

EFFECTS OF THE NEW BASEL CAPITAL ACCORD ON BANK CAPITAL REQUIREMENTS FOR SMES

Edward I. Altman^{a1} and Gabriele Sabato^{b2}

^a NYU Salomon Center, Leonard N. Stern School of Business, New York University,
44 West 4th Street, New York, NY 10012, USA

^b Department of Banking, Faculty of Economics, University of Rome “La Sapienza”,
via del Castro Laurenziano 9, 00161 Rome, Italy

Abstract

Using data from three countries (US, Italy and Australia) and surveying related studies from several other countries in Europe, we investigate the effects of the New Basel Capital Accord (Basel II) on bank capital requirements for small and medium sized enterprises (SMEs). For each country, we analyze different possibilities that banking organizations have in considering SMEs, as either retail or as corporate, with a special discount linked to the firm's sales size. We find that, for all the countries, banks will have significant benefits, in terms of lower capital requirements, when considering small and medium sized firms as retail customers. But they will be obliged to use the Advanced IRB approach (providing their own estimates of probability of default (PD) and loss given default (LGD) for each counterparty) and to manage them on a pooled basis. For SMEs as corporate, however, the results show that capital requirements will be slightly greater than under the existing Basel I Capital Accord. We believe that most eligible banks will use a blended approach (considering some SMEs as retail and some as corporate). Through a breakeven analysis, we find that for all of our countries, banking organizations will be obliged to classify as retail at least 20% of their SME portfolio in order to, at a minimum, maintain the current capital requirement (8%). Moreover, we show that the percentage of SMEs to be classified as retail increases to at least 40% if banks will want to enjoy lower capital requirements by implementing the Advanced IRB instead of the Standardized approach. Since one of the main goals of the new Basel Capital Accord is to improve the efficiency of banks risk management systems, we conclude that a likely impact will be an additional motivation for banks to consider and manage their SMEs clients as retail customers.

JEL classification: G21; G28

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¹ Max L. Heine Professor of Finance. Corresponding author. E-mail address: ealtman@stern.nyu.edu
Tel.: +1 212 998 0709.

² Ph.D. student. Corresponding author. E-mail address: info@gabrielesabato.it Tel.: +1 212 998 0458.

1. Introduction

Small and medium sized enterprises (SMEs) play a fundamental role in the economy of many countries all over the world. For OECD members, the percentage of SMEs out of the total number of firms is greater than 97%. They are a continuing source of dynamism for the economy, producing three-fourths of the total jobs and often more than one-third of the country's GDP. Thanks to the simple structure of SMEs, they can respond quickly to changing economic conditions and meet local customers' needs, growing sometimes into large and powerful corporations or failing within a short time of the firm's inception. Many public and private financial institutions, such as the World Bank¹ or Governments² themselves, launch each year plans in order to sustain this essential player of nations' economy. Borrowings, however, especially from commercial banks³, remain undoubtedly the most important source of external SME financing.

Concerns have been raised that the new Basel Capital Accord (Basel II) will change the way banks analyze credits, introducing new credit risk management techniques and possibly reducing the lending activity toward SMEs. This is due to banks' potential perception that SMEs carry higher risk and, hence, higher capital requirements than under Basel I. Many SME associations in different countries have publicly complained about the new rules and many governments are now concerned. To reduce these concerns, the European Commission published a report⁴ in which the SMEs access to finance, for non-start-up companies, was analyzed. The report concluded that only 13% of European SMEs consider access to finance as a major barrier. Approximately 80% of them had at least one established credit line. However, this study's conclusions did not eliminate SME's concerns about their future under the new Basel Accord.

¹ "The Challenge", World Bank Review of Small Business Activities, (2001).

² See, for example, US Small Business Administration, www.sba.gov, or EU policies and activities for SMEs, http://europa.eu.int/comm/enterprise/entrepreneurship/promoting_entrepreneurship/index.htm.

³ See Berger and Udell (1998), Udell (2004) for a detailed discussion of lending to SMEs.

⁴ See European Commission, Enterprise Publications, "2003 observatory of European SMEs", for further analyses.

From the beginning (1999) of the capital adequacy reform process, the Basel Committee paid particular attention to the SME segment, mainly by having changed the formulas to calculate risk weights linked to SMEs⁵ three times. In the last version (June 2004, par. 232 and 273), banks are able to consider small and medium sized enterprises as retail or as corporate entities, primarily based on their total exposure to this entity. If total exposure is under €1 million, SMEs can be classified as *retail*, but another important qualitative requirement must be followed: the credit must be *managed* as a retail exposure. This means that “the exposure must be one of a large pool of exposures which are managed by the bank on a pooled basis”. On the other hand, if SME credits are classified as *corporate*, a special “discount” in the asset correlation calculation is ensured for exposures to firms with under €50 million in sales. Both approaches specify “haircuts” which are based on the assumption that smaller firms credit risks are less correlated as to default risk than larger corporates and less sensitive to the business cycle. We also expect that the benefits shown for SMEs have been motivated by nations’ concerns about lessening credit possibilities and the importance that SME owners and employees have on voting results.

In this paper, we use data from three different countries (US, Italy and Australia), considering the SME structure of each economy, in order to quantify the expected effect on the bank capital requirements when considering a small firm as either retail or corporate.

In Section 2, we review the extant European and US research literature on the expected effects of Basel II on SMEs. This literature, all based on earlier versions of the new Basel Accord, provides evidence of the potential benefits of the Basel II implementation on the bank capital requirements, but it does not analyze effects on SME lending by banking organizations are analyzed. In Section 3, we derive bank capital requirements using formulas from the Advanced Internal Rating Based (A-IRB) approach as contained in the last version of the Accord (June 2004). Realistic assumptions about maturity, loss given default (LGD) and exposures are made. We are confident that alternative possible realistic assumptions would not affect the results of the analysis. We also provide a sensitivity analysis to show the effects on

⁵ Basel Committee on Banking Supervision, January 2001, April 2003, June 2004.

capital requirements of using different values of LGD and maturity. For two of the countries (US and Australia), where data is available, we also calculate the capital requirements for the large corporate segment (where firms' sales are more than € 50 million), even if it is not the focus of this paper.

In order to perform our analysis, we develop three different models to assign probability of default (PD) estimates to the firms in our samples. In this way, we specifically consider the differences between the structures of SMEs and their credit risk attributes in different countries. Lastly, we summarize our results in terms of banks' capital requirements for the three countries and we derive our main findings focusing on the possible changes in the relationship between banks and SMEs and the expected advantages and disadvantages of these changes. In Section 4, we submit our conclusions.

2. Review of the relevant research literature

In this Section, we review some of the most important works about the possible effects of the Basel II implementation on small and medium sized enterprises. The literature generally finds that for both Europe and the US, the new Basel Capital Accord will have beneficial effects on banks capital requirements (lower) linked to the SME segment, either if the Standardized or one of the IRB (Advanced or Foundation) approaches is used. The various studies find that it is easier to assess the amount of the savings in banks' capital requirements with the Standardized approach than with the IRB approach. Using the Standardized approach to calculate capital requirements results in no savings if the SMEs are considered as corporate (same 8% as before); but, if they are considered as retail, the risk weight goes from 100% to a new 75% (Basel Committee on Banking Supervision, June 2004, par. 69), so the capital requirement effectively becomes 6%. The IRB approaches, however, allow banks to personalize the capital requirement calculation⁶, building their own models in order to estimate PDs (with the Foundation) or even LGDs (with the Advanced) for each client. This means that it is not possible to assess the exact savings in capital

⁶ See Heitfield (2004) which explains how banks should choose their own "rating philosophy".

requirements for banks that will implement the IRB approach, since these will be linked to the specific models utilized and to the characteristics of each portfolio of credits. In our study, we actually do provide models and realistic assumptions to perform this analysis.

Most studies have tried to understand the most probable risk weights and their possible changes under Basel II using a generic sample of small and medium sized enterprises and assumptions in order to estimate PD and LGD. Since we do not have the necessary data to estimate LGDs, we are forced to use some realistic assumptions. We focus our analysis on the probability of default, developing three specific credit risk models with the purpose of estimating PDs in the most Basel II compliant way. Then, to test the soundness of the assumptions that we made in order to derive capital requirements, we provide a sensitivity analysis with respect to LGD and asset's maturity.

2.1 European literature

In a study of the Austrian economy, Schwaiger (2002) uses a sample of 11,610 enterprises, with revenues between €1 and 50 million. A scoring system⁷ is applied in order to assign a score to each enterprise and then these scores are grouped into twelve rating classes. PDs for each rating class are calculated by dividing the number of defaults by the number of enterprises in every class. A fixed LGD of 45% is used, based on the assumption suggested in the Foundation IRB approach (F-IRB) for senior, unsecured loan exposures⁸. Loan exposures are approximated by enterprises' revenues⁹ or by the percentage of firms in each rating class. The formulas used to calculate the bank capital requirements are the ones contained in the October 2002 version of the Accord (QIS 3). The main difference with the final Basel II formulas (June 2004) is that expected losses are not subtracted from the capital requirements. SMEs are considered only as corporate, applying the size "discount", and not as retail. Final results show a cumulative capital requirement of 5.40%, if calculated by

⁷ The "Bonitatsindex" from Creditreform (Austria) is transformed into a rating system.

⁸ Basel Committee on Banking Supervision, QIS3, October 2002, par. 246.

⁹ Higher amounts are supposed to be granted to better quality enterprises and a quite close distribution is found for revenues.

using the revenue assumption, or 6.36%, if the weights for the different rating classes are approximated by the percentage of firms in each class. Both results demonstrate that Basel II (QIS3) reduces quite substantially the banks capital requirements for Austrian SMEs, compared to the current 8%. It is important to point out that expected losses (PDxLGD) are not subtracted from the capital requirements, as is required in the last version of the Accord.

For the Spanish economy, Saurina and Trucharte (2004) apply their analysis to a more complex environment. Results are derived by using the aggregate average PDs for various size categories for eight years (1994-2001) of data, and not through a scoring system, as the Basel Accord requires. The same formulas, as in the Austrian work, are utilized and the expected losses (PDxLGD) are again considered as part of capital requirements. Their first empirical result shows that the smaller an obligor (measured by its volume of sales), the greater its probability of default¹⁰. Indeed, almost all extant literature agrees that there is no evidence that SME loans are less risky, in terms of lower expected losses, than the large corporate ones. The Basel Committee and others (e.g. Lopez (2004)) state only that the asset correlation amongst firms is positively related to the size of a firm and this explains the “correlation discount” for firms with less than €50 million of sales. Moreover, this assumption is probably related to the possibility for banks to classify SMEs loans as retail. We will present our views about this subject at a later point.

The other main result from the Spanish study concerns the amount of bank capital requirements that are calculated using the IRB approach for large firms (6.50%), SMEs corporate (8.94%) and SMEs retail (6.26%). The authors demonstrate that requirements for SMEs considered as retail are considerably less than those for SMEs considered as corporate. However, both are higher than those that would be obtained using the Standardised approach, 8% (for SMEs classified as corporate) and 6% (for SMEs classified as retail). We have to underline again that in the Spanish work no rating classes or exposure weights are used when capital

¹⁰ There are many works on this topic that show the same results, especially for the US market, e.g. Berger and Udell (1990, 1995) Booth (1992). More recently a study by Jacobson, Lindè and Roszbach (2004) demonstrates, for two Swedish commercial banks portfolios of loans, that the new Basel formulas are successful in covering the actual loss rates for the SME portfolio, considered both, as corporate or as retail.

requirements are calculated with the IRB approach and this could significantly affect results since the main goal of the Basel II A-IRB method is the rating of assets in a portfolio based on their different risks and to assign them diverse risk weights.

The European Council of Ministers meeting in Barcelona in March 2002, and subsequently the European Parliament, requested the Commission “to present a report on the consequences of the Basel deliberations for all sectors of the European economy with particular attention to SMEs”. The report (PricewaterhouseCoopers and NIESR (2004)) extensively analyzes the structure of European SMEs and their financial structure. Many academic studies for different countries are compared in order to understand the most probable effects of Basel II on credit risk capital requirements for SMEs. The main conclusions are that the new Accord should not have any negative impact on the availability and cost of finance for SMEs in most European countries. The study points out that worries about an increase in the cost of finance due to an increased use of internal ratings in lending activity are not justified. Indeed, they conclude that credit risk capital requirements relating to SMEs are expected to decrease, especially if an IRB approach is used.

2.2 US literature

The United States position with respect to Basel II implementation is slightly more complex than the European one and has been the source of many discussions. In August 2003, US banking regulators¹¹ proposed a three-tier system in which only large¹², internationally active banking organizations (core banks) will be required to adopt the A-IRB approach on a mandatory basis, while the other organizations, if subject to the Accord¹³, could choose to adopt that approach (opt-in banks) or not (general banks). Most banking organizations will more than likely remain Basel I banks.

¹¹ Advanced Notice of Proposed Rulemaking (ANPR) for the application of Basel II to US banking organizations, August 2003.

¹² Banking organizations with total banking (and thrift) assets of at least \$250 billion or at least \$10 billion in on-balance-sheet foreign exposures. These kinds of banks are expected to be between 10 and 20 in US market.

¹³ The 1988 Accord applied only to internationally active banks. Under the new Accord, the scope of application has been broadened also to encompass bank holding companies that are parents of internationally active “banking groups.”

Many aspects of this proposal have been analyzed in the academic literature (Allen and Saunders, 2004; Hannan and Pilloff, 2004), but the work of Berger (2004) specifically focuses on the effects of Basel II on banks in the US SME credit market. He uses the results of the Quantitative Impact Study 3 (QIS3), carried out by the Basel Committee in 2002 through a survey of large US banking organizations. Seventeen of the 22 responding institutions provided estimates of the A-IRB adoption effects on their SME portfolios showing an average reduction of 33% in required credit risk capital. We must underline again that the A-IRB formulas used at that time to calculate bank capital requirements still considered expected loss as part of these requirements. This means, as we show later, that a higher reduction could be expected applying the new formulas. Based on these results, even if considered “rough estimates”, and on other considerations, the study concludes that the benefits of a decline in marginal costs of SME lending for banking organizations that adopt the A-IRB approach are likely to only slightly affect small banks which will not adopt that method, since they have a greater competitive advantage given by their “relationship lending”. Otherwise, Basel II implementation may significantly adversely influence the competitive positions in the SME market of large banking organizations in the US that will not adopt the A-IRB, since they share the same kind of “hard” information¹⁴.

3. Deriving bank capital requirements

In this Section we explain how we derive bank capital requirements relating to SMEs for the three countries that we consider. Methodologies, formulas and assumptions are clearly defined in order to allow better understanding of the final results. We first examine the definition of a SME comparing the position in different countries and the one assumed by the Basel Committee.

¹⁴ Berger (2004) distinguishes between the kind of information available for large banking organizations (“hard”) and the one (“soft”) available for smaller banks (community banks).

3.1 SME definition

We find that there is no common definition of the segment of small and medium sized enterprises across different countries. The definition varies from country to country, taking into account different quantitative¹⁵ and qualitative¹⁶ variables. We restrict our focus to three important economic zones (US, E.U. and Australia) that will be impacted by the Basel Accord revisions.

The European Union has had a common definition since 1996 that was updated in 2003¹⁷, probably to take into account also the new Basel rules. The number of employees and the annual turnover of a firm are the criteria considered (less than €50 million in sales or less than 250 employees).

In the United States there is a special organization (Small Business Administration, or SBA) that deals with the politics relating to SMEs and also with their definition based on the North American Industry Classification System (NAICS). Four criteria are used to identify small business firms¹⁸: three generic qualitative rules and one quantitative requirement linked to the industry type. In general, the maximum number of employees is 500 and the average annual receipts should be less than \$28.5 million, but these limits are different for each industry.

Australia has many definitions of SMEs linked to the context in which they are used¹⁹. The most common is that the annual turnover should be less than \$10 million, but sometimes the number of employees (less than 50) is used.

Facing all these different criteria, the Basel Committee has mainly chosen to follow the annual turnover definition, setting the same general rules to calculate the capital requirements for all the firms (large, medium and small), but ensuring a lighter treatment for small and medium ones (with annual turnover less than €50 million).

¹⁵ The most commonly used are: annual turnover, total assets, number of employees, average annual receipts or capital.

¹⁶ Usually no attention is given to the legal form, but independence from big enterprises, work organization and industry type are often considered.

¹⁷ Commission Recommendation 96/280/EC of April 3, 1996, updated in 2003/361/EC of May 6, 2003, that replaced the old one from January 1, 2005.

¹⁸ A small business is one that: 1) is organized for profit; 2) has a place of business in the US; 3) makes a significant contribution to the US economy by paying taxes or using products, materials or labor; and 4) does not exceed the numerical size standard for its industry. For the specific table, see <http://www.sba.gov/size/summary-what.html>.

¹⁹ See Gibson (2001).

We believe that this decision, as already expressed, is based on the assumption that these firms have a lower default correlation with each other and not because they are considered less risky, in terms of lower expected losses, than the larger firms. Moreover, a part of SMEs can be classified as retail, but in this case the SME definition does not play any role. The only criterion considered is the bank's exposure (less than €1 million). We conclude that, with this rule, banks are motivated to utilize automatic decision systems to manage clients with lower exposures, regardless of whether they are firms or private individuals, in order to improve their internal efficiency. Scoring or rating systems, in the application and the behavioral process, are the best way to treat "hard information" for the retail segment where low profit margins and high volumes of customers do not allow an efficient "relationship lending" (See Udell, 2004, for further discussions).

3.2 The capital requirements

In Pillar 1 of the new Basel Capital Accord, the rules to calculate bank capital requirements for each of the different segments, or "buckets", are clearly explained. We focus on the formulas that can be used for SMEs when the A-IRB approach is applied. As already stated, banks can classify SMEs as retail, utilizing the formula for "other retail exposures", or as corporate, applying the corporate formula with the firm-size adjustment²⁰. All formulas follow the same calculation steps involving inputs for correlation (R), capital requirement (K) and risk-weighted assets (RWA)²¹. The most important input variables, to be provided by the banks, are three (PDs, LGDs and exposures at default (EADs)²²), while the asset correlation (R) is implicitly given by the Basel formulas. The exact formulas for SMEs from the final version of the Basel Capital Accord are shown in Table 1. Since, in our data samples, we do not have the loan exposures or the possibility to estimate the LGD for each counterparty, we have to make some assumptions, basically following the literature discussed in Section 2.

²⁰ Basel Committee on Banking Supervision, June 2004, par. 330 and par. 272-273.

²¹ $RWA = K \times 12.5 \times EAD$. Since the final capital requirement is the 8% of this amount, we do not multiply the RWA by 12.5.

²² As expressed in par. 334 of the Accord, we assume EAD for on-balance sheet items equal to the loan exposure amount.

Table 1. New SME capital requirement formulas

This table shows the new formulas, the ones contained in the last version (June 2004) of the Basel Accord. For the SMEs classified as retail, the formulas are the ones for the “other retail exposures”. When SMEs are classified as corporate, the formulas to be used are the one for the corporate, considering the size discount. *Source:* Basel Committee on Banking Supervision. 2004. “International Convergence of Capital Measurement and Capital Standards”

SME as retail	SME as corporate
$\text{Correlation}=R=0.03*(1-\text{EXP}(-35*PD))/(1-\text{EXP}(35)) +0.16*[1-(1-\text{EXP}(-35*PD))/(1-\text{EXP}(-35))]$	$\text{Correlation}=R.= 0.12*(1-\text{EXP}(-50*PD))/(1-\text{EXP}(-50)) +0.24*(1-(1-\text{EXP}(-50*PD))/(1-\text{EXP}(-50))) -0.04*(1-(S-5)/45)$
$\text{Capital requirement}=K=\text{LGD}*N((1-R)^{-0.5}*G(PD) +(R/(1-R)^{0.5})*G(0.999)) -PD*\text{LGD}$	$\text{Capital requirement}=K= (\text{LGD}*N((1-R)^{-0.5}*G(PD) +(R/(1-R)^{0.5})*G(0.999))-PD*\text{LGD})*(1-1.5*b)^{-1*(1+(M-2.5)*b)}$ $\text{Maturity adjustment}=(b)= (0.11852-0.05478*\text{LN}(PD)^2)$

A fixed LGD of 45% is assumed, using the one suggested in the Foundation IRB approach (F-IRB) for senior, unsecured loan exposures²³, and the percentage of firms in each rating class is used as weight for the capital requirement, instead of the loan exposure. We believe that both assumptions are reasonable and do not have material effects on the final results²⁴. To be sure of this, we provide, in Appendix D, a sensitivity analysis to show the effects of using different values of LGD and maturity. We focus on one year PDs estimation, developing three statistical models in order to discriminate SME risk in each country sample. Then, we point out that the lower correlation value for the retail assets, implicitly assumed by the Basel formulas, is the main driver of the lower capital requirement for that segment.

Before explaining the models, it is important to discuss the variables used since, amongst SMEs, there are different kinds of customers according to their legal form. Basically, they could be sole traders, partnerships or limited companies, but the main problem is that for each one of these possibilities a different set of information is available. Specifically, for partnerships and limited companies, usually a great deal of balance sheet variables is generally used to develop scoring models, as in our study, but these are not available for sole traders. We believe that in this latter case, the only possibility is to utilize personal information about the owners, considering them as private individuals. For example, internal sources, such as the client's behavior with other bank's products, or external sources, such as public or credit bureau data, could be used. Moreover, in order to improve the performance of the models for all the possible kinds of firms, generic firm quantitative and qualitative variables²⁵ could be very useful.

In our data samples, we exclude sole traders, since we do not have enough variables to develop a specific model for them, while, for other firms, we consider only financial statement variables (financial ratios).

²³ Basel Committee on Banking Supervision, June 2004, par. 287.

²⁴ Perhaps we will observe a slight overestimate since many empirical studies show LGD distributions as highly abnormal with a pronounced positive skew and also we should expect higher exposures for better quality borrowers.

²⁵ Such as the number of employees, the legal form of the business, the region where the main business is carried out, the industry type, etc. See Grunert, Norden and Weber (2004), for further discussions about the role of non-financial factors in internal credit ratings.

3.2.1 The Italian case

In the Italian sample, there are 20,193 SME firms derived from a portfolio of a large Italian bank. We know that none of them have sales over €50 million and an exposure over €1 million, but we do not have the exact amounts for each firm. About 40 financial ratios have been analyzed and 20 of them have been chosen to run in a logistic regression to develop our model (See Appendix A for a detailed discussion about how the model has been developed). The final model contains eight variables: three describing the leverage structure, one the profitability and four the liquidity situation of the firm. Our model creates nine rating classes that allow discriminating PDs ranging from 0.03% to 15%. For each rating class, PDs are calculated by dividing the number of defaults by the number of enterprises in each class. Rating classes have been created in order to obtain the value of PD closest to the one showed by bond equivalent PD distributions (Column 2 in Table 2). Classifying all SMEs as *retail*, we obtain a capital requirement of 4.88% for Italy (Table 2).

To consider SMEs as corporate (Table 3), we have to make two additional assumptions. The first is the effective maturity (M_{eff}), three years for smaller firms and five years for medium sized firms. The maturity adjustment ($(b)_{\text{corp.}}$) is a function only of PD. The second assumption is about the amount of sales to use for the size adjustment. We split the SME population into two groups: one with sales between €5 and €25 million (small) and the other with sales between €26 and €50 million (medium). In this way we use an average amount of sales of €10 and €30 million in each group, respectively²⁶. The two groups' percentages of capital requirements are aggregated, considering the most likely distribution of these size firms in banks' portfolios. We assume that the SME portfolios are typically comprised of 85% of small and 15% of medium sized firms²⁷. The resulting weighted capital requirement of the two size components of SMEs, calculated in Table 3, is 8.45% ($0.85 \cdot 8.25 + 0.15 \cdot 9.66$) for the Italian SME population.

²⁶ These average amounts are based on the realistic assumption that each sales distribution is skewed with more relatively small borrowers than relatively large borrowers.

²⁷ This breakdown was suggested to us by Centrale dei Bilanci, an Italian organization, based in Turin, owned by over fifty banks and the Bank of Italy, which has access to the financial statements of more than 40,000 Italian firms.

Table 2. All SMEs as retail (Italy)

This table shows the capital requirement when all SMEs are classified as retail. In the first column, rating classes have been assigned on the bond equivalent basis. In the second and third column, probability of default (PD) and loss given default (LGD) are shown. In the fourth column, the correlation for each rating class is calculated using the formula: $R_{sme} = \text{Correlation} = 0.03 * (1 - \text{EXP}(-35 * \text{PD})) / (1 - \text{EXP}(-35)) + 0.16 * [1 - (1 - \text{EXP}(-35 * \text{PD})) / (1 - \text{EXP}(-35))]$. In the fifth column, the capital requirement linked to each rating class is calculated with the following formula: $K_{sme} = \text{Capital requirement} = \text{LGD} * N((1 - R)^{-0.5}) * G(\text{PD}) + (R / (1 - R)^{0.5}) * G(0.999) - \text{PD} * \text{LGD}$. In the sixth column, the weights are assigned utilizing the percent of firms in each rating class. In the last column, the product of the capital requirement (K_{sme}) and the weight is cumulated to obtain the total capital requirement.

Rating	PD	LGD	R_{sme}	K_{sme}	Weight	Cum. Weighted K_{sme}
AAA	0.03%	45%	0.15864	0.0035609	0.0000	0.000%
AA	0.05%	45%	0.15774	0.0053033	0.0045	0.002%
BBB	0.44%	45%	0.14145	0.0240566	0.0226	0.057%
BB	1.06%	45%	0.11971	0.0375285	0.0746	0.337%
BB-	1.91%	45%	0.09662	0.0458465	0.2622	1.539%
B+	3.31%	45%	0.07081	0.0509144	0.3578	3.361%
B	5.61%	45%	0.04825	0.0537624	0.2551	4.732%
B-	9.34%	45%	0.03495	0.0591754	0.0143	4.817%
CCC	15.00%	45%	0.03068	0.0708806	0.0089	4.880%

Table 3. All SMEs as corporate (Italy)

This table shows the capital requirement when all SMEs are classified as corporate. In the first column, rating classes have been assigned on the bond equivalent basis. In the second and third column, probability of default (PD) and loss given default (LGD) are shown. In the fourth column, the correlation for each rating class is calculated using the formula: $R_{corp.} = \text{Correlation} = 0.12 * (1 - \text{EXP}(-50 * \text{PD})) / (1 - \text{EXP}(-50)) + 0.24 * (1 - (1 - \text{EXP}(-50 * \text{PD})) / (1 - \text{EXP}(-50))) - 0.04 * (1 - (S - 5) / 45)$, where S is the amount of sales for each firm. In the fifth column, the maturity adjustment is calculated as: $(b)_{corp.} = \text{Maturity adjustment} = (0.11852 - 0.05478 * \text{LN}(\text{PD})^2)$. In the sixth column there is the effective maturity ($M_{eff.}$). In the seventh column, the capital requirement linked to each rating class is calculated with the following formula: $K_{corp.} = \text{Capital requirement} = (\text{LGD} * N((1 - R)^{-0.5} * G(\text{PD})) + (R / (1 - R)^{0.5} * G(0.999)) - \text{PD} * \text{LGD}) * (1 - 1.5 * b)^{-1 * (1 + (M - 2.5) * b)}$. In the eighth column the weights are assigned utilizing the percent of firms in each rating class. In the last column the product of the capital requirement (K_{sme}) and the weight is cumulated to obtain the total capital requirement.

	Rating	PD	LGD	$R_{corp.}$	$(b)_{corp.}$	$M_{eff.}$	$K_{corp.}$	Weight	Cum. Weighted $K_{corp.}$
Sales €5-25mil	AAA	0.03%	45%	0.20266	0.31683	3.0	0.0103082	0.0000	0.000%
	AA	0.05%	45%	0.20148	0.28612	3.0	0.0137376	0.0045	0.006%
	BBB	0.44%	45%	0.18075	0.17286	3.0	0.0437287	0.0226	0.105%
	BB	1.06%	45%	0.15508	0.13513	3.0	0.0617752	0.0746	0.566%
	BB-	1.91%	45%	0.13062	0.11245	3.0	0.0730465	0.2622	2.481%
	B+	3.31%	45%	0.10738	0.09316	3.0	0.0834057	0.3578	5.465%
	B	5.61%	45%	0.09171	0.07635	3.0	0.0973451	0.2551	7.949%
	B-	9.34%	45%	0.08557	0.06170	3.0	0.1185345	0.0143	8.118%
	CCC	15.00%	45%	0.08451	0.04948	3.0	0.1425111	0.0089	8.245%

	Rating	PD	LGD	$R_{corp.}$	$(b)_{corp.}$	$M_{eff.}$	$K_{corp.}$	Weight	Cum. Weighted $K_{corp.}$
Sales €26-50mil	AAA	0.03%	45%	0.22044	0.31683	5.0	0.0173454	0.0000	0.000%
	AA	0.05%	45%	0.21926	0.28612	5.0	0.0211578	0.0045	0.010%
	BBB	0.44%	45%	0.19852	0.17286	5.0	0.0540392	0.0226	0.132%
	BB	1.06%	45%	0.17285	0.13513	5.0	0.0734324	0.0746	0.679%
	BB-	1.91%	45%	0.14840	0.11245	5.0	0.0857668	0.2622	2.928%
	B+	3.31%	45%	0.12515	0.09316	5.0	0.0975877	0.3578	6.420%
	B	5.61%	45%	0.10948	0.07635	5.0	0.1135301	0.2551	9.316%
	B-	9.34%	45%	0.10335	0.06170	5.0	0.1367453	0.0143	9.512%
	CCC	15.00%	45%	0.10229	0.04948	5.0	0.1618240	0.0089	9.656%

3.2.2 The Australian case

For the Australian case, we apply the *Corporate Scorecard Credit Rating (CSCR)*, derived by the Altman et al. (1977) ZETA score model, adopted for Australia by the *Corporate Scorecard Group*. We obtain 15 rating classes, with expected PDs from 0.03% to 20%. The assumptions and considerations are the same made for Italy. The PDs are derived from the Basel Accord's directives for each bond equivalent rating class.

The Australian sample contains 10,000 firms, 5,749 of which are SMEs, with sales less than €50 million, that can be classified as retail or corporate. When all SMEs are considered as *retail*, results show a capital requirement of 4.62% (Table 4). For SMEs classified as corporate (Table 5), we split the population into two groups²⁸ (small and medium) using the same average amount of sales (€10 and €30 million). The resulting weighted capital requirement for Australian corporate SMEs is 8.81% ($0.64*8.33+0.36*9.71$).

We also calculate the capital requirement for 4,251 large companies, with sales over €50 million. The result is a cumulated capital requirement of 7.83% (Table 6), just slightly less than the current 8% requirement.

²⁸ This breakdown was suggested to us by the Corporate Scorecard Group, the company that provided us the data. In the sample, out of 5,749 SMEs, 3,650 (64%) were small and 2,099 (36%) were medium sized.

Table 4. All SMEs as retail (Australia)

This table shows the capital requirement when all SMEs are classified as retail. In the first column, rating classes are listed. In the second and third column, probability of default (PD), assigned on the bond equivalent basis, and loss given default (LGD) are shown. In the fourth column, the correlation for each rating class is calculated using the formula: $R_{sme} = \text{Correlation} = 0.03 * (1 - \text{EXP}(-35 * \text{PD})) / (1 - \text{EXP}(-35)) + 0.16 * [1 - (1 - \text{EXP}(-35 * \text{PD})) / (1 - \text{EXP}(-35))]$. In the fifth column, the capital requirement linked to each rating class is calculated with the following formula: $K_{sme} = \text{Capital requirement} = \text{LGD} * N((1 - R)^{-0.5} * G(\text{PD}) + (R / (1 - R)^{0.5}) * G(0.999)) - \text{PD} * \text{LGD}$. In the sixth column, the weights are assigned utilizing the percent of firms in each rating class. In the last column, the product of the capital requirement (K_{sme}) and the weight is cumulated to obtain the total capital requirement.

Rating	PD	LGD	R_{sme}	K_{sme}	Weight	Cum. Weighted K_{sme}
AAA	0.03%	45%	0.15864	0.0035609	0.0009	0.000%
AA	0.07%	45%	0.15685	0.0068515	0.0236	0.016%
A+	0.09%	45%	0.15597	0.0082644	0.0091	0.024%
A	0.10%	45%	0.15553	0.0089303	0.0182	0.040%
A-	0.11%	45%	0.15509	0.0095731	0.0318	0.071%
BBB+	0.20%	45%	0.15121	0.0145806	0.0300	0.114%
BBB	0.30%	45%	0.14704	0.0190389	0.0381	0.187%
BBB-	0.50%	45%	0.13913	0.0258890	0.0390	0.288%
BB+	0.75%	45%	0.12999	0.0320784	0.0572	0.471%
BB	1.00%	45%	0.12161	0.0366182	0.0744	0.744%
BB-	1.50%	45%	0.10690	0.0426968	0.1361	1.325%
B+	2.60%	45%	0.08233	0.0490728	0.1742	2.180%
B	6.00%	45%	0.04592	0.0541848	0.1416	2.947%
B-	10.00%	45%	0.03393	0.0604342	0.0717	3.380%
CCC	20.00%	45%	0.03012	0.0802219	0.1543	4.618%

Table 5. All SMEs as corporate (Australia)

This table shows the capital requirement when all SMEs are classified as corporate. In the first column, rating classes are listed. In the second and third column, probability of default (PD), assigned on the bond equivalent basis, and loss given default (LGD) are shown. In the fourth column, the correlation for each rating class is calculated using the formula: $R_{corp.} = \text{Correlation} = 0.12 * (1 - \text{EXP}(-50 * \text{PD})) / (1 - \text{EXP}(-50)) + 0.24 * (1 - (1 - \text{EXP}(-50 * \text{PD})) / (1 - \text{EXP}(-50))) - 0.04 * (1 - (S - 5) / 45)$, where S is the amount of sales for each firm. In the fifth column, the maturity adjustment is calculated as: $(b)_{corp.} = \text{Maturity adjustment} = (0.11852 - 0.05478 * \text{LN}(\text{PD})^2)$. In the sixth column there is the effective maturity ($M_{eff.}$). In the seventh column, the capital requirement linked to each rating class is calculated with the following formula: $K_{corp.} = \text{Capital requirement} = (\text{LGD} * N((1 - R)^{-0.5}) * G(\text{PD}) + (R / (1 - R)^{0.5}) * G(0.999) - \text{PD} * \text{LGD}) * (1 - 1.5 * b)^{-1 * (1 + (M - 2.5) * b)}$. In the eighth column the weights are assigned utilizing the percent of firms in each rating class. In the last column the product of the capital requirement (K_{sme}) and the weight is cumulated to obtain the total capital requirement.

	Rating	PD	LGD	$R_{corp.}$	$(b)_{corp.}$	$M_{eff.}$	$K_{corp.}$	Weight	Cum. Weighted $K_{corp.}$
Sales €5-25mil	AAA	0.03%	45%	0.20266	0.31683	3.0	0.0103082	0.0009	0.001%
	AA	0.07%	45%	0.20032	0.26674	3.0	0.0166174	0.0236	0.040%
	A+	0.09%	45%	0.19916	0.25271	3.0	0.0191437	0.0091	0.058%
	A	0.10%	45%	0.19859	0.24694	3.0	0.0203066	0.0182	0.095%
	A-	0.11%	45%	0.19802	0.24177	3.0	0.0214139	0.0318	0.163%
	BBB+	0.20%	45%	0.19302	0.21064	3.0	0.0296251	0.0300	0.251%
	BBB	0.30%	45%	0.18773	0.19075	3.0	0.0364547	0.0381	0.390%
	BBB-	0.50%	45%	0.17790	0.16709	3.0	0.0462932	0.0390	0.571%
	BB+	0.75%	45%	0.16692	0.14942	3.0	0.0546619	0.0572	0.884%
	BB	1.00%	45%	0.15723	0.13749	3.0	0.0605946	0.0744	1.334%
	BB-	1.50%	45%	0.14113	0.12151	3.0	0.0685692	0.1361	2.268%
	B+	2.60%	45%	0.11715	0.10141	3.0	0.0786754	0.1742	3.638%
	B	6.00%	45%	0.09042	0.07433	3.0	0.0996762	0.1416	5.050%
	B-	10.00%	45%	0.08525	0.05986	3.0	0.1218895	0.0717	5.924%
	CCC	20.00%	45%	0.08445	0.04272	3.0	0.1557644	0.1543	8.327%

	Rating	PD	LGD	$R_{corp.}$	$(b)_{corp.}$	$M_{eff.}$	$K_{corp.}$	Weight	Cum. Weighted $K_{corp.}$
Sales €26-50mil	AAA	0.03%	45%	0.22044	0.31683	5.0	0.0173454	0.0009	0.002%
	AA	0.07%	45%	0.21809	0.26674	5.0	0.0243731	0.0236	0.059%
	A+	0.09%	45%	0.21694	0.25271	5.0	0.0271871	0.0091	0.084%
	A	0.10%	45%	0.21637	0.24694	5.0	0.0284790	0.0182	0.136%
	A-	0.11%	45%	0.21580	0.24177	5.0	0.0297070	0.0318	0.230%
	BBB+	0.20%	45%	0.21080	0.21064	5.0	0.0387449	0.0300	0.346%
	BBB	0.30%	45%	0.20551	0.19075	5.0	0.0461809	0.0381	0.522%
	BBB-	0.50%	45%	0.19568	0.16709	5.0	0.0567986	0.0390	0.744%
	BB+	0.75%	45%	0.18470	0.14942	5.0	0.0657834	0.0572	1.120%
	BB	1.00%	45%	0.17501	0.13749	5.0	0.0721596	0.0744	1.657%
	BB-	1.50%	45%	0.15891	0.12151	5.0	0.0808140	0.1361	2.757%
	B+	2.60%	45%	0.13493	0.10141	5.0	0.0921371	0.1742	4.362%
	B	6.00%	45%	0.10820	0.07433	5.0	0.1161421	0.1416	6.006%
	B-	10.00%	45%	0.10303	0.05986	5.0	0.1403267	0.0717	7.013%
	CCC	20.00%	45%	0.10223	0.04272	5.0	0.1750002	0.1543	9.713%

Table 6. Corporate – Large firms (Australia)

This table shows the capital requirement for large corporate firms. In the first column, rating classes are listed. In the second and third column, probability of default (PD), assigned on the bond equivalent basis, and loss given default (LGD) are shown. In the fourth column, the correlation for each rating class is calculated using the formula: $R_{corp.} = \text{Correlation} = 0.12 * (1 - \text{EXP}(-50 * \text{PD})) / (1 - \text{EXP}(-50)) + 0.24 * (1 - (1 - \text{EXP}(-50 * \text{PD})) / (1 - \text{EXP}(-50)))$. In the fifth column, the maturity adjustment is calculated as: $(b)_{corp.} = \text{Maturity adjustment} = (0.11852 - 0.05478 * \text{LN}(\text{PD})^2)$. In the sixth column there is the effective maturity (M_{eff}). In the seventh column, the capital requirement linked to each rating class is calculated with the following formula: $K_{corp.} = \text{Capital requirement} = (\text{LGD} * N((1 - R)^{-0.5}) * G(\text{PD}) + (R / (1 - R)^{0.5}) * G(0.999)) - \text{PD} * \text{LGD} * (1 - 1.5 * b)^{-1 * (1 + (M - 2.5) * b)}$. In the eighth column the weights are assigned utilizing the percent of firms in each rating class. In the last column the product of the capital requirement (K_{sme}) and the weight is cumulated to obtain the total capital requirement.

Rating	PD	LGD	$R_{corp.}$	$(b)_{corp.}$	$M_{eff.}$	$K_{corp.}$	Weight	Cum. Weighted $K_{corp.}$
AAA	0.03%	45%	0.23821	0.31683	5.0	0.0192569	0.0000	0.000%
AA	0.07%	45%	0.23587	0.26674	5.0	0.0270318	0.0235	0.064%
A+	0.09%	45%	0.23472	0.25271	5.0	0.0301399	0.0165	0.113%
A	0.10%	45%	0.23415	0.24694	5.0	0.0315661	0.0329	0.217%
A-	0.11%	45%	0.23358	0.24177	5.0	0.0329213	0.0376	0.341%
BBB+	0.20%	45%	0.22858	0.21064	5.0	0.0428891	0.0494	0.553%
BBB	0.30%	45%	0.22328	0.19075	5.0	0.0510895	0.0659	0.890%
BBB-	0.50%	45%	0.21346	0.16709	5.0	0.0628223	0.1341	1.732%
BB+	0.75%	45%	0.20247	0.14942	5.0	0.0728073	0.1059	2.503%
BB	1.00%	45%	0.19278	0.13749	5.0	0.0799553	0.1341	3.575%
BB-	1.50%	45%	0.17668	0.12151	5.0	0.0897988	0.1765	5.160%
B+	2.60%	45%	0.15270	0.10141	5.0	0.1029990	0.1412	6.614%
B	6.00%	45%	0.12597	0.07433	5.0	0.1305268	0.0494	7.259%
B-	10.00%	45%	0.12081	0.05986	5.0	0.1566594	0.0188	7.554%
CCC	20.00%	45%	0.12001	0.04272	5.0	0.1919380	0.0141	7.825%

3.2.3 The United States case

For the United States, we use data from WRDS Compustat²⁹ for US firms during the period 2000-2003. Considering the variables contained in the original Z''-score model for manufacturing and non-manufacturing firms (Altman (1993))³⁰, a new model has been developed specifically for SMEs. The actual model's construction is given in Appendix B. Using this model, we create eleven rating classes that allow discriminating PDs from 0.03% to almost 20%. In order to calculate the capital requirements, the same assumptions as in the previous cases are made.

The SME sample contains 3,552 firms, 2,730 (77%) small (with sales less than €25 million) and 822 (23%) medium sized (with sales between €26 and €50 million). The capital requirement is calculated based on whether the SMEs are considered all as retail or all as corporate. For the *retail* case (Table 7), the capital requirement is 4.65%. When all SMEs are classified as corporate (Table 8), the resulting weighted capital requirement for the US SME population is 8.61% ($0.77*8.29+0.23*9.67$).

For large corporate firms, where sales are over €50 million, the original Z''-Score model for manufacturing and non-manufacturing firms (Altman (1993)) has been applied to over 3,700 US companies extracted from the WRDS Compustat database for the years 2000-2003. Seven rating classes have been created, discriminating PDs from 0.03% to 20%. Results show a capital requirement of 6.64%, consistently lower than the current 8% requirement (Table 9).

²⁹ Compustat North America (Standard & Poor's Corp., a division of Mc Graw-Hill Corp.) is a database of US and Canadian fundamental and market information on more than 24,000 active and inactive publicly held companies from 1994 to 2003.

³⁰ See also Altman, Hartzell and Peck (1995).

Table 7. All SMEs as retail (US)

This table shows the capital requirement when all SMEs are classified as retail. In the first column, rating classes are listed. In the second and third column, probability of default (PD), assigned on the bond equivalent basis, and loss given default (LGD) are shown. In the fourth column, the correlation for each rating class is calculated using the formula: $R_{sme} = \text{Correlation} = 0.03 * (1 - \text{EXP}(-35 * \text{PD})) / (1 - \text{EXP}(-35)) + 0.16 * [1 - (1 - \text{EXP}(-35 * \text{PD})) / (1 - \text{EXP}(-35))]$. In the fifth column, the capital requirement linked to each rating class is calculated with the following formula: $K_{sme} = \text{Capital requirement} = \text{LGD} * N((1 - R)^{-0.5} * G(\text{PD}) + (R / (1 - R)^{0.5}) * G(0.999)) - \text{PD} * \text{LGD}$. In the sixth column, the weights are assigned utilizing the percent of firms in each rating class. In the last column, the product of the capital requirement (K_{sme}) and the weight is cumulated to obtain the total capital requirement.

Rating	PD	LGD	R_{sme}	K_{sme}	Weight	Cum. Weighted K_{sme}
AAA	0.03%	45%	0.15864	0.0035609	0.0080	0.003%
AA	0.07%	45%	0.15685	0.0068515	0.0206	0.017%
A	0.12%	45%	0.15465	0.0101949	0.0319	0.049%
BBB+	0.28%	45%	0.14786	0.0182169	0.0408	0.124%
BBB	0.35%	45%	0.14501	0.0209678	0.0612	0.252%
BB	1.26%	45%	0.11364	0.0401706	0.1975	1.046%
BB-	1.61%	45%	0.10400	0.0436673	0.1641	1.762%
B+	2.75%	45%	0.07965	0.0495529	0.1437	2.474%
B	6.32%	45%	0.04423	0.0545513	0.1229	3.145%
B-	10.34%	45%	0.03349	0.0611066	0.0920	3.707%
CCC	19.87%	45%	0.03012	0.0800075	0.1173	4.645%

Table 8. All SMEs as corporate (US)

This table shows the capital requirement when all SMEs are classified as corporate. In the first column, rating classes are listed. In the second and third column, probability of default (PD), assigned on the bond equivalent basis, and loss given default (LGD) are shown. In the fourth column, the correlation for each rating class is calculated using the formula: $R_{corp.} = \text{Correlation} = 0.12 * (1 - \text{EXP}(-50 * \text{PD})) / (1 - \text{EXP}(-50)) + 0.24 * (1 - (1 - \text{EXP}(-50 * \text{PD})) / (1 - \text{EXP}(-50))) - 0.04 * (1 - (S - 5) / 45)$, where S is the amount of sales for each firm. In the fifth column, the maturity adjustment is calculated as: $(b)_{corp.} = \text{Maturity adjustment} = (0.11852 - 0.05478 * \text{LN}(\text{PD})^2)$. In the sixth column there is the effective maturity (M_{eff}). In the seventh column, the capital requirement linked to each rating class is calculated with the following formula: $K_{corp.} = \text{Capital requirement} = (\text{LGD} * N((1 - R)^{-0.5} * G(\text{PD})) + (R / (1 - R)^{0.5} * G(0.999)) - \text{PD} * \text{LGD}) * (1 - 1.5 * b)^{-1 * (1 + (M - 2.5) * b)}$. In the eighth column the weights are assigned utilizing the percent of firms in each rating class. In the last column the product of the capital requirement (K_{sme}) and the weight is cumulated to obtain the total capital requirement.

	Rating	PD	LGD	$R_{corp.}$	$(b)_{corp.}$	$M_{eff.}$	$K_{corp.}$	Weight	Cum. Weighted $K_{corp.}$
Sales €5-25mil	AAA	0.03%	45%	0.20266	0.31683	3.0	0.0103082	0.0080	0.008%
	AA	0.07%	45%	0.20032	0.26674	3.0	0.0166174	0.0206	0.042%
	A	0.12%	45%	0.19746	0.23711	3.0	0.0224718	0.0319	0.114%
	BBB+	0.28%	45%	0.18877	0.19406	3.0	0.0352240	0.0408	0.258%
	BBB	0.35%	45%	0.18518	0.18344	3.0	0.0392977	0.0612	0.498%
	BB	1.26%	45%	0.14836	0.12826	3.0	0.0652130	0.1975	1.786%
	BB-	1.61%	45%	0.13809	0.11882	3.0	0.0698990	0.1641	2.933%
	B+	2.75%	45%	0.11479	0.09946	3.0	0.0797299	0.1437	4.079%
	B	6.32%	45%	0.08954	0.07279	3.0	0.1015793	0.1229	5.328%
	B-	10.34%	45%	0.08513	0.05896	3.0	0.1235601	0.0920	6.464%
CCC	19.87%	45%	0.08445	0.04287	3.0	0.1554966	0.1173	8.288%	

	Rating	PD	LGD	$R_{corp.}$	$(b)_{corp.}$	$M_{eff.}$	$K_{corp.}$	Weight	Cum. Weighted $K_{corp.}$
Sales €26-50mil	AAA	0.03%	45%	0.22044	0.31683	5.0	0.0173454	0.0080	0.014%
	AA	0.07%	45%	0.21809	0.26674	5.0	0.0243731	0.0206	0.064%
	A	0.12%	45%	0.21523	0.23711	5.0	0.0308780	0.0319	0.163%
	BBB+	0.28%	45%	0.20655	0.19406	5.0	0.0448456	0.0408	0.346%
	BBB	0.35%	45%	0.20296	0.18344	5.0	0.0492587	0.0612	0.647%
	BB	1.26%	45%	0.16613	0.12826	5.0	0.0771527	0.1975	2.171%
	BB-	1.61%	45%	0.15587	0.11882	5.0	0.0822757	0.1641	3.521%
	B+	2.75%	45%	0.13256	0.09946	5.0	0.0933470	0.1437	4.862%
	B	6.32%	45%	0.10731	0.07279	5.0	0.1182625	0.1229	6.316%
	B-	10.34%	45%	0.10290	0.05896	5.0	0.1421017	0.0920	7.623%
CCC	19.87%	45%	0.10223	0.04287	5.0	0.1747425	0.1173	9.673%	

Table 9. Corporate – Large firms (US)

This table shows the capital requirement for large corporate firms. In the first column, rating classes are listed. In the second and third column, probability of default (PD), assigned on the bond equivalent basis, and loss given default (LGD) are shown. In the fourth column, the correlation for each rating class is calculated using the formula: $R_{corp.} = \text{Correlation} = 0.12 * (1 - \text{EXP}(-50 * \text{PD})) / (1 - \text{EXP}(-50)) + 0.24 * (1 - (1 - \text{EXP}(-50 * \text{PD})) / (1 - \text{EXP}(-50)))$. In the fifth column, the maturity adjustment is calculated as: $(b)_{corp.} = \text{Maturity adjustment} = (0.11852 - 0.05478 * \text{LN}(\text{PD})^2)$. In the sixth column there is the effective maturity (M_{eff}). In the seventh column, the capital requirement linked to each rating class is calculated with the following formula: $K_{corp.} = \text{Capital requirement} = (\text{LGD} * N((1 - R)^{-0.5} * G(\text{PD}) + (R / (1 - R)^{0.5}) * G(0.999)) - \text{PD} * \text{LGD}) * (1 - 1.5 * b)^{-1 * (1 + (M - 2.5) * b)}$. In the eighth column the weights are assigned utilizing the percent of firms in each rating class. In the last column the product of the capital requirement (K_{sme}) and the weight is cumulated to obtain the total capital requirement.

Rating	PD	LGD	$R_{corp.}$	$(b)_{corp.}$	M_{eff}	$K_{corp.}$	Weight	Cum. Weighted $K_{corp.}$
AAA	0.03%	45%	0.23821	0.31683	5.0	0.0192569	0.0381	0.073%
AA	0.07%	45%	0.23587	0.26674	5.0	0.0270318	0.1356	0.440%
A	0.10%	45%	0.23415	0.24694	5.0	0.0315661	0.2410	1.201%
BBB	0.30%	45%	0.22328	0.19075	5.0	0.0510895	0.2644	2.552%
BB	1.00%	45%	0.19278	0.13749	5.0	0.0799553	0.1288	3.582%
B	6.00%	45%	0.12597	0.07433	5.0	0.1305268	0.1016	4.908%
CCC	20.00%	45%	0.12001	0.04272	5.0	0.1919380	0.0904	6.643%

3.3 Summary of results

In Table 10, we summarize the bank capital requirements that we believe are likely under Basel II for all three of our countries. The results are consistent with our expectations³¹. Capital requirements under the A-IRB approach, if all SMEs will be classified as retail, should be between 1 and 2 percentage points less than the requirement (6%) if the Standardized approach would be used. Many factors will play a role in assessing the exact savings, but the primary determinants will be the quality of the SME portfolio and of the models used to assign PDs and LGDs. Moreover, the difference compared to the current requirement (8%) is likely to be lower by about 3 percentage points or more. On the other hand, if *all* SMEs should be considered as corporate, the requirements will likely be higher than the current 8%. We believe that many banks will be obliged to choose a blended approach (considering some SMEs as retail and some as corporate). Based only on credit risk considerations, our breakeven analysis shows that, for all of our countries, banking organizations should classify as retail no less than the 20% of their SME portfolio in order to not increase their current capital requirement (8%) relating to SMEs. However, we believe that this percentage is likely to be higher if other kinds of risk, for example operational risk, were considered in the capital requirement calculation.

Looking at the entire set of results, we can conclude that concerns about an increase in capital requirements are not justified for the SME portfolio, especially if banks will have the chance to classify at least the 20% as retail. Moreover, our breakeven analysis (Table 11) shows that by implementing the *A-IRB* instead of the *Standardized* approach, at least 40% of SME portfolio should be considered as retail. For this to occur, banks must consider not only the exposure requirement (less than €1 million) to classify SMEs as retail, but they should also treat SMEs as “retail” in a pooling of assets.

³¹ Results for Italy, especially for SMEs considered as retail, are very close to those reported in a research made by Prometeia and the University of Bologna (see Bocchi and Lusignani (2004)). They applied the A-IRB on 75,000 Italian SMEs obtaining a capital requirement of 4.8% (SMEs retail) and 7.5% (SMEs corporate).

Table 10. Impact of Basel II on SMEs

This table shows the capital requirements for all of our countries when the A-IRB approach is applied. In each column, all of the countries are listed. For each row, the different possibilities in considering all SMEs as retail or as corporate are shown. In the last row, the requirements for the large corporate segment are presented.

	Italy	US	Australia
SMEs as retail	4.88%	4.65%	4.62%
SMEs as corporate	8.45%	8.61%	8.81%
Corporate - Large firms	n.a.	6.64%	7.83%

Table 11. Breakeven analysis for capital requirements of possible new approaches versus the current system

This table compares the different levels of capital requirements for each approach, considering the percentage of SMEs that the bank will want or will be able to classify as retail and as corporate. For all of our countries, in the first column, the A-IRB requirements are derived by using the results shown in Table 11 multiplied by the percentages of firms considered as retail and as corporate. In the second column, the capital requirement is calculated multiplying the 8% requirement by the percentage of SMEs considered as corporate plus the 6% requirement by the percentage of SMEs considered as retail. The current requirement is always 8%.

Percentage of SMEs classified as retail and as corporate	Capital Requirements								
	Italy			United States			Australia		
	A-IRB	Standardized	Current	A-IRB	Standardized	Current	A-IRB	Standardized	Current
0% SMEs as retail 100% SMEs as corporate	8.45%	8.00%	8.00%	8.61%	8.00%	8.00%	8.81%	8.00%	8.00%
10% SMEs as retail 90% SMEs as corporate	8.09%	7.80%	8.00%	8.21%	7.80%	8.00%	8.39%	7.80%	8.00%
20% SMEs as retail 80% SMEs as corporate	7.74%	7.60%	8.00%	7.82%	7.60%	8.00%	7.97%	7.60%	8.00%
30% SMEs as retail 70% SMEs as corporate	7.38%	7.40%	8.00%	7.42%	7.40%	8.00%	7.55%	7.40%	8.00%
40% SMEs as retail 60% SMEs as corporate	7.02%	7.20%	8.00%	7.03%	7.20%	8.00%	7.13%	7.20%	8.00%
50% SMEs as retail 50% SMEs as corporate	6.67%	7.00%	8.00%	6.63%	7.00%	8.00%	6.72%	7.00%	8.00%
60% SMEs as retail 40% SMEs as corporate	6.31%	6.80%	8.00%	6.23%	6.80%	8.00%	6.30%	6.80%	8.00%
70% SMEs as retail 30% SMEs as corporate	5.95%	6.60%	8.00%	5.84%	6.60%	8.00%	5.88%	6.60%	8.00%
80% SMEs as retail 20% SMEs as corporate	5.59%	6.40%	8.00%	5.44%	6.40%	8.00%	5.46%	6.40%	8.00%
90% SMEs as retail 10% SMEs as corporate	5.24%	6.20%	8.00%	5.05%	6.20%	8.00%	5.04%	6.20%	8.00%
100% SMEs as retail 0% SMEs as corporate	4.88%	6.00%	8.00%	4.65%	6.00%	8.00%	4.62%	6.00%	8.00%

This means that banks will be forced to update their systems and procedures to manage SMEs in a more efficient way. Automatic decision systems, such as scoring or rating models, commonly used only for private individuals, are needed to evaluate “hard information” about SMEs in a more profitable and efficient way³². Even if, in the short term, A-IRB adopting banks will likely face higher implementation costs, we believe that in the long run they will, in fact, maximize their returns by reducing transaction costs.

Many recent studies³³ find that smaller banks specialized in small business lending enjoy a competitive advantage, mainly due to their ability to reduce default risk through their “relationship lending”. We believe that with the new Basel Capital Accord, large, well-diversified banks, which will adopt the A-IRB approach, will have the opportunity to reap benefits in terms of either lower capital requirements or internal systems and procedures improvement. Following the right strategies in credit risk management and capital adequacy, large banking organizations are likely to reduce, or possibly eliminate, the current competitive gap with small, specialized banks in the so-called middle market, since smaller banks are more likely to use the higher capital requirements’ Standardized approach or to remain Basel I banks. Moreover, the expected excess of regulatory capital that would be created at A-IRB organizations as a result of reduced capital requirements can motivate an increase in the acquisition process toward non-adopting banking organizations³⁴. We also expect that the acquisitions of small US banks will accelerate since the assets of these institutions will be more valuable on the balance sheets of Basel II banks versus on Basel I banks.

For SMEs, we expect an increase in lending activity, especially by large banking organizations that will find this business more profitable. Concerns have been raised that costs of the A-IRB implementation will likely increase credit prices for small and medium sized enterprises. We suppose that this could be possible, at least at the beginning, but, thanks to the new techniques for credit risk discrimination

³² See Berger and Udell (2004) about the role of lending infrastructures for SMEs.

³³ See Kolari and Shin (2004) and Berger (2004).

³⁴ See Hannan and Pilloff (2004).

and to the most advanced risk-based pricing methods, good quality firms will likely enjoy benefits in terms of lower credit prices. The costs of transactions lending technologies will be recovered in a few years considering that the possible expansion of SME business will lead to better capital allocations.

Lastly, although we should be cautious with regard to the conclusions of this work, since this paper has not addressed some other elements of the new Basel Accord (e.g. the costs of operational risk), we conclude that the relationship between banks and SMEs will more than likely change in a positive way for both.

4. Conclusions

This paper has addressed the subject of the possible effects that the implementation of the new Basel Capital Accord will have on banks and SMEs. Surveying several other studies focusing on a similar theme and adding new methodologies, we compare and expand upon the received evidence and conclusions with several important findings.

First, credit risk models have been developed specifically for SMEs in order to specify one-year PDs for samples from three different countries in the most recent and relevant Basel II compliant way. For several of the other inputs needed in the new Basel formulas, realistic assumptions have been made. Our assumptions, while reasonable, have been further analyzed by applying a sensitivity analysis to the critical variables.

Second, the new Basel formulas, the ones contained in the last version of the Accord (June 2004), have been utilized to calculate the requirements. Indeed, for the first time, new formulas where expected losses (PDxLGD) are subtracted from the capital requirements have been tested.

Third, our findings confirm, to some extent, what has also been found in the other studies: i.e., that the part of SMEs classified as retail can enjoy significantly lower capital requirements than the part classified as corporate. However, our results also show that, if banking organizations should consider their entire SME portfolio as corporate and utilizing the A-IRB approach, they will likely face *higher* capital

requirements than under the Basel I Capital Accord. Banks may be inclined to treat SMEs as corporate, even for relatively small exposures, since there are additional organizational and technological requirements to treat them as retail customers. Now the trade-off between lower capital requirements and higher organizational costs will be clearer and better evaluated.

The results of our analysis show that, for all three of the countries, a minimum of 20% of small and medium sized enterprises must be classified as retail in order to maintain the SME capital requirement at least at the current level (8%). Then, we find that the percentage of SMEs to be considered as retail should be at least 40% if the banking organizations will want to enjoy a lower capital requirement under the Basel II Advanced IRB approach versus the Standardized approach. We acknowledge that banks, developing and implementing their own internal models, will likely find slightly different breakevens from the one proposed in this work. However, having developed and applied three models to estimate PDs, we have found a very similar distribution of SMEs for all of our countries amongst different rating classes. Indeed, we believe that the relationship between SMEs and credit risk can be considered, on average, as similar to the ones shown in this work and we expect the range of possible breakeven values to be distributed in close proximity in either side of our values (20% and 40%).

We conclude that one of the main results of the new Basel Capital Accord will be to motivate banks to update their internal systems and procedures in order to be able to manage SMEs on a pooled basis through the use of a scoring, rating or some other automatic decision system. Only in this way will A-IRB banking organizations receive major benefits in terms of lower capital requirements and more efficient and profitable management of the SME portfolio. We argue that especially large, well-diversified banks, which will be the first to implement the A-IRB approach, will reap the biggest benefits, probably reducing (as Berger, 2004, argues) or possibly even eliminating the current competitive advantage of small, specialized banking organizations based on their privileged “relationship lending” situation. This reduction or possibly even elimination of the competitive advantage will likely be the case in the US where smaller banks will almost surely not change from the

present Basel I structure. The exact result is difficult to estimate since it will mainly be a function of customers' reactions to pricing changes (if any).

Lastly, for SMEs, themselves, we point out that access to bank financing is likely to become easier and possibly cheaper, since large banks will find SME lending more profitable. Through the use of advanced credit risk management techniques an even more attractive capital allocation will be possible. We conclude that worries about an increase in the costs of SME finance, mainly due to Basel II implementation costs sustained by banks, can also be valid, but the use of the most advanced risk-based pricing techniques should result in higher prices primarily only toward lower quality firms and only during the initial years after incurring these costs.

Appendix A: Italian SMEs model development

Construction of the data sample

In order to estimate one year PDs for Italian SMEs, the necessary data for the statistical analysis has been provided by a large Italian bank. The original data set consisted of about 86,000 firm-year observations spanning the time period 2000 to 2003. These have been extracted from the loan portfolio of all customers (except private individuals) that had an exposure less than €1 million and sales less than €50 million. First, we excluded sole traders, 62,520 clients, since we did not have enough variables to develop a specific model for them. Then, due to missing data items, the final data set contained 20,193 small and medium sized firms.

To create the binomial dependent variable (default/no default), we observed the situation of each firm at the end of the next financial year. Following Basel II definition, only if the company was 90 or more days past due, was it considered as a default. The distribution of the companies in the data set is shown in Table A-1.

Table A-1. Final data set for Italian SMEs

In this table, the structure of the Italian sample used to develop the model is shown.

	Number	Percentage
Good firms	19,392	96.5%
Defaults	701	3.5%
Total	20,193	100%

Selection of candidate variables

In the next step, candidate variables for the final model have been selected. Using univariate analysis, about 40 accounting ratios have been analyzed and 20 of them selected as the most important and predictive. These have been chosen to be considered in the logistic regression to develop the final model (Table A-2).

Table A-2. List of selected variables

In this table, the variables used in the logistic regression to develop the final model are shown.

Bank Debt/(Total Assets-Bank Debt)	Financial Profits-Financial Charges/Debt
Debt/Equity	Cash Flow/Short Term Bank Debt
Added Value/Total Assets	Bank Debt/Current Assets-Current Liabilities
Cash/Total Assets	Equity/Bank Debt
Long Term Liabilities/Total Assets	Financial Charges/Debt
Tangible Assets/Total Assets	ROE
Account Payable/Total Assets	Financial Charges/Liabilities
Long Term Bank Debt/Bank Debt	Extra-Ordinary Profits/Ordinary Profit
Sales/Current Assets	Sales Growth
Ordinary Profits+Depreciation/Debt	Assets Growth

Finally, each of the selected ratios was studied from a credit risk point of view, testing its linearity and its behavior in predicting bankruptcy. All of them were consistent with our expectations and with the ones found in the literature (See Hayden, 2003, for a complete analysis of the most important accounting ratios and their expected behavior in predicting bankruptcy. See also Tamari , 1966, and Edmister , 1972).

The logit regression

Amongst statistical models, at least five main methods could be used to develop default prediction models (See Dimitras, Zanakis and Zopoundis, 1996, for a literature review about most of these methods):

- Linear or non-linear discriminant analysis
- Linear regression
- Logit and probit regression
- Neural networks
- Recursive partitioning analysis.

Considering the quality of the input variables and the opinions expressed by many studies (see Crouhy et al., 2001), a logit regression has been chosen.

Using a stepwise variable selection procedure, based on a likelihood-ratio test with the significance level set at 20%, eight variables were selected in the final model (Table A-3).

Table A-3. Variables entered in the final model

In this table, the variables entered in the final model are listed.

Debt/Equity
Bank Debt/(Total Assets-Bank Debt)
Long Term Liabilities/Total Assets
Economic Value Added/Total Assets
Cash/Total Assets
Tang. Assets/Total Assets
Accounts Payable/Total Assets
Long Term Bank Debt/Bank Debt

These variables can be grouped into three categories describing different aspects of firms' structure (Table A-4).

Table A-4. Categories of the variables

In this table, the variables entered in the final model are grouped on the basis of the Different aspect of the firms' structure that they describe.

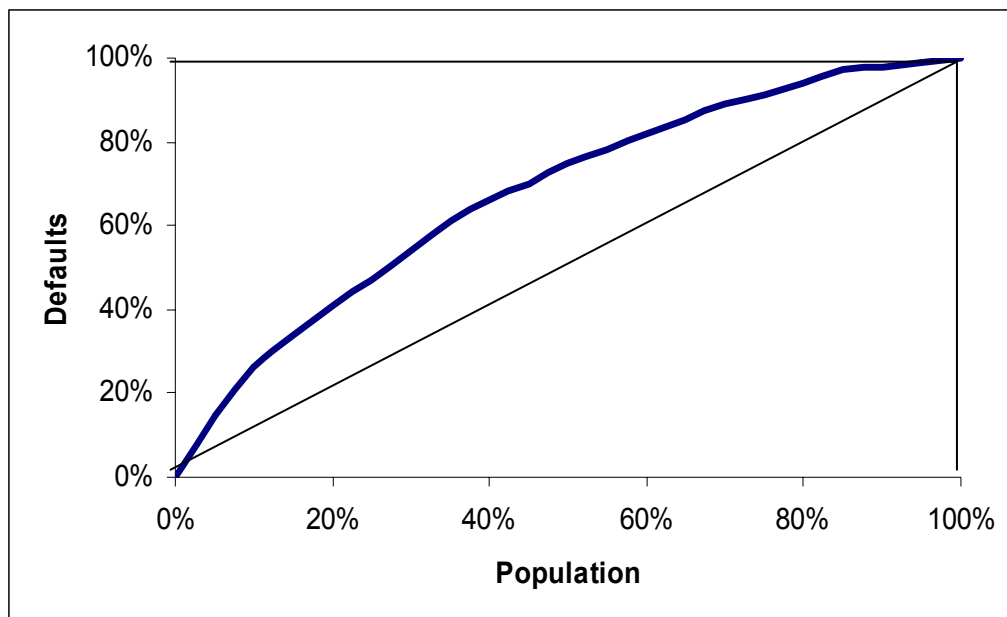
Debt/Equity Bank Debt/(Total Assets-Bank Debt) Long Term Liabilities/Total Assets	Leverage
Economic Value Added/Total Assets	Profitability
Cash/Total Assets Tang. Assets/Total Assets Accounts Payable/Total Assets Long Term Bank Debt/Bank Debt	Liquidity

Model performance

Figure A-1 shows the cumulative accuracy profile of the developed model. The curved line shows the performance of the model being evaluated in depicting the percentage of defaults captured by the model at different percentages of the data set, while the thin straight line below represents the naïve case of zero information or random assignment of default probabilities (See Kraft, Kroisandt and Muller, 2004, and Engelman, Hayen and Tasche, 2003, for further discussions about how to measure the performance of a model).

Figure A-1. Cumulative accuracy profile of the Italian model

In this figure, the cumulative accuracy profile of the Italian model is shown. The curved line shows the performance of the model being evaluated in depicting the percentage of defaults captured by the model at different percentages of the data set, while the thin straight line below represents the naïve case of zero information or random assignment of default probabilities.



Appendix B: US SMEs model development

Construction of the data sample

In order to estimate one-year PDs for US SMEs, the necessary data for the statistical analysis has been extracted from WRDS Compustat. The original data set consisted of about 69,000 firm-year observations spanning the time period 2000 to 2003, for firms with sales less than \$65 million. Missing data caused us to drop the majority of firms, but there were still 12,739 available observations. Then, to develop the model, we selected only the active and not defaulted companies at the beginning of 2001 and we used their financial data to predict which of them would have defaulted at the end of the year. The final sample had 3,048 not defaulted firms and 25 defaulted (Table B-1). To create the binomial dependent variable (default/no default), we observed the footnote field of Compustat, considering as default firms listed as “TL” or “AG”³⁵. Since the low number of defaults is due only to the bad quality of the data, a weight has been used in the regression to increase the power of their information.

Table B-1. Final data set for US SMEs

In this table, the structure of the US sample used to develop the model is shown.

	Number	Percentage
Good firms	3,048	99.2%
Defaults	25	0.8%
Total	3,073	100%

Selection of candidate variables

We considered the Altman Z''-Score (Altman, 1993) model (Table B-2), for manufacturing and non-manufacturing firms, and analyzed the variables within a logistic regression structure.

Table B-2. List of selected variables

In this table, the variables entered in the final model are listed.

Working Capital/Total Assets
Retained Earnings/Total Assets
EBIT/Total Assets
Book value Equity/Book Value of Total Liabilities

³⁵ “TL” footnote is used to indicate firms in bankruptcy, while “AG” means that the firm is in reorganization.

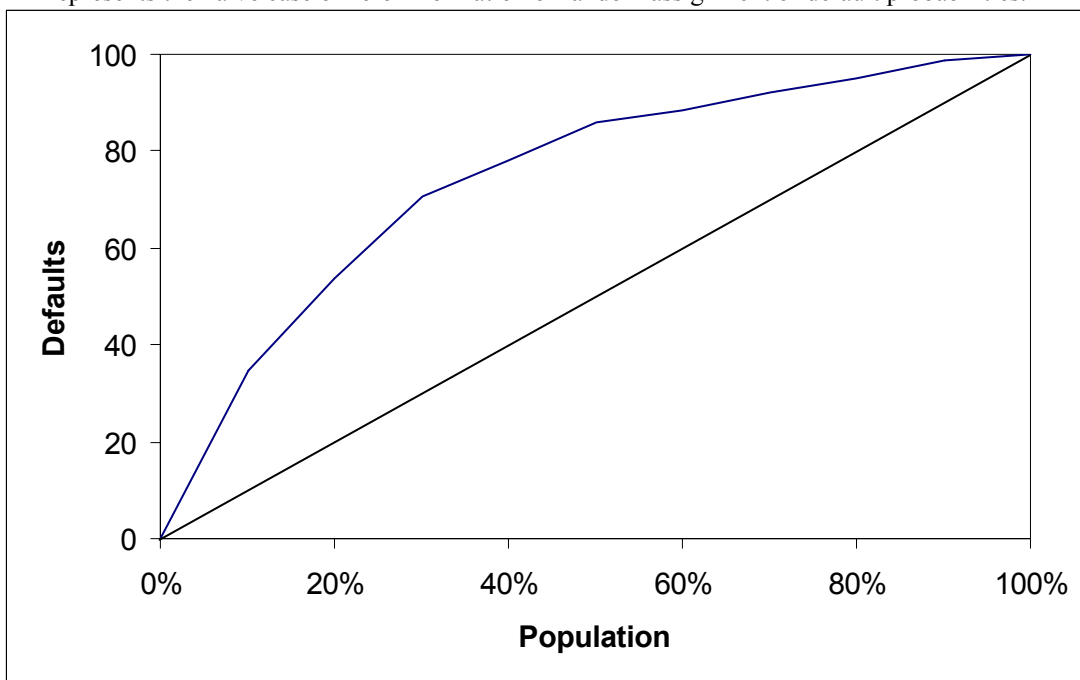
The logit regression - Model performance

Using a statistical stepwise variable selection procedure, based on a likelihood-ratio test with the significance level set at 20%, after five steps, all the variables were inserted in the model.

Figure B-1 shows the cumulative accuracy profile of the developed model. The curved line shows the performance of the model being evaluated in depicting the percentage of defaults captured by the model at different percentages of the data set, while the thin straight line below represents the naïve case of zero information or random assignment of default probabilities.

Figure B-1. Cumulative accuracy profile of the US model

In this figure, the cumulative accuracy profile of the US model is shown. The curved line shows the performance of the model being evaluated in depicting the percentage of defaults captured by the model at different percentages of the data set, while the thin straight line below represents the naïve case of zero information or random assignment of default probabilities.



Appendix C: Australian SMEs model

For the Australian case, we used the data provided by the *Corporate Scorecard Group*. The model applied to these SMEs was the *Corporate Scorecard Credit Rating (CSCR)* derived by the ZETA-Score model (Altman et al., 1977). The ZETA-Score model utilizes the following seven variables:

X_1 =EBIT/total assets

X_2 =stability of earnings

X_3 =EBIT/total interest payments

X_4 =retained earnings/total assets

X_5 =current ratio

X_6 =equity/total capital

X_7 =total assets.

This model is widely accepted in Australia, demonstrating a high degree of default/non-default accuracy.

Appendix D: Sensitivity analysis

In order to apply the new Basel formulas for the A-IRB approach, we had to provide four inputs: probability of default (PD), loss given default (LGD), exposure at default (EAD) and maturity (M). As discussed in the text, we developed and applied specific models to estimate PD. To further test our assumptions, a sensitivity analysis was performed to test the effect on our results of using different levels of LGD or M. For LGD, we always use the same value for the recovery rate for all the rating classes, even if PDs are different. The values of LGD that we test have a symmetric distance of 20 percentage points from the average value that we used in the paper (45%).

Table D-1. Results with LGD=25%

In this table, a value of 25% for LGD is used to derive bank capital requirements.

	Italy	US	Australia
SMEs as retail	2.71%	2.58%	2.56%
SMEs as corporate	4.70%	4.78%	4.90%
Corporate - Large firms	n.a.	3.69%	4.34%

Table D-2. Results with LGD=65%

In this table, a value of 65% for LGD is used to derive bank capital requirements.

	Italy	US	Australia
SMEs as retail	7.05%	6.71%	6.67%
SMEs as corporate	12.21%	12.43%	12.73%
Corporate - Large firms	n.a.	9.60%	11.30%

In Table D-1 and D-2, the significant importance of LGD in the new Basel formulas is shown. We observe that for low values of LGD, e.g. 25%, all company types (SME retail, SME corporate and large corporate) demonstrate significant reductions from the current Basel I requirement (8%) and from the use of a Standardized approach (6%-8%). But, for large LGDs (e.g. 65%), a higher percentage of SMEs (between 70% and 80%) will be required to be classified as retail in order to enjoy lower capital requirements by applying the A-IRB instead of the Standardized approach.

In Table D-3 and D-4, we show the results changing the value of the maturity (from 3 and 5 years to 1 and 3 years and 5 and 10 years). First, it is clear that the maturity has a little effect on the capital requirements and it does not affect at all the part of SMEs considered as retail. However, this analysis also points out that for longer maturities, banks should increase the part of SMEs classified as retail in order to maintain a lower level of capital requirements.

Table D-3. Results with maturity of 1 and 3 years

In this table, a one year maturity is used only for small firms (with sales less than €25 million), while a three years maturity is used for medium (sales between €25 and €50 million) and large firms (sales more than €50 million).

	Italy	US	Australia
SMEs as retail	4.88%	4.65%	4.61%
SMEs as corporate	8.20%	8.32%	8.52%
Corporate - Large firms	n.a.	6.12%	7.34%

Table D-4. Results with maturity of 5 and 10 years

In this table, a five years maturity is used only for small firms (with sales less than €25 million), while a ten years maturity is used for medium (sales between €25 and €50 million) and large firms (sales more than €50 million).

	Italy	US	Australia
SMEs as retail	4.88%	4.65%	4.61%
SMEs as corporate	8.80%	9.05%	9.34%
Corporate - Large firms	n.a.	8.49%	9.28%

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