Regulatory Capital Arbitrage Opportunities under the standardized approach in the new Basel Capital Accord

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Abstract

This paper introduces a new concept of regulatory capital arbitrage that can be performed under the "standardised approach" of the new Basel Capital Accord when the return on regulatory capital does not increase monotonically with the credit risk of financial assets as proxied by external ratings. We demonstrate that this arbitrage opportunities arises, for certain credit risk levels, in 90% of trading days between 1993 and 2005. We also find that the probability of arbitrage opportunities increases with the slope of the yield curve, and decrease with its convexity. Albeit we see that financial markets are becoming more efficient thus reducing arbitrage opportunities we state that the standardized approach introduces a relevant distortion in the financial system generating a potentially strong discrimination between borrowers with different credit risk levels and producing potentially harmful credit crunch situations.

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1. Introduction

The Basel Committee on Banking Supervision began work on Basel II, as the New Capital Accord is called, in 1999. The latest version of Basel II was issued in November 2005. The purpose of the New Capital Accord (NCA) is to establish the level of regulatory capital on the basis of the degree of risk run by each bank. Among other things, the new system should eliminate or drastically reduce regulatory capital arbitrage possibilities.

For credit risk, according to the NCA, banks can follow two alternative routes: in the first, the so called "standardised approach", where risk weights are based on external ratings supplied by credit rating agencies, export credit agencies and other qualified institutions. The second approach is based on internal ratings assigned by banks on the base of proprietary models developed according to a set of general guidelines.

In this paper we focus on the consistency of the risk weights suggested in the standardized approach and particularly on the possible credit rationing effect that could be generated for borrowers with certain ratings: bonds (or loans) with higher credit risk usually yields higher returns in order to compensate lenders, and the size of the risk premium is determined by the risk aversion of investors that have to be incentivated to choose the riskier investment. For banks an additional problem arises if a different amount of regulatory capital is required by the two investments: the risk premium paid by the riskier bond may not be sufficient to compensate the additional capital requirement and the riskier borrower will be credit constrained (for the bank channel) or will experience an increase in his cost of funding.

The credit constraint may be generated by risk weights imposed by the capital accord: while for all loans made to companies and individuals which are not secured, the current Capital Accord specifies a single risk weight, namely 8% of the amount of the loan, in the standardised approach, this basic risk weight is increased or decreased according to pre-defined weighting factors[1] that discriminate between companies with different credit risk levels. The main goal of this new structure is to force banks to lend to safer companies but it's easy to see that if the risk weight factor imposed is not perfectly proportional to the effective credit risk level of the counterpart the bank will discriminate certain borrowers that will be credit rationed: they will be able to raise capital from the bank channel only paying a risk premium that is not justified by their risk level.

Various contributions have analysed the adequacy of the risk weights of the standardised approach in terms of their ability to cover losses generated by different categories of loans in a pre-defined confidence interval. Altman and Saunders (2001) analyzing the historical default rates find a higher degree of heterogeneity among credit risk levels of different ratings than that implied by the risk weights of the NCA[2], and these results are confirmed by Altman, Bharath and Saunders (2002). Resti and Sironi (2003) working on bond spreads on the primary market find that the slope of the required capital / rating relation implied in the standardized approach is not sufficient to capture the greater risk of high yield bonds. Calem and LaCour-Little (2004) find that the risk weights of the standardized approach are not coherent with the risk profiles of mortgage loans.

In our work we will follow a somewhat different path: we will analyze the standardized approach from the point of view of a bank that has to allocate its capital among a number of possible investments with different credit risk levels. We will show that using the capital requirements suggested by the NCA some ratings are consistently discriminated: the bank can earn a higher return on regulatory capital by investing in a bond portfolio with a lower credit risk level. For example from May 1993 to February 2005 the par yield return of a Baa2 bond

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1 The risk weighting factor is 20% for position with rating from Aaa to Aa3, 50% for ratings from A1 to A3, 100% for positions with ratings from Baa1 to Ba3 and, finally, 150% for exposures below Ba3. Non rated positions uses a risk weight equal to 100%.

2 Actually the Basel Committee proposal at the date of their paper was less granular than the actual one, with a single bucket for bonds with rating from A to B. Nonetheless the conclusions of the paper still hold under the current proposal.

portfolio has always been higher than the par yield produced by a A3 bond portfolio, but if we consider the expected return on regulatory capital the safer investment beats the riskier one in 93% of trading days. Under these conditions a risk averse, or even a risk neutral, financial institutions will never lend to firms with Baa2 since it is possible to find on the market an investment with a lower risk level and a higher expected return. Of course this is a retrospective analysis based on data from a period of time when the NCA was not effective. Our main conclusion demonstrates that risk premium paid in the past are non consistent with the new accord and that only a significant increase of those premium will prevent a serious credit crunch for borrowers with specific ratings. We also analyze the market conditions that increase the probability to observe this discrimination effect and we find that this effect is influenced by the shape and the slope of the term structure and we also see a decreasing trend in time.

The rest of the paper is organised as follows: section 2 defines some preliminary concepts relating to regulatory capital arbitrage operations, while section 3 outlines the main characteristics of our database, section 4 gives an example of possible regulatory capital arbitrage operations in a single trading day, section 5 analyses the evolution of arbitrage opportunities trough time, section 6 analyses the market conditions that increase the frequency of arbitrage opportunities, section 7 draws some policy implications and concludes.

2. Regulatory capital arbitrage operations

Regulatory capital arbitrage occurs when there is a difference between regulatory capital and the economic capital estimated by the bank for a given investment. Jones (2000) analyses the situation of a bank that is able to replace exposures subject to high risk weighting with other exposures subject to low risk weighting, mainly by means of securitisation techniques, without significantly changing the bank's risk exposure.

The situation that we face in this paper can be seen as a slightly different form of capital arbitrage where a bank can increase the portfolio expected return decreasing, at the same time, the regulatory capital. This situation can be generated both by:

– a market inefficiency: there is at least one asset that simultaneously yields a higher ex ante return with a lower degree of risk than a second asset. In this case, there is a real opportunity for arbitrage due to some form of imperfection of the market.

– a regulatory bias: market prices do not offer arbitrage opportunities (and the ex ante return on economic capital increase in proportion to risk), but risk-weighted capital requirements alter the normal risk/return relation, so that for some types of assets the ex ante return on regulatory capital does not increase in proportion to risk[3].

In this paper we focus on this second type of situation where an arbitrage opportunity is introduced by a specific regulation that sets capital requirements that may not be proportional to the risk of a position as perceived by the market.

Both types of arbitrage defined above have undesirable consequences. With the traditional situation à la Jones a bank could conceal the deterioration of its economic conditions, while simultaneously presenting capital ratios complying with the Accord. Moreover, banks with similar risk exposure may have different ratios, depending on whether or not they have recourse to arbitrage operations. The second type of arbitrage affects banks' portfolio composition, thus contravening the principle of neutrality of the Accord by creating discrimination between different categories of borrowers.

[3] The level of the risk-weighted capital requirements also implicitly influences the return on capital of the different types of loan: inconsistencies in determining the risk weights can make some categories of loan more advantageous at the expense of others. As will be shown below, this situation occurs in a fairly large number of cases if the risk weights laid down by the standardized approach are applied.

3. Data

In order to test the existence of regulatory capital arbitrage under the standardized approach we use bond yields indices contained in the Bloomberg “Fair Market Curves” database.

“Fair Market Curve” is the curve of par yields relating to bonds with the same currency and rating class. The curve is constructed using as input the bid and ask prices of a basket of benchmark securities which meet minimum requirements in terms of number of trades and volume traded. The prices are supplied each day, at a pre-defined time, by a group of dealers who feed the database. A given security is only used to construct the curve if its price is supplied by a minimum number of dealers (which varies according to the markets). The input price, called the Bloomberg Generic Price, corresponds to the average of the prices supplied by the various dealers, calculated after extreme values have been eliminated. Starting from the benchmark prices, a par yield curve is generated by means of a specific optimisation procedure that minimises the difference between the input prices and those calculated by discounting flows at rates belonging to the curve. Fair market curves are supplied on a daily basis for all the rating classes between Aaa and B3. The yields obtained are not based on actual trading prices, but are consistent with those observed on a curve constructed with the most liquid securities in each sector. This feature allows us to consider the yield as a very good and consistent measure of market prices for bonds with a given maturity and a given rating, avoiding the main pitfall of empirical studies on bond indices that usually do not represent actual market conditions for single bonds.

We extracted the yields relating to four different maturities (6 and 12 months, 5 and 10 years) for all 14 available rating classes (from Aaa to B3) from the Bloomberg US Corporate Bond market database. The period considered runs from 1.5.1993 to 28.2.2005. We also extracted from the same database the yields of treasury bonds with the same maturities. Finally, to calculate the gross interest margin generated by investment in bonds, we extracted the series of 6- and 12-month LIBOR rates and the 5- and 10-year swap rates from Datastream[4].

[Insert Table 1 about here]

Table 1 shows the main descriptive statistics corresponding to the spread of 10-year bonds, calculated as the difference between the par yield of corporate bonds and the par yield of treasury bonds. The high variability of spreads within the rating classes is immediately evident. It should obviously be borne in mind that the period in question includes the tragic events of 11 September 2001. However, the variability of the spreads was already high during the preceding period. For example, the spread of 10-year bonds with a Ba1 rating rose from 0.92 to 2.02 in the 6 months between April 1998 and October 1998. The risk-weighted capital requirements suggested by the standardized approach are constant for rating classes. Consequently, the degree of credit risk coverage insured by regulatory capital is not constant over time. It might be objected that the spreads do not only reflect the probability of default and the estimated recovery rate, but are also influenced by liquidity, tax factors and an actual risk premium, similar to that characteristic of the equity market[5]. However, there is no doubt that a variation in spread, whatever the cause, leads to a variation in market value which is proportional to the duration of the bond. When the market value of the assets held decreases, the fair value of bank capital also declines.

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[4] Quotations relating to annual fixed-rate payments were selected for swaps.

[5] For an analysis of the factors that determine the spreads of corporate bonds, see Elton et al. (2001 and 2004) and Collin-Dufresne et al. (2001).

Moreover, an examination of spreads for different maturities[6] shows that they are considerably differentiated according to the maturity; however, this aspect is not taken into account in the standardised approach. Consequently, a bank whose exposures are highly concentrated on the short term is subject to the same requirement as a bank with exposures which are highly concentrated on the long term, rating being equal.

4. A day in the life of Basel II

In order to evaluate the consistency of the risk weighting system imposed by the new capital accord we can calculate the gross margin produced by an investment in different bond portfolios with the same maturity (1 year) but different ratings. Table 2 reports the result of this analysis using market data of the first trading day of 2005. We have assumed a $1000 investment, for each rating class the regulatory capital absorbed has been calculated on the basis of the NCA risk weights. Every investment produces an interest income equal to the yield to maturity of the bond portfolio and interest expenses equal to the 12-month LIBOR rate that can be seen as the marginal cost of funding for the bank[7]. In the last column of the table we calculate the gross interest margin as a percentage of the regulatory capital absorbed.

We can see from the table that the market interest rate of the bond portfolios is a strictly positive function of the credit risk, but when we calculate the ratio of the gross interest margin on the absorbed capital we find that this number does not increase monotonically with the credit risk. Actually we observe a number of "reversals", where the margin produced by a portfolio with a lower credit risk is higher than the margin produced by a riskier group of bonds.

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[6] Data are available from authors upon request.

[7] Of course this assumption could be somewhat disputed. Probably it would be more realistic to assume that the cost of funding increases with the credit risk of the investment. Actually this second assumption would reduce the interest margin produced by lower rating investments and thus strengthen the conclusions of our paper. In our analysis we prefer to use a flat rate in order to avoid the introduction of an additional degree of directionality since we would have to estimate the sensitivity of the cost of funding at the risk of the investment.

[Insert Table 2 about here]

To fully assess the relevance of this situation we have to keep into account that the gross interest margin analyzed in Table 2 is the ex ante gross margin before any consideration about defaults and the relative losses[8]. We should expect an higher gross interest margin on lower quality portfolios because we also expect a higher default rate that should be, on average, compensated. The "reversal condition" generate the absence of a risk premium for low credit quality bonds: why should a bank, in the specific day analyzed in Table 2, lend to a B1 company when she could lend to a Ba2 with a higher gross margin (9,70% against 9,19%) and a lower default rate (0,66% against 3.34% if we consider the 1983 – 2004 mean values, or 0.68% against 1.91% if we only consider the 2000 – 2004 period[9]).

In the example of Table 2 the lack of a positive risk premium for some rating class has to be entirely blamed on the different risk weightings: if we consider again the Ba2 and the B1 bond portfolios we see that the market acknowledges the greater risk of the latter group: the yield to maturity for the bonds with lower credit quality is 4,20% against 3,87% for the safer bonds. Nonetheless the risk premium disappear if we consider that the safer position absorbs an amount of capital that is only two thirds of the capital absorbed by the riskier portfolio.

If the NCA had been in force in this market situation, it is hard to deny that there would have been distortions in the banks' process of capital allocation. It is important to establish whether the situation observed is the result of special and unusual circumstances or occurs frequently on the market. We will endeavour to answer this question in the following sections.

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[8] This margin is gross also because we do not consider other operating expenses. Since these costs should not be sensitive to the credit risk level of the portfolio they are not a relevant issue in our analysis.

[9] Moody's (2004).

5. The consistency of risk weights

In order to evaluate the frequency of reversals we evaluate the ratio between the gross interest margin and the absorbed capital for every rating in every day between May 1993 and February 2005 for a total of 3311 daily observations. In every day we have 14 ratings and 69 possible reversals (we only consider crossovers between rating classes with different capital requirements).

We have data for 4 different maturities: 6 months, 1 year, 5 years and 10 years (the gross interest margin is calculated on the assumption that each bond is financed with funds having a maturity that coincides with that of the loan). For sake of simplicity we will only present results for the 1 year maturity, the other panels shows results that may vary a bit but the main intuition does not change[10].

As an exception for this rule Table 3 shows the mean values for the period relating to the percentage gross interest margin for all classes of bonds considered and for every maturity. We see that we have reversals also in the mean values, and so the distortions analysed in the example in Table 2 cannot be linked to exceptional market conditions.

[Insert Table 3 about here]

To fully evaluate the relevance of the problem we have measured the frequency of every possible reversal. Table 4 shows the frequency through time of different margin reversals observed for bonds with a maturity of 1 year. The results confirms the significance of the potential distortion: for example, in 1921 days out of 3311 (that is 58% of observations), bonds with an AA rating offered a higher percentage margin than bonds with an A1 rating. An A3 rating is nearly always more advantageous than a Baa1 or Baa2 rating: 94% and 83% of observations respectively.

[10] The other results are available form the authors upon request

[Insert Table 4 about here]

Calculation of margin reversals for other maturities confirms the picture that emerges from Table 4. On the whole, 38834 margin reversals were observed for bonds with a 1-year maturity out of a total of 228459 observations. If the same analysis is repeated with the risk weights currently in force (8% for all loans, regardless of rating), only 69 margin reversal are observed out of the same number of observations. The difference between these two numbers highlights the distortion introduced with the differentiation of capital requirements.

From these results it appears that the distortion in capital allocation can be pretty serious: certain ratings seems to be dominated by safer bond groups in more than 50% of days in our sample with a consequent increased difficulty of fund raising.

In order to overcome this problem, discriminated companies, will have to increase the interest rate paid on the debt. The amount of this increase can be seen as the cost that the NCA charges over the companies with a specific rating. We have estimated this burden by calculating, for the pairs of ratings with a reversal frequency greater than 50%, the increase of the interest rate of the bond with the lower rating that would eliminate the reversal. As can be seen by the fourth column of Table 5 this cost ranges from 19 to 94 basis points. Obviously even the parity condition between the two gross interest margins is not sufficient to eliminate the discrimination because the bank would still lend to the safest company. In the fifth column of the table we have estimated the increase of the interest rate that would generate a difference between the two gross margins equal to the one that exists under the current capital accord. If the bank risk aversion does not change this increase should be sufficient to grant funding to the company. We see that this increase ranges from 42 to 192 basis points and, from the consideration of the last column, that it represent increase of the risk premium paid by the company over the government bonds of 45% - 50% (with a notable exception where the increase more than double the risk premium).

This numbers give us a measure of the relevance of the distortion that will be introduced by the NCA.

[Insert Table 5 about here]

A possible objection to these results could come from the consideration of the expected default probabilities. In fact the bank would probably try to maximize a measure of return net of expected default losses. The reversals in Table 4 could disappear once we consider the different expectations on default rates (and recovery rates) that the bank has for bonds with different ratings.

In order to rule out this possibility we run again our experiment using a more complete allocation variable. Usually banks allocate capital in order to maximize the so called Raroc that is the ratio between the expected payoff of the position (taking into account yield to maturity, default probabilities, loss given default and cost of funding) and the economic capital that is a measure of the capital that the bank should allocate to this position in order to cover possible losses. Since we are interested in measuring the effect of the standardized approach capital requirements we will use a modified version of the Raroc where we will consider, as denominator, the regulatory capital instead of the economic capital. We call this measure Rorc (Return on Regulatory Capital) and we define it according to the following formula

$$RORC_i^t = \frac{\left(1 - pd_i^t\right) \cdot r_i^t - pd_i^t \cdot LGD_i^t - libor^t}{\mathrm{RegCap}_i} \qquad (1)$$

where: pd^t_i is the expected default probability in day t for a bond with rating i, r^t_i is the yield to maturity of the bond, LGD^t_i is the expected loss given default, $libor^t$ is the marginal cost of funding for that day and $RegCap_i$ is regulatory capital for an investment with rating i under the standard approach.

Obviously the expectations on the default probabilities and the LGDs are not directly observable. We assume that the bank is a perfect forecaster and that the expected default probability is equal to the ex post realized default rate. We compute this rate from yearly data provided by Moody's. For example, for the observation of October 1, 2003 the expected default rate is equal to 25% of the realized default rate of 2003 and 75% of 2004 rate. We use the same algorithm to calculate the expected LGD. Since we only have yearly data on realized default rates until 2004 now our sample is reduced to 3014 observation from May 1993 to December 2003.

The results are summarized in Table 6. Actually we see an increase of reversals frequencies, specially for lower ratings. We know that part of these results could be driven by our specification of the expected quantities in the Rorc calculation, nonetheless it seems unlikely that different (but reasonable) expectations could overturn the main finding of this analysis: the consideration of time varying default probabilities and LGDs cannot justify the presence of reversals in the gross interest margins produced by bonds with different capital requirements.

[Insert table 6 about here]

In order to test the consistency of this finding we have also tested different models of expected values formation. Specifically, we have considered three different cases:

a) The agents have adaptive expectations and the default probabilities and recovery rates are equal to the last 12 months realized values.

b) The agents forms their expectations as in the case before but on three years of historical data.

c) The agents uses all the available information and the expectations are equal to the historical average values from the first available numbers (1983) to the beginning of the current year.

We find that none of this different methodologies reduce the number of reversal in a significant way: we get a rate of reversals of 47,5% with our forward looking expectations compared with a 39,8% rate with the 12 months adaptive expectations, 48% with the 36 months "historical" expectations and 58,7% with the expectation based on long term historical values.

A possible criticism to our conclusions is that they are based only on the consideration of the expected RORC, while it is reasonable to expect that a bank will use a decision rule based both on the expected value and the variance of the risk adjusted performance measure[11]. A first possible answer to this statement is that the concept of risk should already be included in the rating of the investment: if an asset with a higher rating produces an higher expected return than an investment with a lower rating we should be able to say that the first asset is strictly dominant since it produces an higher expected return with the lower risk implied by the better rating. Saying that we still need to consider the volatility of the RORC as a risk measure of the investment means that the rating is not able to discriminate the risk of bonds and so it should not be used in the first place as a criterion for risk discrimination.

6. The determinants of interest margin reversals

An interesting question, both from the theoretical and the empirical point of view, is to analyze which market conditions increase the probability to observe a reversal of the natural ranking of gross interest margins. Table 7 shows the distribution of the percentage margin reversals during the sample period. We observe a sort of clusterization, with a period of high reversal frequency from 1993 to 1996, followed by a period of low frequencies (1997 – 2000) and again high frequencies from 2001 to 2003. In order to explain this variability we estimate a multivariate logistic regression where the dependent variable is a binary indicator of a reversal (1 if the gross interest margin of a better credit quality index return is higher than the gross interest margin of a lower credit quality index and 0 otherwise). As independent variables we use a set of variates that define the shape and the position of the yield curve, namely a position indicator (the yield of a 6 months t-bill), a slope indicator (the difference between the return of a 10 years t-bond and a 6 months t-bill) and a convexity indicator (the return of a 5 years t-bond and a linear

[11] This would not be the case using Raroc since for this measure the denominator, the economic capital, is proportional to the volatility of the position, and so the risk is, in a certain way, already included.

combination of a 6 months t-bill and a 10 years t-bond). We also define dummy variables for every year (null case 1993) in order to control for time fixed effects (as control variables we also use monthly dummy variables[12]). We also know that reversals are more frequent between index with similar credit risk: to check for this proximity effect we define a distance variable defined as the number of notches between the two indices involved in the reversal.

[Insert Table 7 here]

Results have been summarized in Table 8. We have estimated two different models: in the first one we only consider the shape of the yield curve, in the second we consider also dummy variables for the years and control for monthly effects[13]. Of course there must be a sort of dependence between the year and the shape of the yield curve. In the second model we see that the sign and the significance of the shape coefficients do not change in a meaningful way, so we can interpret the years dummy variables as a sort of residual time coefficient that captures other elements related to different years, for example the degree of market competitiveness and efficiency, regulation issues, other macroeconomics conditions etc. The main results of the analysis can be summarized as follows:

1. The probability of a reversal between two given bond indices increases with the slope of the yield curve, the convexity seems to have an opposite effect. There is not a statistically significant effect of the level of interest rates.
2. The probability of a reversal between two given bond indices increases with the average credit spread of low rated bonds that we use as a proxi of the "stress level" of the corporate bond market.

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[12] The results for these variables are not reported in the paper and are available from the authors upon request.

[13] Results on monthly dummy variables are not reported in the table and are available from the authors upon request.

3. Taking 1993 as a benchmark year we see, cœteris paribus, a higher reversal probability from 1994 to 1996, from that point the probability is lower, with an additional sharp decrease from 2003. This reduction seems to be confirmed from the first data of 2005.

To assess the relevance of the coefficients we can perform some static analysis.

Consider for example the probability to observe a gross interest margin for a A3 bond higher than the margin generated by the investment in a Baa2 security during the month of may with the market efficiency level (and others structural conditions) of year 2000. We consider two possible shapes for the yield curve: the first (July 1998) is an almost flat curve (slope coefficient at 0.25%) with virtually no convexity (convexity coefficient at -0,01%) and characterized by a high level of interest rates (6 months t-bill at 5.39%) and a low average risk premium (2.28% average for bonds from B1 to B3 and maturities from 6 months to 10 years). The second structure (July 2002) is a steep curve (coefficient at 3.65%) with a certain degree of convexity (0.81%) and a low level of interest rates (t-bill at 1,28%) with high risk premium level (coefficient at 6.27%). With this setting the reversal probability goes from 24.3% (with the 1998 curve) to 82.7% (with the 2002 curve). This sharp increase is mainly due to the change in the slope of the curve, this coefficient alone would bring the probability from 24.3% to 92.0%. The increase in the convexity of the curve moves the probability in the other direction by 9.8%, while the increase in the average risk premium (the stress condition of the corporate bond market) increase the probability by 8.1%.

Also the residual effect of the year dummy variables can be assessed in this way. We now consider the average yield curve in our sample period (6 months interest rate 4.01%, slope 1.85%, convexity 0.37%, average risk premium 3.94%). The probability to observe the reversal described before considering the institutional setting and the market efficiency level of 1994 is 73.5% but goes down to 28.1% if we consider year 2004. Of course this huge effect has to be considered "residual" with respect to the shape of the yield curve that is, considering the yearly mean values, slightly more favorable in 1994 than in 2004.

Since the most relevant element seems to be the slope of the yield curve it may be useful to spend some time in the economic interpretation of this coefficient. From Harvey (1989 and 1993) we know that the slope of the term structure predicts economic growth[14], so a steep curve should produce a positive economic outlook, reduced default rate expectations and a decrease in risk premia for corporate bonds. Since, under the standardized approach, this decrease is not compensated by a reduction in the capital requirements we see a sharply increased probability of reversals since, after considering the cost of capital, the high credit quality investments become relatively more convenient.

We think that this particular feature is highly relevant since it could generate a credit constraint for low credit quality firms in expansion economies when many subjects would find more convenient to start relevant investments.

[Insert Table 8 here]

7. Conclusions

This paper analyze a new type of regulatory capital arbitrage that is possible under the standardized approach of the new Basel Capital Accord when a bank can increase the expected return of the loan (or bond) portfolio by switching from a riskier investment to a safer one. We name this operation an "arbitrage" because the increase in the expected return does not come from an inefficiency in the risk premia paid on the market but from different capital requirements for the two investments.

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[14] According to Harvey (1993) the term spread can explain about 44% of GDP growth rate volatility from 1967 to 1992. Of course the relation is non deterministic and can be influenced by other variables but the author demonstrates that three to five quarters prior to an economic downturn we observe an excess of demand for long term bonds with a subsequent rise in prices and a reduction in the term spread slope.

The empirical analysis outlines four main findings:

1. Using daily data from 1993 to 2005 we see that, under the capital requirements of the NCA, reversals of the gross percentage interest margin are very frequent. For certain pairs of ratings they happen in more than 50% of trading days.
2. This situation does not change if we use a more refined measure of performance (the Return on Regulatory Capital) that includes reasonable expectations on default probabilities and recovery rates.
3. In order to avoid credit crunches companies with lower ratings should increase the risk premium paid over government bonds by 50% on average.
4. The probability of observing a reversal is higher when credit risk level is higher and when the steepness of the yield curve increases. This last element is particularly unfavorable because it makes harder for companies to obtain funds when the economic outlook improves and productive investments would be more desirable.

We are perfectly aware that the overall effect of these distortions should be a reduction in the average risk level of banks loan portfolios, and that this was precisely the goal of the NCA. Nonetheless we think that it’s important to understand that a multiple capital requirements system reduces the traditional regulatory capital arbitrage only at the cost of the introduction of another form of arbitrage, and that this generates a relevant cost for issuers with specific rating levels. Moreover it is clear that those companies will be able to find cheaper sources of funding from subjects that do not apply the NCA. This will generate a transfer of credit risk from the banking system to other areas of the financial industry where, probably, the protection for private investors is lower.

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Table 1

Credit Spreads distributions of 10-years bonds

The table reports the main descriptive statistics for the time series of credit spreads for bond portfolios with different ratings. For every rating the credit spread has been calculated as the difference between the (10-years) par yield of the bond portfolio and the (10-years) par yield of Treasury Bonds. The statistics are calculated over 3311 daily observation from May 1992 to February 2005.

	Min	Max	Mean	St Dev	1st qt	2nd qt	3rd qt
Aaa	-0,23	0,99	0,37	0,16	0,25	0,35	0,49
Aa	0,01	1,01	0,45	0,17	0,31	0,40	0,56
A1	0,16	1,22	0,56	0,22	0,39	0,51	0,70
A2	0,18	1,35	0,64	0,25	0,44	0,58	0,84
A3	0,20	1,46	0,75	0,29	0,53	0,68	1,00
Baa1	0,24	1,69	0,87	0,35	0,59	0,80	1,17
Baa2	0,29	1,97	0,99	0,39	0,67	0,94	1,27
Baa3	0,39	2,42	1,21	0,53	0,74	1,07	1,68
Ba1	0,50	5,82	2,00	1,17	0,89	1,72	2,91
Ba2	0,65	6,28	2,36	1,26	1,13	2,28	3,26
Ba3	0,69	7,04	2,75	1,33	1,70	2,49	3,69
B1	0,97	7,18	3,19	1,32	2,32	3,02	4,04
B2	1,12	8,40	3,73	1,48	2,88	3,44	4,60
B3	1,64	9,66	4,56	1,66	3,56	4,42	5,58

Table 2

Gross Interest Margins produced by 1-year bonds on the January 3, 2005

The table summarizes the gross interest margins produced by bond portfolios with different ratings on the January 3, 2005 considering an investment of 1000$. The *Regulatory Capital* has been calculated under the recommendations of the standardized approach. *Interest receivables* have been calculated using the par yield of the bond portfolio, while the *Interest payable* have been proxied with the 12 months Libor. *% GIM* is the gross interest margin divided by the regulatory capital.

Rating	Invest-ment	Regulatory capital	Interest income	Interest expense	Gross Interest Margin	% GIM
Aaa	1000	16	31.847	31	0.847	5.29%
Aa	1000	16	31.975	31	0.975	6.09%
A1	1000	40	32.756	31	1.756	4.39%
A2	1000	40	32.853	31	1.853	4.63%
A3	1000	40	33.459	31	2.459	6.15%
Baa1	1000	80	35.379	31	4.379	5.47%
Baa2	1000	80	35.515	31	4.515	5.64%
Baa3	1000	80	36.541	31	5.541	6.93%
Ba1	1000	80	37.176	31	6.176	7.72%
Ba2	1000	80	38.756	31	7.756	9.70%
Ba3	1000	80	39.282	31	8.282	10.35%
B1	1000	120	42.025	31	11.025	9.19%
B2	1000	120	45.309	31	14.309	11.92%
B3	1000	120	46.420	31	15.420	12.85%

Table 3

Mean values of percentage gross interest margin

Gross interest margin is calculated, for every rating and every maturity as the difference between the par yield of a bond portfolio with the given rating and an interest rate representative of the cost of funding for the bank. This difference is then divided by the amount of capital that has to be reserved, under the standard approach, in order to cover the risk on a position of 1 €. For maturities equal to 6 months and one year the cost of funding is equal to the 6 and 12 months libor rate, while for the 5 and 10 years maturities it is set equal to the swap rates for similar maturities. The means are calculated over 3311 daily observation from May 1992 to February 2005.

	6 months	1 year	5 years	10 years
Aaa	2.7%	3.1%	-0.7%	0.0%
Aa	8.2%	7.7%	3.4%	4.6%
A1	6.4%	6.1%	4.6%	5.2%
A2	8.3%	8.0%	7.4%	8.0%
A3	10.8%	10.7%	10.3%	11.2%
Baa1	6.9%	6.9%	6.6%	7.1%
Baa2	8.5%	8.3%	8.1%	8.6%
Baa3	11.3%	11.1%	10.5%	11.6%
Ba1	21.2%	21.0%	19.6%	20.8%
Ba2	25.5%	25.5%	25.9%	28.1%
Ba3	30.2%	30.4%	31.7%	32.9%
B1	23.6%	23.9%	24.7%	24.9%
B2	27.9%	28.4%	29.8%	30.0%
B3	34.8%	35.3%	37.9%	38.3%

Table 4

Gross interest margin reversals for 1-year bonds

A reversal is observed when, in a given day, the gross interest margin produced by a bond with a given rating (in row in the table) is higher than the gross interest margin produced by a bond with a lower rating (in column in the table) and the two ratings fall into two different capital requirement brackets under the standard approach. The gross interest margin is calculated, for every rating, as the difference between the par yield of a bond portfolio with a maturity of one year and the given rating and the 12 months libor. The percentages are calculated over 3311 daily observations from May 1992 to February 2005.

	Aaa	Aa	A1	A2	A3	Baa1	Baa2	Baa3	Ba1	Ba2	Ba3	B1	B2	B3
Aaa	-	-	33%	24%	12%	33%	27%	17%	6%	3%	0%	0%	0%	0%
Aa		-	58%	47%	32%	52%	45%	34%	11%	5%	1%	3%	1%	0%
A1			-	-	-	34%	20%	8%	1%	0%	0%	0%	0%	0%
A2				-	-	65%	41%	15%	3%	0%	0%	0%	0%	0%
A3					-	94%	83%	44%	7%	1%	0%	0%	0%	0%
Baa1						-	-	-	-	-	-	0%	0%	0%
Baa2							-	-	-	-	-	0%	0%	0%
Baa3								-	-	-	-	0%	0%	0%
Ba1									-	-	-	26%	10%	1%
Ba2										-	-	60%	31%	9%
Ba3											-	90%	62%	24%
B1												-	-	-
B2													-	-
B3														-

Table 5

Average expected cost of the New Capital Accord for discriminated ratings

For the pairs of ratings with reversal frequency greater than 50%, the table shows the percentage of reversals observed over the entire sample (3311 daily observations from May 1992 to February 2005), the increase (measured in basis points) of the interest rate that the bond with the lower rating should experience in order to eliminate the reversal (*Interest increase for Parity*), the increase of the interest rate (measured in basis points) that would produce a difference between the gross interest margin of the lower rated bond and the one of bond with the higher rating equal to the difference observed under the current capital accord (*Interest increase for Equilibrium*). *Incidence over risk premium* is the ratio of Interest increase for equilibrium and the risk premium paid by the bond measured as the difference between the return of the bond and the yield to maturity if a government bond with the same maturity. For the last three columns the table reports mean values calculated over the days when a reversal is observed.

Higher Rating	Lower Rating	Percentage of reversals	Interest increase for Parity	Interest increase for Equilibrium	Incidence over risk premium
A3	**Baa1**	93.8%	34.56	47.35	52.2%
Ba3	**B1**	90.5%	93.68	152.68	45.1%
A3	**Baa2**	84.1%	25.69	50.87	48.3%
A2	**Baa1**	69.0%	19.29	42.27	46.0%
Ba3	**B2**	65.7%	68.63	192.46	46.0%
Ba2	**B1**	59.9%	66.24	171.05	45.4%
Aa	**A1**	59.0%	25.22	31.30	51.0%
Aa	**Baa1**	53.3%	59.77	105.66	110.4%

Table 6

RORC reversals for 1 year bonds under the standard approach

A reversal is observed when, in a given day, the RORC produced by a bond with a given rating (in row in the table) is higher than the RORC produced by a bond with a lower rating (in column in the table) and the two ratings fall into two different capital requirement brackets under the standard approach. The RORC is calculated, for every rating, using as proxies for the expected default rate and the expected loss the ex post realizations according to the official Moodys reporting. For every rating we use the appropriate capital requirement under the standard approach. The 12 months libor is used as a proxy for the cost o f funding of the bank. The percentages are calculated over 3014 daily observation from May 1992 to December 2003.

	Aaa	Aa	A1	A2	A3	Baa1	Baa2	Baa3	Ba1	Ba2	Ba3	B1	B2	B3
Aaa	-	-	34%	27%	16%	39%	31%	25%	7%	3%	2%	23%	57%	69%
Aa		-	59%	53%	37%	58%	50%	46%	15%	6%	7%	42%	69%	74%
A1			-	-	-	49%	32%	23%	1%	0%	8%	35%	65%	71%
A2					-	73%	53%	34%	5%	0%	12%	38%	68%	73%
A3					-	96%	93%	65%	14%	1%	18%	51%	71%	74%
Baa1						-	-	-	-	-	-	34%	59%	65%
Baa2							-	-	-	-	-	38%	66%	71%
Baa3								-	-	-	-	53%	69%	71%
Ba1									-	-	-	77%	83%	85%
Ba2										-	-	88%	86%	90%
Ba3											-	90%	87%	96%
B1												-	-	-
B2													-	-
B3														-

Table 7

Frequency of reversals across the sample period

The table shows, for every year from 1993 to 2004, the total number of reversal observed, the average number of reversal observed every trading day and the percentage of the observed reversal over the maximum number of possible reversals. A reversal is observed when, in a given day, the gross interest margin produced by a bond with a given rating is higher than the gross interest margin produced by a bond with a lower rating and the two ratings fall into two different capital requirement brackets under the standard approach. The gross interest margin is calculated, for every rating, as the difference between the par yield of a bond portfolio with a maturity of one year and the given rating and the 12 months libor.

Year	N° of reversals	N° of reversals per day	% of reversals
1993	3856	15.7	22.8%
1994	4781	18.4	26.6%
1995	4137	15.9	23.1%
1996	4296	16.5	23.9%
1997	1353	5.2	7.5%
1998	1144	4.4	6.4%
1999	1603	6.1	8.9%
2000	1660	6.4	9.3%
2001	3112	12.0	17.4%
2002	4312	16.5	23.9%
2003	2801	10.7	15.6%
2004	1836	7.0	10.2%

Table 8

Logistic Regression

The table reports the results of a multivariate logistic regression. The dependent variable assume the value 1 when in a given day we observe a reversal: a higher Gross Interest Margin for a high credit quality bond index compared with a lower credit quality index if the two ratings fall into two different capital requirements brackets under the Basel 2 Standard Approach. The Gross Interest Margins have been calculated using 1 year bond indices daily returns from the beginning of 1993 to the end of February 2005. For the independent variables: *Distance* is the number of notches between the two ratings, *Level* is the 6 months t-bill rate of return, *Slope* is the difference between the 10 years t-bond and the 6 months t-bill returns, *Convexity* is the difference between the 5 years t-bond return and a linear combination of the 10 years t-bond and the 6 months t-bill returns. *Risk* is the average spread of corporate bonds with ratings from B1 to B3 with maturity 6 months, 1, 5 and 10 years over the yield to maturity of a government bond with the same maturity. The other variables are dummy variables for the year (neutral case 1993) and the month (results omitted). The R^2 reported is the Nagelkerke pseudo-R^2, *Classification* is the overall correct classification ratio using a cut point equal to 0.5.

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	Model (A)		Model (B)	
	Coefficient	**p-value**	**Coefficient**	**p-value**
Constant	-4.84	0.00	-0.74	0.00
Distance	-0.82	0.00	-0.85	0.00
Level	0.78	0.00	0.16	0.00
Slope	1.63	0.00	1.05	0.00
Convexity	-1.73	0.00	-1.10	0.00
Risk	0.30	0.00	0.18	0.00
D_1994			0.80	0.00
D_1995			1.20	0.00
D_1996			1.16	0.00
D_1997			-0.37	0.00
D_1998			-0.33	0.00
D_1999			-0.29	0.00
D_2000			-0.03	0.68
D_2001			-0.10	0.12
D_2002			-0.49	0.00
D_2003			-1.19	0.00
D_2004			-1.16	0.00
D_2005			-1.11	0.00
Pseudo - R^2	0.48		0.51	
Classification	0.88		0.88	