BANK CAPITAL MANAGEMENT – THE COUNTERCYCLICAL RESERVE

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Abstract:
Since the outburst of the recent economic crisis, both regulatory institutions and researchers alike have shown increased concern in enhancing the ability to predict financial crises and reduce the pro-cyclical characteristics of banking. The initial plan was established and until implementation there are few steps left. We should ask in advance if this new regulatory requirement can be managed in optimal terms.

Keywords: management, risk management, early warning system, financial crisis, banking crisis, financial stability, logistic

Introduction

For a long time, banks have been acknowledged and accepted as the central pillar of the financial system and the main financing source for the real economy. It is seldom knowledge that, acting as a rational agent, a bank should try to enroll in profitable and sustainable activity. On the other hand, due to their importance in the macro system, all other entities should wish for a competitive, resilient and stable bank system. From a different viewpoint, history has shown us the strong proc-cyclical character of the banking industry, prospering in times of economic growth, and becoming fragile in times of recession. In line with economic slowdown, banks will decrease credit supply, pressuring the real economy and generating vicious spirals with prolonged negative effects.

With the objective of strengthening the financial system, the Basel committee has developed the Basel I, II & III packs, which impose a series of constraints, most important being the one regarding the minimum capital. In broad lines, this refers to an initial 8% of total assets to be held in form of tier I capital. The first versions have been criticized for rigidity, but the newer ones allow a decent degree of flexibility in calculating the risk weighted assets and therefore in calculating the regulatory capital.

(For example, banks can use internal rating systems in determining risk weights – AIRB). Therefore, by using the AIRB approach, banks would have capital consumptions in direct link to their risk appetite.

The motivation for the current studies lies in the new requirements comprised in the Basel III – CRD IV accord. More precisely, from a new mass of requirements one can identify the request for the countercyclical capital buffer. Therefore we can expect an increase up to 2.5% in regulatory capital strictly from the capital buffer. In those that follow it desired to analyze the impact of this requirement in the financial management of banking institutions. Moreover an attempt to optimize this reserve by using a statistical model will be presented.

Considering those mentioned

above, both national and international authorities have generated a regulative framework meant to reduce the incidence of negative events, such as excessive credit, bank crises and bankruptcies. From the perspective of assets and liabilities management, more general financial management, the most precious financial resource for a bank is the economic capital. Alongside other macro prudential measures imposed by the authorities, like minimum reserves, credits/deposits ratio, the 8% minimum capital requirement, is uncontestable the most efficient method to impose moderation. In more detail, banks are required to permanently have an 8% (The ECB imposed 10% and most national authorities supplemented) ratio of tier I capital over risk weighted assets. Through risk weight we understand and method to account for risk in various assets. This capital requirement stands for unexpected loss. Expected loss is covered by provisioning.

From a conceptual standpoint, the countercyclical capital buffer wishes to prevent the built up of systemic risk associated with excess credit through reducing the credit appetite of banks by introducing extended capital requirements. The mechanism proposed by the European Commission has 2 main phases: of accumulation of reserves during periods of economic expansion, and of release during periods of adversity. Amongst the indicators tested for guiding the capital level, the credit/gdp gap has shown the best predictive power. The countercyclical buffer should be 0.25% of RWA for every percentage point of de credit/gdp gap over 2%. The maximum level should be 2.5%*RWA, but could be increased in special conditions.

From the private management's perspective, this requirement was a rather hostile one, especially coming in a period of financial difficulties in which the real value of bank capital was especially high. However, at macro-economical level, despite the possibility of initially reducing credit supply, looking forward, this requirement will have obvious positive effects. In a certain consultative document, the Basel committee admits a series of deficiencies in constructing this reserve based on the previously presented indicator. Here one can refer to the facts that the credit/gdp gap does not account for different economic development phases and for heterogeneous credit dynamics. At the same time, it is not specified if the responsibility of establishing this reserve should be at the national monetary authority. A more desired version would be to a joint venture, in which commercial banks should have the freedom to develop, implement and use their own methods with the approval of supervision of the regulator. In the following, this paper will propose a statistical model that has better predictive power than the credit/gdp gap.

Review of the existing literature

Recent research focused on the utilization of limited dependence regressions, especially the logistic regression, with satisfying results, hence the decision to follow this path in the current study. By using the logistic regression, all values of the dependent variable are restricted to the [0,1] interval, and can be thought of as probabilities of incidence. The advantages of this approach is that it greatly reduces subjectivity, it captures the impact of each variable on the final outcome, it provides the opportunity to analyze and manipulate the effects of inter-group heterogeneity when dealing with panel data and it allows the analyst

to run a multitude of statistical tests in order to obtain an unbiased model with considerable discriminatory power. This approach was first used to predict financial crises by Frankel & Rose (1998). Specific models, targeting baking crises where developed by Demirguc & Detragiache (1998) and Eichengreen & Rose (1998). The last analyze banking crises in developing economies using a multinomial logit model. The article shows an important contribution of external variables. For example, the interest rates in Nordic countries were significantly correlated with the emergence of crises and the general economic cycle of OECD Countries. Other variables such as exchange rates and external debt also showed positive results. Variables from the budgetary and fiscal spheres did not show satisfactory results.

The recent financial crisis and the propositions towards the new architecture for the regulatory capital within Basel III have motivated a new wave of research aimed to develop ways to predict episodes of financial turbulence. Behn & Detken (2013) build an early warning system based on a binomial multivariate logistic regression. They use a database consisting of variables with quarterly observations for a number of EU economies. Following the work of Do Luca & Peltonen (2011), global variables are included in order to account for contagion. In order to account for post crisis bias, the authors exclude from the sample all observations that fall between 1 and 6 quarters after a crisis. In order to expand the bad rate sample and, at the same time, calibrate the model to predict an episode of financial distress rather than the precise outburst of the crisis, the authors give the dependent variable the value of “1” for all quarters between 7 and 12 quarters before the crisis. Based on their performance, the following variables where relevant: the credit/gdp gap, credit growth, inflation, economic growth, stock market growth and real estate market growth.

The Database

As a general rule of thumb, for credit risk analysts, when constructing a scorecard one of the key aspects to target is a comprehensive database of variables, consisting of as many observations as possible. I bring up credit scorecards, because, as we will see in the following, the process, the methods, the models and the validations are quite the same in the case of developing a statistical early warning model for macro economical events. Considering those mentioned above, we are faced with an early setback due to the frequency of statistical data at national level. As we all know most of the economic indicators are calculated and published mostly on a yearly basis, with some of them being available quarterly. Alongside the reduced sample problem generated by yearly frequency, a more important drawback is that a lot can happen within one year. For example if the crisis emerges in January, and our variables are as of December, all the variables for the respective year are compromised. In addition to this, for most developing economies standardized statistical information has begun to be collected relatively recently with long term history not being available. Moreover, even for developed countries ,due to geo-political factors, we cannot look at some economies the same way for periods spanning over 40 years (ex. Germany with former West and East, all former communist countries, Czech Republic and Slovakia, etc.). Another important aspect to consider is that financial crises are quite rare events and so the binary dependent

variable of the model will have a reduced sample of positive events.

In order to overcome the issues stated above, some compromises must be made. Firstly, in order to increase the development sample and account for the "January-December" bias, some variables must be sacrificed in order to maintain at least a quarterly observation frequency (some variables are available monthly, but most are not). There is a possibility to transform yearly indicators to quarterly by various interpolation techniques, but this would only generate data based on trends with a "smoothing" effect and would add a certain point of subjectivity to the analysis, this being quite the opposite of what is desired. Secondly, it would be quite cumbersome to attempt the modeling at the country level, firstly because the few observations of the crisis variable (most countries only had 1 banking crisis, while some had none). Considering all those stated above, a panel approach will be used in those that follow.

To account for the dependent variable – the crisis incidence, we will be using a sample developed by Babecky et al. (2012) as part of an exercise for data mining initiated by the Heads of Research Group (HOR) within the European System of Central Banks (ESCB). This database has quarterly observations spanning from 1970 up to 2010. It contains banking, fiscal and currency crises suffered by number of countries (both EU and external). The crisis variable is binary: 1 for quarters in which such an episode occurred and 0 for all other quarters. This database combines information from a series of relevant articles. It was also reconciled and validated by the HOR Group before publication. The dependent variable in this article will be based on this dataset with a correction in order to account for the post-crisis bias as noted in other studies like Bussiere & Fratzscher (2006). The variable will remain 1 for the first quarter after incidence and all quarters that had a crisis or fall up to 6 quarters after the end of one will be completely excluded from the sample.

While confronting the data mentioned above with the availability of national level time series, some countries where excluded from the sample, reducing the number to 24 EU and non-EU economies. Considering findings from other studies, a number of variables where constructed by mining the BIS, OECD, EUROSTAT and IMF databases. To account for non-stationarity and heterogeneity issues, the greater portion of candidate repressors where transformed in some manner. As mentioned before, one main constraint was the availability of historical statistics, due to which the 1970-1980 period was excluded from the sample.

In order to select the best variables and their best lags for the inclusion in the final model, a univariate approach will be used. Thus, a regression will be performed by using only one variable at a time for 12 lags (all quarters up to 12 before the dependent variable observation). As main indicator of discriminatory power, the AUROC will be used, coupled with the P value and the model's R squared.

Credit variables where constructed starting from the BIS Long Series on Credit. Credit growth was derived as being the year on year (yoy) % of credit to national private entities. After the univariate analysis the 11^{th} lag shows the best indicators. As recommended by BIS, and following the consultative document, the credit/gdp gap variable was constructed by applying a Hodrick-Prescott filter to the credit/gdp series. The univariate procedure showed that the 1^{st} and 2^{nd} lag of this variable

showed potential. Unfortunately, this event horizon is too low for early warning rigors.

Using the OECD Statistical Warehouse, the variable for economic growth was constructed as being de yoy % of GDP (deflated). After analyzing this variable we retain its 8th lag as being the most effective in prediction. Considered a great indicator of general economic overheating, rapidly rising values of inflation are often proposed as indicators of financial distress. The 11th lag of yearly inflation shows an AUROC of 65%.

In a healthy and efficient economy, interested rates are thought to include the risk premium associated with the country, the financial institution and the final debtor. For the inclusion in the final model, both short term and long term interest rates were considered, as available in the OECD Database. However while looking at these time series it is quite obvious that interest rates followed a descending trend for most countries in sample. Due to this factor, in order to avoid non-stationarity issues, for both series a yoy% transformation was performed. After the univariate procedures, the short term interest rate shows discriminatory power at 2 years before the crisis, while long term interest rates AUROC peaks at the 4th lag.

The inflation and the burst of the real estate bubble are widespread acknowledged as one of the key contributing factors of the recent global crisis. In order to construct a variable to include this effect the BIS „Property price statistics" database was used, and the values where transformed in year on year % growth. This variable shows significant discriminatory power at 10 quarters before the event. Stock market dynamics where often used in similar studies as proposed indicators. Being part of the greater economic system, stock markets should be the place where the demand and supply of capital meet. Due to their relatively unrestricted nature, stock price dynamics should include all available information at that certain point in time, thus having the potential to act as a leading indicator for financial turbulence. The constructed variable was also transformed to yoy%. Univariate analysis highlights the first 3 lags as potential candidates, but similar to the credit/gdp gap, this is still too early for effective prediction. In addition to those mentioned above, other candidates where considered. Motivated by Kamnisky's & Reinhart's (1999) "twin crises", variables specific to currency crises prediction where also analyzed: current account balance and central bank's reserve assets. The public debt to gdp ratio and unemployment where also considered. Unfortunately, none of the variables mentioned in this paragraph showed meaningful prediction abilities. AUROC Values for the indicators that passed the univariate analysis step are summarized in the following table.

Table 1 - Univariate Results

LAG	***CRDGR***	***GDP***	***INFL***	***STIR***	***LTIR***	***REALEST***
0	58.13%	51.43%	62.10%	54.31%	53.47%	64.79%
-1	57.10%	49.63%	63.27%	57.69%	55.05%	72.26%
-2	51.26%	55.79%	50.87%	61.59%	52.99%	55.80%
-3	61.92%	50.20%	75.33%	62.27%	60.19%	57.42%
-4	52.69%	55.59%	54.58%	67.27%	69.90%	52.05%
-5	56.19%	53.71%	51.61%	69.77%	49.60%	57.76%
-6	61.79%	53.25%	49.52%	70.21%	55.61%	54.95%
-7	64.69%	58.10%	71.90%	70.02%	66.48%	55.97%
-8	57.69%	64.52%	52.69%	71.85%	64.14%	58.55%
-9	64.42%	55.70%	55.21%	67.91%	66.90%	55.18%
-10	57.38%	56.99%	52.45%	66.44%	52.74%	69.19%
-11	68.93%	54.91%	68.42%	57.48%	51.08%	63.69%
-12	55.22%	53.66%	55.56%	52.72%	66.80%	64.39%
Medie	59.03%	54.88%	58.73%	63.81%	58.84%	60.15%

Estimation

The first step in this section is to perform the multivariate analysis by including all variables in a single equation to test for correlation between the explicative variables and the associated multicolinearity issues. At this point it must be noted that the inclusion of both short and long term interest rates in the same model might seem biased. Nevertheless there was no significant correlation between the two. Moreover the assumption is that they reflect the perceptions on risk on different timescales. The correlation matrix after this first estimation showed significant correlation between economic growth, credit growth and real estate prices (around 30%). In order to avoid unwanted negative effects, the combination of these three variables in a single model will be avoided. This leads us to construct 2 main models, one based on credit growth and one based on real estate prices. A model based on gdp growth was also estimated but results where unsatisfactory and thus, it won't be presented.

Table 2 - Estimation Output for Model 1

	Coef.	Std. Err.	z	P>z
CRDGR_11	24.92168	11.6	2.15	0.032
INFL_7	0.7676187	0.29	2.68	0.007
LTIR_12	-0.0975092	0.05	-2.13	0.033
STIR_8	0.0314629	0.01	2.3	0.022
_cons	-6.450163	0.72	-8.97	0
LogLikelihood	-85.794602		*OBS*	1543
McFadden R	0.50913631		*Groups*	24
AIC	183.5892		*Obs /Group*	64.3
BIC	215.6381		*Wald chi2(8)*	22.37
AUROC	0.8483		*Prob > chi2*	0.0002

From the output above we can note that all coefficients are significant at the 95% bound. R squared stands at 51% and AUROC at 85%. The signs of the parameters do not contradict the general economic theory and can easily be explained. Considering small values in the correlation matrix, coupled with significant probabilities for the parameters one can state that the model respects the rigors of a good econometric performance. Following those stated earlier, a second regression will be estimated by replacing the credit growth variable with the real estate prices growth. By doing this, the following output is obtained.

Table 3 - Estimation Output for Model 2

	Coef.	Std. Err.	z	P>z
REALEST_10	0.2331684	0.09	2.6	0.009
INFL_7	1.055013	0.33	3.16	0.002
LTIR_12	-0.0952669	0.05	-1.87	0.062
STIR_8	0.0440859	0.02	2.24	0.025
_cons	-29.62465	9.31	-3.18	0.001
LogLikelihood	-65.222199		*OBS*	1109
McFadden R	0.62683888		*Groups*	22
AIC	142.4444		*Obs /Group*	50.4
BIC	172.5117		*Wald chi2(8)*	25
AUROC	0.887		*Prob > chi2*	0.0001

Noting that for the majority of countries within the sample, data regarding housing prices is available only since around the year 2000, we can observe that this estimation has significantly less observations when comparing with Model 1. Also, before making statements about the performance of this model, it is imperative to consider the following. The majority of observations of banking crises correspond to the period following Lehman Brothers bankruptcy. As it is well known, the evolution of the real estate market was a main factor in the recent great crisis. Returning to the estimation presented above, we can observe that all parameters are still valid at least at the 90% threshold. The signs have not changed and are still in line with good economic reasoning. Comparing with the previous model we can observe slightly better Log-Likelihood, R squared, AIC and AUROC values. There are no significant values in the correlation matrix, thus multicolinearity should not be an issue.

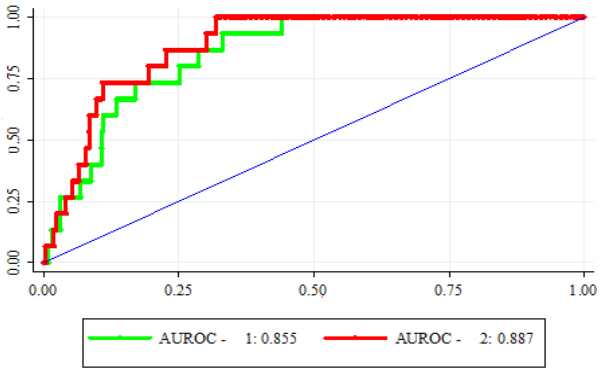

Figure 1 - ROC Curves for Models 1 & 2

By consulting the figure above, one can note the superiority of model 2. However we must not conclude that the real estate variable is a better indicator of banking crises. I would like to reinstate the mention that the majority of crises (around 40% of the sample) occurred after the 2008 events. In respect to this one can state that housing prices would have been a better indicator just for the recent crisis.

Out of sample testing

In order to evaluate the effective prediction ability of the models presented in the previous section, some out of sample scenarios will be considered. First, a number of countries will be excluded from the sample and the parameters will be re-estimated based on the remaining data. Using these new values we will see if we could have predicted the crisis in the exclusion sample. Secondly, considering the uniform dynamics before the current crisis, all observations after 2007 will be excluded, and the same methodology as above will be followed in order to test the out-of-time performance.

For the out of sample testing, the selection will include countries that have experienced a banking crisis. A euro zone country will be selected, a country that had a crisis after 2007 will be selected, a country from the Nordic bank crisis episode from the 1990's and a country from the Asian financial crisis of 1997 will also be selected as it follows:

- France – crises in: 1994Q1 – 1995Q2 & 2008Q1 – 2008Q4;
- Great Britain – crises in: 1984Q1 – 1984Q2, 1991Q1 – 1991Q4, 1995Q1 – 1995Q2 & 2007Q1-2007Q2;
- Sweden – 1991Q1 – 1994Q4 & 2008Q3 – 2008Q4;
- South Korea – 1983Q1 – 1983Q4, 1986Q1 – 1986Q4, 1997Q1 – 1998Q4.

After the re-estimations both out of sample and out of time, ROC curves where constructed for the exclusion samples. The results are summarized below.

Table 6 - Out of Sample AUROC

AUROC		
Model	*Out of sample*	*Out of time*
1	**81.95%**	**64.70%**
2	**82.46%**	**57.67%**

We can observe good AUROC values for the out of sample validation. The ability to generate satisfactory results on a reduced sample can suggest that, although there are differences in structure and dynamics between various economies, the factors that generate financial distress are generally homogenous. However, in the case of the out if time analysis a significant drop in discriminatory power can be noticed. Despite this, a satisfactory result is obtained for the model based on the credit variable. This reinstates the former statement that the housing market boom was a specific characteristic of the 2007-2008 banking crisis. With this in mind, there is a generally accepted link between housing prices and credit dynamics. While in the recent events, credit supply got channeled towards real estate, this might not be the case in future events to come. It is obvious that excessive crediting policies have the potential to fuel different asset price bubbles, but a meaningful question to ask is what will be next one, and more important, can we foresee it?

Conclusions

Expecting a further strengthening of the regulatory capital requirements, in the present paper the possibility of developing a more advanced methodology, meant to optimize capital consumption was investigated. From a private viewpoint, a higher capital level is not wished. Therefore using the credit/gdp gap as the single indicator could generated unwanted over/under estimation effects. Especially in periods of growth immediately after recession, this indicator has shown the tendency to over evaluate systemic risk. On the other hand, for crises generated by non-credit price bubbles the indicator's utility is marginal.

In the current study, a model was constructed that accounts for a larger scale of macro economical indicators, with promising results. The value derives from the decent discriminatory power, especially the out-of-sample one. There are developing economies that do not have historical databases of economic indicators, thus they do not have the capacity to develop national models. As most of banking groups do business on an international scale, this type of methodology can be absorbed in internal regulations to satisfy regulatory requests and optimize risk evaluation, even for decision in investing in new economies.

Although the responsibility of dimensioning the countercyclical capital reserve will be at the monetary authorities, maybe a venture approach would be more beneficial. It is quite obvious that the main objective of central banks will be to insure financial stability and Basel conformity. Still a 2.5% extra capital will be a considerable restraint on credit institutions. We must keep in mind that international banks have a high

stock of specialists and resources and not allowing them into this process would be a true waste. A similar approach is used in determining regular regulatory capital. In the present, the requirement is 8%*Assets*Risk Weight. The risk weight is determined by using internally developed models. In this way, banks with higher risk appetites should use up more capital. In a similar manner, the countercyclical buffer could be based on an internal developed indicator of financial instability. Regulators can then perform quarterly evaluations and validations in order to assure performance non-biasness. This way, by partnership we could aim towards an ideal compromise between profitability and sustainability.

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