord was implemented, pushing for banks to increase their buffer capital, which is when it started to increase again. Already in 1993 when the first Basel accord had been implemented for a year the aggregated level was at almost 10 %, implying the ratio before 1993 was already high and above the minimum level of 6 %. This suggests banks' already had higher internal ratios before the implementation of the first Basel accord, or banks' increased the ratio in time for the new requirements. According to Furfine (2001), changes in supervisory regulation have a positive effect on capital ratios, and with the possibility of intervention banks' are keen on keeping a solid capital buffer. Given the buffer ratio already being high when the first Basel accord was implemented, the regulation is not the only reason why banks have had such high buffer throughout the years. But most likely financial regulation has had a clear positive effect and give banks strong incentives to keep their buffer above the minimum level to avoid supervisory intervention.

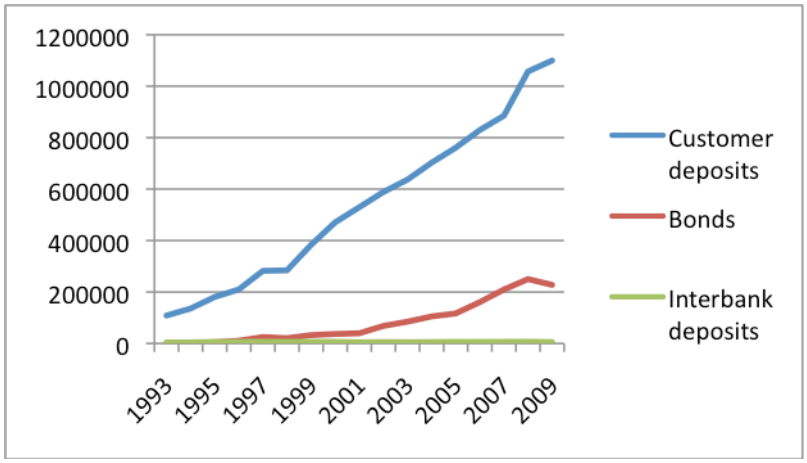


*Figure 2: The allocation of banks' internal funding*

Looking at the allocation of banks' internal funding (Figure 2), interbank deposits have had a quite constant level throughout the time period. Bonds have had a positive growth and have increased slightly during the whole period, but increased most during years 2004-2009. Customer deposits stands out as the form of internal fund that has grown the most, and has increased every year, especially 1999 and onward.

This development has been positive for banks' in terms of available capital, and could be a response from banks' in an attempt to increase internal capital. Customer deposits have during the entire time period constituted the largest part of banks' internal funds, and have also the least risk attached. It could also be an increase in customers' financial activities and the importance for consumers to have savings. Consumers' savings are proven to be cyclical, and during times of poor economic climate consumers tend to spend less and save more, vice versa. This development is positive for banks and the more capital available at low risk, the more solvent and safe is the bank.

## 4.2 Empirical results

*Table 2.Capital buffer as dependent variable, eq. 1A.*

| **Variable** | **1993-2006** | **1993-2009** |
|---|---|---|
| *Profit* | 0,052*** | 0,053** |
| | (0,018) | (0,022) |
| *Interest rate* | 0,505*** | 0,555*** |
| | (0,165) | (0,140) |
| *Customer deposits* | 0,037 | 0,008 |
| | (0,107) | (0,106) |
| *Interbank deposits* | -0,096** | -0,108*** |
| | (0,042) | (0,032) |
| *Real GDP Growth* | 0,004 | 0,006 |
| | (0,009) | (0,005) |
| *Hansen test* | 1,000 | 1,000 |
| *Arellano-Bond test (A2)* | 0,706 | 0,469 |

*(*1% = *** 5% = ** 10% = *)

Due to collinearity, Stata dropped year 1993 in equation (1A) and years 1993 and 2009 in equation (1B). The values in parenthesis are the standard errors. Looking at the regression (table 2 and 3) with capital buffer as dependent variable, neither customer deposits (positive) nor bonds (negative) have a significant effect on capital buffer. Customer deposits were expected to have a positive impact, since increased customer deposits means more available capital. But with no significance it cannot be statistically certain. One explanation for why customer deposits do not have a significant effect on capital buffer could be that banks with a high level of customer deposits see it as a safe source of capital, and might not then see the

need to have such a high ratio of capital buffer. Customer deposits are capital with low risk and could therefore be seen as safe financing, and in excess of customer deposits to also have savings of buffer capital some banks might consider as redundant.

Interbank deposits on the other hand have a negative and significant effect in both time periods. The effect is slightly larger for the entire time period (1993-2009) in both equations. It is difficult explaining this unexpected negative effect, and since the effect is the same in both equations interbank deposits have indeed a negative impact on capital buffer. One explanation could be that interbank deposits are capital that is not really available capital but rather capital that is lent and borrowed between banks as security. Profit has a positive and significant effect (1 %) for both time periods, which was expected, and indicates no difference in the effect before or during the crisis. The interest rate is positive and significant (1 %) and has the largest impact on capital buffer, and if the interest rate increases with one unit then the capital buffer will increase with between 0,365 and 0,555 units. The reason why the interest rate has such large positive impact on capital buffer could be because banks sometimes take advantage of periods with high nominal interest rates to increase their own marginal. This can partly be considered as a risk premium since higher nominal rates often goes hand in hand with increased volatility, and partly because it could be easier for banks to increase their margins when the real interest rate reaches higher levels. This increases banks earnings and thereby also increases capital, having a positive impact on their capital buffer.

Real GDP growth is positive but insignificant and do not differ between the two periods. The null hypothesis of the Hansen test is “the instruments as a group are exogenous”, and the higher value the better. With a value of 1 it means the hypothesis cannot be rejected and there is no evidence of correlation with the error term. The Arellano-Bond test (AR2), which checks for autocorrelation, has as value of between 0,419 and 0,722 (>0,05) and therefore can be rejected, implying there probably is autocorrelation in the first-difference errors. This could have an effect on the size of the values of the variables.

*Table 3. Capital buffer as dependent variable, eq. 1B.*

| **Variable** | **1993-2006** | **1993-2009** |
|---|---|---|
| *Profit* | 0,043*** | 0,036*** |
| | (0,014) | (0,014) |
| *Interest rate* | 0,365*** | 0,434*** |
| | (0,075) | (0,096) |
| *Bonds* | -0,037 | -0,016 |
| | (0,041) | (0,032) |
| *Interbank deposits* | -0,052** | -0,064** |
| | (0,031) | (0,032) |
| *Real GDP Growth* | 0,008 | 0,007 |
| | (0,010) | (0,005) |
| *Hansen test* | 1,000 | 1,000 |
| *Arellano-Bond test (A2)* | 0,722 | 0,419 |

*(*1% = *** 5% = ** 10% = *)

*Table 4. Profit as dependent variable, eq. 2A.*

| **Variable** | **1993-2006** | **1993-2009** |
|---|---|---|
| *Capital buffer* | 0,356 | 0,337 |
| | (0,263) | (0,306) |
| *Interest rate* | 0,898*** | 0,772** |
| | (0,294) | (0,323) |
| *Customer deposits* | 0,877*** | 0,927*** |
| | (0,030) | (0,031) |
| *Interbank deposits* | 0,246*** | 0,165** |
| | (0,079) | (0,075) |
| *Real GDP Growth* | 0,083*** | 0,078** |
| | (0,016) | (0,035) |
| *Hansen test* | 1,000 | 1,000 |
| *Arellano-Bond test (A2)* | 0,227 | 0,398 |

*(*1% = *** 5% = ** 10% = *)

With profit as dependent variable (table 4 and 5), capital buffer have a positive and large but insignificant effect. According to the franchise value theory the larger the profit and the future

expected profit is, the more reason for a bank to have a higher level of buffer capital. The positive effect is expected however with no significance, and one reason could be that the capital buffer has fluctuated during these years which could be an explanation for why it is not significant. Interest rate is positive and highly significant (1 %) in both periods. The impact is large in both equations and positive as expected. The values of the interest rate are very high, 2,402 and 2,188 (table 5). This despite logging the variable and looking at the data nothing appears to be wrong. Since it occurs only in this equation and not the others with the same data it is therefore difficult establishing why these values are so high.

*Table 5. Profit as dependent variable, eq. 2B.*

| **Variable** | **1993-2006** | **1993-2009** |
|---|---|---|
| *Capital buffer* | 0,812 | 0,428 |
| | (0,648) | (0,435) |
| *Interest rate* | 2,402** | 2,188** |
| | (1,007) | (0,934) |
| *Bonds* | 0,818*** | 0,802*** |
| | (0,119) | (0,101) |
| *Interbank deposits* | 0,304*** | 0,204 |
| | (0,159) | (0,154) |
| *Real GDP Growth* | 0,191*** | 0,200*** |
| | (0,068) | (0,053) |
| *Hansen test* | 1,000 | 1,000 |
| *Arellano-Bond test (A2)* | 0,100 | 0,050 |

*(*1% = *** 5% = ** 10% = *)

Customer deposits are significant and have a large positive impact on profit, with values being close to the same in both time periods. Bonds are also highly significant and have a large positive effect on profit, with a value of around 0,8. Interbank deposits differ a bit between the two equations (table 4 and 5) and with customer deposits included the interbank deposits are significant and positive in both periods with values ranging from 0,165 to 0,246. With bonds instead included the interbank deposits are significant (but on 10 % level) in the period pre-crisis and insignificant for the entire time period, however both being positive. Since all values are positive, but not all significant, interbank deposits will be regarded as having a

positive impact on profit. Real GDP is positive and significant, and there is hardly any difference between the time periods. Looking at the Hansen test, with a value of 1 it means the hypothesis cannot be rejected and there is no evidence of correlation with the error term. The Arellano-Bond test (AR2), which checks for autocorrelation, has a high value in table 4 and autocorrelation probably exist in these first-difference errors. In table 5 the values are low and the null hypothesis of "no autocorrelation" cannot be rejected which is better, and these values are not affected by any autocorrelation with the error term.

## 5. Conclusion

In this paper, we have looked at how banks capital buffer and profit has changed during increased financial regulation, 1993-2009. Using two regression models displaying how capital buffer and profit have changed during the years and also looking at the relation between them, with internal funding- and economic control variables as explanatory variables for both regressions. Reviewing what effects the capital buffer, profit and interest rate have a positive effect while interbank deposits have a negative impact. The positive effect of profit on capital buffer supports the franchise value theory, and the regression shows profit during this time period is equally important for the capital buffer during a crisis as otherwise. The negative impact of the interbank deposits is difficult to explain, and in what way it negatively effects capital buffer is difficult to establish. One explanation could be that funds being borrowed from one bank to another decreases capital available and it is capital that cannot be saved as buffer. What affects profit are interest rate, the internal capital variables and GDP growth, all having a positive effect. Capital buffer also have a positive impact, which coincides with the franchise value theory, however insignificant making it difficult to statistically establish. Interest rate have a large and positive effect on profit which was expected, while customer deposits and bonds were expected to have a positive impact but not to have such high values as they have. Interbank deposits also have a positive effect (but insignificant in eq. 2B in the second time period). Internal capital is shown to have a large positive effect on profit, and to have a solid capital base improves profit, whether there is a crisis or not. So internal funds are important for profit, and profit in turn is vital for capital buffer, making internal capital important also for the capital buffer. Higher profits and a higher ratio of capital buffers therefore increase bank stability and demonstrate how increased regulation has not affected banks profitability during these years in a negative way. This was

also displayed in the data which showed that profits generally increased up until 2007 when the crisis hit.

Despite looking at two time periods, before the crisis and the entire period, there was little difference for the impact of the explanatory variables. However, since the data reaches 2009, only two years after the crisis started, the effects of the crisis might now show yet. In a couple of years from now this will be more clear, and also when looking at bank behavior and reactions to regulations and such it takes years to see the full effect of changes. The variables used in this paper are not being changed overnight; bonds for example are bound for a specific time and cannot just be redirected. Bank management makes decisions based on their long-term strategy, which results in a delayed effect when there are new changes to be done. Economic variables have in general a lagged effect when changes are made, and it takes some time to see the effect of it. Transforming the financial industry to become more stable and to reduce the risk behavior takes time, displayed by the third Basel Accord, which takes from 2013 to 2019 to be fully implemented.

Most important for the increase of capital buffer is profit and interest rate, and while interest rate is set by the market, a profitable bank will most likely have a higher buffer ratio compared to a less profitable bank. It is more costly to hold equity compared to debt, and retained earnings being a less costly way to increase the capital buffer makes it a good way to increase or rebuild it. Also, according to the franchise value theory, profitable banks have more to lose and to ensure expected future profits it becomes more important for the bank to be solid and to not take unnecessary risks. For the financial industry to be more stable profitable banks is preferable and in that way larger and more solvent banks are better for the entire economy.

What was clear when looking at how the capital buffer has changed during the years was the low level of buffer capital of 7 % between 1999 and 2004. It indicates how the extra capital was needed during those years. Most likely it was an after math of the financial difficulties during the nineties, and displays how important it is to have extra equity available. It will be interesting to see how the level of buffer capital has changed since 2009, and whether banks capital buffers were used and if it was, whether it has been rebuilt again.

For future studies it would be interesting to look at what affects banks choice of internal and external capital, given the new financial regulation. Whether the use of external capital will

decrease since it includes more risk than internal capital do. Will the ratio of internal/external capital change and what will have been the most important factors for capital buffer during and after the past crisis? This will give many answers as to how banks react and behave during a crisis, and learning how banks act during extreme situations will be very valuable when trying to understand bank behavior.

# 6. Appendix

Two correlation matrixes of the regressions illustrates that there is high correlation between customer deposits and bonds (table A1 and A2). In the equations the correlation between the variables are 0,89 and 0,85 respectively, which is very high. Therefore the equations were split into two to separate customer deposits and bonds, resulting in two equations out of each regression done instead.

*Table A1: Correlation matrix of the variables in eq. 1*

| | lprofit | lcusdep | lbonds | lintdep | lintrate | rgdpg | linsti~s |
|---|---|---|---|---|---|---|---|
| lprofit | 1.0000 | | | | | | |
| lcusdep | 0.9462 | 1.0000 | | | | | |
| lbonds | 0.8518 | 0.8983 | 1.0000 | | | | |
| lintdep | 0.5094 | 0.5335 | 0.6436 | 1.0000 | | | |
| lintrate | -0.1188 | -0.0690 | -0.2261 | -0.3974 | 1.0000 | | |
| rgdpg | 0.0425 | -0.0795 | -0.1635 | -0.2773 | 0.0965 | 1.0000 | |
| linstituti~s | 0.0868 | 0.1261 | 0.1121 | 0.1781 | 0.0087 | -0.2604 | 1.0000 |

*Table A2: Correlation matrix of the variables in eq. 2*

| | capbuf | lprofit | lcusdep | lbonds | lintdep | lintrate | rgdpg |
|---|---|---|---|---|---|---|---|
| capbuf | 1.0000 | | | | | | |
| lprofit | -0.2991 | 1.0000 | | | | | |
| lcusdep | -0.3634 | 0.9475 | 1.0000 | | | | |
| lbonds | -0.4174 | 0.8575 | 0.9081 | 1.0000 | | | |
| lintdep | -0.3129 | 0.5087 | 0.5322 | 0.6548 | 1.0000 | | |
| lintrate | 0.0115 | -0.0888 | -0.0483 | -0.1755 | -0.4118 | 1.0000 | |
| rgdpg | 0.0520 | 0.0255 | -0.0899 | -0.1823 | -0.2873 | 0.1328 | 1.0000 |
| linstituti~s | -0.0549 | 0.1133 | 0.1473 | 0.1443 | 0.1902 | -0.0344 | -0.2500 |

| | linsti~s |
|---|---|
| linstituti~s | 1.0000 |

| Country |
| --- |
| Austria |
| Belgium |
| Chile |
| Czech Republic |
| Estonia |
| Ireland |
| Italy |
| Korea |
| Netherlands |
| New Zealand |
| Norway |
| Poland |
| Slovak Republic |
| Spain |
| Sweden |
| Switzerland |

*Figure A1: OECD countries included in the selection.*

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