Basel II: developing countries and portfolio diversification

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The proposed new Basel Capital Accord aims to better align regulatory capital with the risk that banks actually take on. This paper argues that current proposals will inappropriately and significantly increase the cost or reduce the quantity of bank lending to developing countries, as they will make the requirements for lending to them far more stringent. The failure of the Basel proposals to take account of the benefits of international diversification implies that risk is overestimated at the portfolio level. We show that, for a number of variables (such as bank profitability) and for a number of periods, the degree of correlation between developed economies is greater than that between developed and developing countries. We also show via simulations that a portfolio diversified across developed and developing economies has a lower level of risk than one focused only on developed ones. We therefore urge the Basel committee to explicitly incorporate the clear benefits of international diversification.

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I

Introduction

Our concerns about the potential impact of the proposed new Basel Capital Accord (Basel II) were first expressed following the release of the second Consultative Paper (CP2) in January 2001.[1] However, since that time a number of modifications have been made to the proposals that go some way to addressing these original concerns.

The last paper we prepared on the subject was published in the *Financial Regulator* in September 2002.[2] There we reiterated our doubts about the consequences the proposals might have for developing economies, assessed the likely impact of the modifications announced by that time, and highlighted remaining areas of concern. These were twofold.

The **first of these concerns** is that widespread adoption of the internal ratings-based (IRB) approach by internationally active banks would lead to a significant increase (decrease) in capital requirements for loans to lower (higher) rated borrowers. To the extent that the pricing and availability of international bank loans is influenced by the capital requirements that relate to them, this would imply a sharp increase in the cost or a reduction in the quantity of international lending to developing and emerging economies. Given the current very low levels of such lending, this raises the possibility of the current situation becoming "institutionalized", so that, even if global conditions improved, the potential of international bank lending to contribute towards the development of poorer countries would be significantly reduced.

It has long been argued that one of the major benefits of investing in developing and emerging economies is their relatively low correlation with "mature" markets. As we show below this is clearly the case and, consequently, clear benefits —at the portfolio level— would accrue to banks with well diversified international portfolios. That is, a bank with a loan portfolio that is distributed widely across a range of relatively uncorrelated markets is less likely to face simultaneous problems in all of those markets than a bank with loans concentrated in a smaller number of relatively correlated markets. Therefore, in order to accurately align regulatory capital with the actual risks a bank might face, the Accord should take account of this portfolio-level effect: the capital requirements for a bank with a well diversified international loan portfolio should reflect the fact that total risk is lower than it would be for a more concentrated portfolio. At present the proposals contain no such considerations, suggesting that, in this area at least, capital requirements may not accurately reflect actual risk.

The argument that asset correlation is variable is self-evident. Furthermore, the suggestion that this variability impacts upon the level of risk in an overall portfolio, and should therefore be reflected in capital requirements, would also seem to have force. Indeed, the Basel Committee on Banking Supervision has recognized this fact with the modifications it has already made in respect of lending to small and medium-sized enterprises (SMEs). Following the release of the original consultative document in January 2001, there was widespread concern that lending to SMEs would be adversely affected by a large increase in the capital requirements associated with such lending. After intensive lobbying the Committee reconsidered the issue, and agreed that the treatment of SMEs should be separated from other corporate lending, with borrowers with less than 50 million euros in annual turnover receiving an average reduction in capital requirements of about 10% relative to larger corporates. The rationale for this modification is that the chance of a large number of SMEs defaulting simultaneously is lower than for a smaller group of large borrowers. That is, the correlation between probability of default is lower. Consequently, a loan portfolio that is well diversified across a large number of SMEs will face lower overall risk at the portfolio level than one focused on a few larger borrowers.

The results of our empirical work suggest strongly that a similar modification is justified with respect to international diversification.

The **second aspect of concern** is that the use of market-sensitive measures of risk —as envisaged in the

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[1] See Griffith-Jones and Spratt (2001).

[2] See Griffith-Jones, Spratt and Segoviano (2002).

IRB approaches— is inherently procyclical. The fact that capital requirements will move in conjunction with the business cycle implies an amplification of that cycle as loans "migrate" between bands as circumstances improve or deteriorate. The natural tendency of market practitioners —including bankers— to underestimate risks in booms and overestimate risks in recessions will thus be formalized, and legitimized, in regulation. Thus, in an upturn, the perception of generally reduced risks would result in lower capital requirements, further strengthening this perception of lower risk, but perhaps resulting in a longer "boom" period and the build-up of greater levels of potentially systemic risk. Conversely, in a downturn or recession, higher capital requirements, as determined by the IRB approach, would reduce further incentives to lend, and —coupled with the difficulty of raising capital in a recession— create the possibility of a "credit crunch" wherein even potentially profitable business propositions were unable to attract funding. The danger is that a downturn is turned into a recession, or an existing recession lengthened or deepened.

These concerns about the potentially damaging impact of Basel II were viewed in the context of a more general analysis. This argued that the major problems facing developing countries in their attempts to access international finance for purposes of growth and development were: i) the current low level of all types of flows (particularly, but not exclusively, bank lending) and ii) the increasingly short-term and procyclical nature of these flows (Griffith-Jones, 2002). Given our view of this discouraging general environment, it remains of serious concern that the proposals for Basel II may exacerbate, rather than attempt to counter, these damaging trends.

This paper will present the results of empirical work that we have undertaken to address the first point detailed above. We suggested in our most recent paper on this subject that one reason why capital requirements under the new proposals could be inappropriately high for developing and emerging economies was that the benefits of international diversification were not taken into account. We suggested that, if it could be demonstrated that the correlation between developed/developed-country lending was higher than that between developed/developing, then a case could be made that an internationally diversified loan portfolio, with a range of developed- and developing-country borrowers, would have a lower level of risk –in terms of the overall portfolio– than one which focused primarily on developed-country lending. If this is, in fact, the case, then it would be possible —and certainly desirable— for the Basel Committee to incorporate the benefits of international diversification into the new Accord.

This argument is similar to that used to support the recent modifications (November 2001) that resulted in a flattening of the IRB curve with respect to corporate lending. In the original proposals of January 2001 it was implicitly assumed that the average asset correlation was 0.2. However, following empirical research initiated by the Committee, a modification to the IRB formula was proposed so that the correlation coefficient would decline from 0.2 to 0.1 as probability of default increased. In essence, the argument is that a higher probability of default for a corporate reduces correlation, as bankruptcy/default may be the result of any number of non-systemic factors that would not necessarily have any impact on the prospects for other corporates.

The argument that asset correlation is variable is self-evident. Furthermore, the suggestion that this variability impacts upon the level of risk in an overall portfolio, and should therefore be reflected in capital requirements, would also seem to have force. Consequently, we have followed this approach in our own empirical work, which, as we shall detail below, provides strong support for a similar modification of the IRB formula with respect to internationally diversified lending.

It has long been argued that one of the major benefits of investing in developing and emerging economies is their relatively low correlation with mature markets. Therefore our first hypothesis can be stated as follows:

Hypothesis 1: The degree of correlation between the real and financial sectors of developed economies is greater than that which exists between developed and developing economies.

We have tested this hypothesis of differential correlations, first with specific regard to international bank lending and profitability and, second, in a more general but supportive sense. All of our results offer significant support for the validity of this position. This has provided the basis for a second hypothesis, which relates specifically to the ongoing work of the Basel Committee.

Hypothesis 2: An international loan portfolio which is diversified across the developed, emerging and developing regions enjoys a more efficient risk/return trade-off —and therefore lower overall portfolio-level

risk as measured by unexpected losses— than one focused exclusively on developed markets.

In order to test this hypothesis we have simulated levels of unexpected loss for two portfolios, one of loans that are evenly distributed across developed and developing regions, the second of loans that are distributed across only the developed regions. The results of these simulations provide convincing support for the second of our hypotheses, suggesting that the level of unexpected loss that a portfolio focused on purely developed-country borrowers would face in an extreme event would be about 25% higher than a portfolio diversified across developed and developing countries.

The fact that the tests we have performed, using a variety of variables, over a range of time periods, all provide strong evidence in support of our diversification hypothesis, seems to us compelling. This evidence is further strengthened by the results of our simulations of loan portfolios, which, by employing a similar methodology to that used by the most sophisticated banks, demonstrate the beneficial impacts of international diversification, as they would be viewed by the major banks. Taken together, this evidence suggests that, so as not to unfairly penalize emerging and developing economies, the Basel Committee should closely examine the practicalities of incorporating the benefits of international diversification into the forthcoming final consultative paper. It is hoped that the evidence presented below will demonstrate the validity of this view.

This paper consists of five sections. After the present introduction (section I), section II details the sources of data and methodology used, section III presents the results of the econometric work, section IV presents a simulation of two loan portfolios, and section V explores the implications of our results and concludes. Technical details on the statistical and simulation work are contained in appendices A and B.

II

Data and sources

The countries analysed are as follows:

— *Developing countries:* Argentina, Brazil, Chile, Ecuador, Mexico, Panama, Peru and Venezuela; Indonesia, Malaysia, Philippines, the Republic of Korea and Thailand; Bulgaria, Poland and Russia; Nigeria and South Africa.

— *Developed countries:* Canada and the United States; Japan; France, Germany, Italy, Spain and the United Kingdom.

— *Others:* Singapore; Finland, Greece, Ireland and Portugal.

The variables analysed are shown in table 1.

III

Results

All the statistical significance tests we have undertaken provide strong support for our first hypothesis. Crucially for the validity of our results, cumulative distribution function (CDF) tests were undertaken in each instance. The purpose of the tests was to establish, for any given level of correlation, the probabilities that the developed/developing series would have a lower level of correlation than the developed/developed series. The results of two of these tests are shown in figures 1 and 2 as an illustration of the fact that, in every instance, the developed/developed correlation dominates that of the developed/developing correlation (the remaining results are contained in appendix A).

That is, for any level of correlation x, the probability that the actual correlation between developed/developing indicators is lower than x is higher than the probability that the correlation between developed/developed indicators is lower than x.

The results in table 2 offer further support for the first of our hypotheses, in both a general and a specific

TABLE 1

Grouping, description and other characteristics of the variables analysed, selected periods

Grouping	Code	Description	Period	Frequency	Source
Financial sector	ROA	Return on assets (banks)	1988-2001	Annual	*The Banker*
Financial sector	ROC	Return on tier one capital (banks)	1988-2001	Annual	*The Banker*
Financial sector	Syndicated	Syndicated loan spreads	1993-2002	Monthly	Bank for International Settlements (BIS)
Bonds	GBI[a]	Global Bond Index	1987-2002	Daily	JP Morgan/Reuters
Bonds	EMBI[b]	Emerging Market Bond Index	1987-2002	Daily	JP Morgan/Reuters
Bonds	EMBI+[c]	Emerging Market Bond Index Plus.	1987-2002	Daily	JP Morgan/Reuters
Stocks	IFC G[d]	Standard & Poor and International Finance Corporation (IFC) (global)	1990-2002	Daily	IFC/S&P
Stocks	IFC I[e]	S&P and IFC (investable)	1990-2002	Daily	IFC/S&P
Stocks	COMP	Developed countries listed above: composite stock indexes	1990-2002	Daily	Reuters
Macro	GDP	GDP growth rate	1985-2000	Six-monthly	IMF, World Bank (authors' calculations)
Macro	GDP HP	Hodrick-Prescott decomposition of GDP	1950-1998	Annual	National data (authors' calculations)
Macro	STIR	Short-term nominal interest rate	1985-2000	Six-monthly	National data (BIS) or IMF, IFC
Macro	STIRR	Short-term real interest rate	1985-2000	Six-monthly	National data (BIS) or IMF, IFC

Source: Prepared by the authors.

[a] The GBI consists of regularly traded, fixed-rate domestic government bonds. The countries covered have liquid government debt markets which are freely accessible to foreign investors. GBI excludes: floating-rate notes, perps, bonds with less than one year maturity, bonds targeted at the domestic market for tax reasons and bonds with callable, puttable or convertible features.

[b] Included in the EMBI, which is prepared by J.P. Morgan, are dollar-denominated Brady bonds, Eurobonds, traded loans and local debt market instruments issued by sovereign and quasi-sovereign entities.

[c] EMBI+ is an extension of the EMBI. The index tracks all of the external currency-denominated debt markets of the emerging markets.

[d] IFC G (Global) is an emerging equity market index produced jointly by the International Finance Corporation (IFC) and Standard & Poor (S&P). The index does not take into account restrictions on foreign ownership that limit the accessibility of certain markets and individual stocks.

[e] IFC I (Investable) is adjusted to reflect restrictions on foreign investments in emerging markets. Consequently, it presents a more accurate picture of the actual universe available to investors.

sense. The specific results, for the financial sector, are presented first, followed by those for other, more general economic and financial variables.

As can be seen from table 2, all the results were tested to ensure statistical significance. In all cases, the results were significant at the 99.5% confidence level and the null hypothesis that the average mean correlations of the two series were equal (H_0: Mx = My) was clearly rejected.

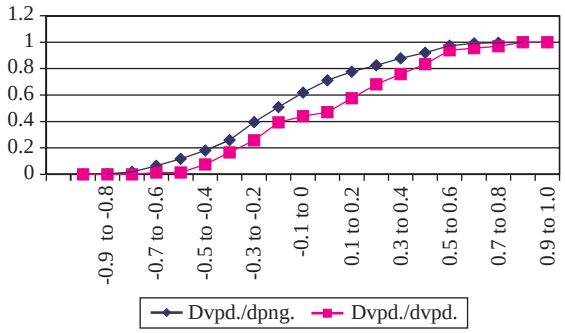
1. Discussion

As is clear from table 1, a wide variety of financial, market and macro variables have been employed in our tests. Whilst it might be suggested that each of the variables we have used could be criticized as imperfect in some way, we would argue strongly that distortions in the data are likely to be cancelled out, as they are unlikely to be the result of common causes. Consequently, the fact that every statistical test that we have performed, regardless of variable, time period or frequency, has pointed in the same direction, and all are clearly statistically significant on a variety of tests, offers robust and unequivocal support for our first hypothesis.

In the case of spreads on syndicated bank loans, and adopting the reasonable assumption that they are indicative of the risk associated with the loans —and therefore a proxy for probability of default— it is clear

FIGURE 1

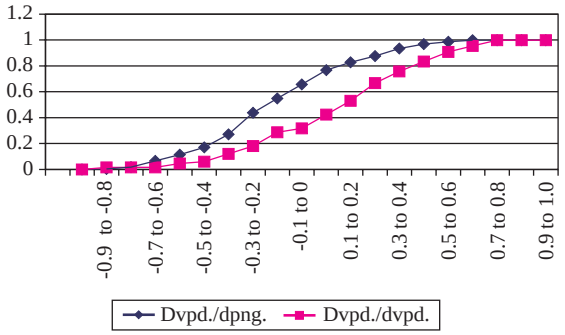
First-order stochastic dominance tests for correlations on banks' return on assets (1988-2001)



Source: Analysis conducted for this study.

FIGURE 2

First-order stochastic dominance tests for correlations on banks' return on capital (1988-2001)



Source: Analysis conducted for this study.

TABLE 2

Mean correlation coefficient

Variable	Period	Frequency	Developed/ developed mean correlation coefficient	Developed/ developing mean correlation coefficient	Test statistic (H_0: Mx = My)[a]
Syndicated	1993-2002	Monthly	0.37	0.14	3.33 (3.29)
ROA	1988-2001	Annual	0.10	-0.08	4.40 (3.29)
ROC	1988-2001	Annual	0.14	-0.11	6.92 (3.29)
GDP	1985-2000	Six-monthly	0.44	0.02	9.08 (3.29)
GDP HP	1950-1998	Annual	0.35	0.02	9.41 (3.29)
STIR	1985-2000	Six-monthly	0.72	0.23	11.09 (3.29)
STIRR	1985-2000	Six-monthly	0.66	0.22	10.93 (3.29)
GBI-EMBI	1991-2002	Daily	0.78	0.53	5.45 (3.29)
GBI-EMBI	1991-1997	Daily	0.90	0.74	4.64 (3.29)
GBI-EMBI	1998-2002	Daily	0.42	0.09	5.87 (3.29)
IFC I-COMP	1990-2000	Daily	0.58	-0.15	7.83 (3.29)
IFC G-COMP	1990-2000	Daily	0.58	-0.17	8.06 (3.29)

Source: Analysis conducted for this study.

[a] Critical value of 0.05% one-tailed test.

that risks, as measured in this way, have had a greater tendency to rise and fall together *within* the developed regions than has been the case for the developed and developing regions. Consequently, this first result would appear to offer support to our hypothesis. That is, over the sample period of 1993 to 2002 a bank with a loan portfolio that was well diversified across the major developed and developing regions would have enjoyed diversification benefits at the portfolio level: the correlation between the risks associated with loans to each of these regions would have been lower than was the case for a bank with a loan portfolio which focused only on developed markets.

Similarly, the fact that the profitability of banks in developed markets has a slight negative correlation with that of banks in developing markets, whilst the profitability of banks within developed markets has a slight positive correlation, provides further support for our hypothesis of the benefits of diversification. Although there may be many factors affecting the level of profitability of a country's domestic banking system, it seems reasonable to assume that one of the more significant factors would be the incidence of non-performing loans in the domestic economy. More generally, the health and consequent profitability of the country's domestic economy must plausibly impact

strongly upon the profitability of its banking sector. Thus, over the sample period, a bank lending to both banks and corporates across a wide range of developed and developing countries would have obtained diversification benefits, at the portfolio level, relative to a bank with a loan portfolio concentrated solely on developed markets.

The results from the macro variables, whilst more general, give some indication of the extent to which developed economies have tended to move in step with each other to a far greater extent than have developed and developing economies. If we plausibly assume that the incidence of non-performing loans (NPLs) in an economy is, at least partially, inversely related to the rate of gross domestic product (GDP) growth, then banks with an internationally diversified portfolio would be less likely to experience sharp increases in the incidence of NPLs in these markets simultaneously. Conversely, a bank that focused entirely on the (more highly correlated) mature markets would have a greater chance of experiencing such an outcome. Similar implications arise if we take movements in short-term interest rates as a proxy for the business cycle (rising rates indicating the close of an upturn and vice versa), and these results provide further evidence in support of our argument. As with GDP growth, the fact that business cycles —and therefore movements in short-term interest rates— are more correlated between developed countries than between developed and developing countries suggests that the incidence of NPLs and defaults is likely to be more correlated in the former than the latter.

For many market practitioners, movements in government bond prices and yields are seen as a strong indicator of both economic fundamentals and market views on the economic prospects of each country. The fact that developed-country bond prices move in step to a far greater extent than do developed- and developing-country prices suggests a closer correlation between both economic fundamentals in developed countries *and* market sentiment towards them. The evidence of lower correlation between developed and developing stock markets also supports this view. To the extent that a country's stock market reflects economic fundamentals and investor sentiment towards the country, a lower correlation between developed and developing countries provides further evidence in support of our first hypothesis.

The evidence presented above clearly supports our hypothesis that a bank whose loan portfolio is diversified internationally between developed and developing countries will have lower overall portfolio risk than one which focuses exclusively on lending to developed countries. In order to test this hypothesis in the specific context of a bank's loan portfolio, a simulation exercise has been undertaken to assess the potential unexpected loss resulting from a portfolio diversified within developed countries, and one diversified across developed and developing regions.

IV

Simulated loan portfolios

The testing of our second hypothesis involves the construction of two simulated loan portfolios, which enables us to assess the probable level of unexpected loss in each portfolio. Thus we can directly compare the simulated behaviour of a portfolio diversified across developed and developing regions with one focused solely on developed markets.

The basic context for our approach and the results obtained are detailed below. Appendix B contains more information, as well as technical details of the construction of the simulated portfolios.

1. Context

The fact that the quality of the credit portfolio of any bank can change at any time in the future means that there is a need to make frequent calculations of the losses that a bank could suffer, under a variety of situations. Given the constant changes in portfolio quality, it is unlikely that the computed preventive reserves will be the same for different periods. The difference between preventive reserves computed at different periods (due to changing credit quality) is the cause of the potential losses to the bank—those that could erode its capital in extreme situations. These

losses are called "unexpected losses". Our second hypothesis, in effect, states that the levels of unexpected loss for a portfolio that is diversified across developed and developing markets will be lower than that for a portfolio that focuses exclusively on developed markets. This hypothesis is supported, in principle, by the results of our statistical work above, which demonstrated that there was a lower level of correlation between developed and developing markets than among developed markets only.

2. Simulation

The approach we employ represents a modification of the well known CreditMetrics approach, which has been widely used to simulate unexpected losses in portfolios. Following a similar approach, two simulated portfolios were constructed: one with an even distribution of loans across the major developed and developing regions, the other with the loan portfolio evenly distributed across the developed regions. We then programmed an algorithm that simulated 10,000 different "quality scenarios" that might impact on these portfolios, and so produce migration of loans between credit quality bands.[3] Each quality scenario shows a change in the market value of the assets of the creditors in the portfolio, and therefore the difference between the initial and final credit quality can be assessed. Once the credit portfolio quality scenarios have been simulated, it is possible to compute the losses or gains that come from the difference between initial and final credit quality.

The losses or gains obtained from the simulation process are used to build a histogram, which summarizes the loss distribution of the credit portfolio. From this distribution a "value at risk" (VaR) is defined from which we obtain the amount of unexpected losses from the portfolio.[4] The unexpected losses divided by the total amount of the portfolio represent the percentage that, with a given probability (defined by the chosen percentile), could be lost in an extreme event.

3. Results

The results obtained from our simulations (table 3) offer strong support for our second hypothesis. As the table shows, the unexpected losses simulated for the portfolio focused on developed-country borrowers are, on average, almost 23% higher than for the portfolio diversified across developed and developing countries.

4. Discussion

The simulated loan portfolios constructed offer clear evidence that international diversification produces a more efficient risk/return trade-off for banks at the portfolio level. Given that capital requirements are intended to deal with unexpected loss, the fact that the level of unexpected loss in our simulation is lower for

TABLE 3

Comparison of non-industrially diversified portfolios
(Weights and percentages)

Portfolio diversified between developed and developing countries Total exposure = 117 625 333.00			Portfolio diversified among developed countries Total exposure = 117 625 333.00			
Percentile	Loss value	Unexpected loss	Percentile	Loss value	Unexpected loss	Percentage difference
99.8	22 595 312	19.21	99.8	27 869 349	23.69	+23.34
99.9	26 390 246	22.44	99.9	32 187 075	27.36	+21.96

Source: Analysis conducted for this study.

[3] Developing regions include Africa and the Middle East, Asia and the Pacific, developing Europe and Latin America. Developed regions include European Union countries outside economic and monetary union, those within it, other industrialized countries and offshore centres.

[4] There are, of course, many problems with and criticisms of the VaR approach to risk management. See Zigrand and Danielsson (2001) and Persaud (2001), for example. However, it is beyond the scope of this paper to assess these issues. For the purposes of this research, our simulation is designed to demonstrate –in broad terms– the relative difference in unexpected losses that would be likely to occur in each portfolio, in a similar fashion to that currently practised by many major, internationally active banks.

TABLE 4

Comparison of two simulated industrially diversified portfolios
(Weights and percentages)

Portfolio diversified between developed and developing countries Total exposure = 117 625 333.00			Portfolio diversified among developed countries Total exposure = 117 625 333.00			
Percentile	Loss value	Unexpected loss	Percentile	Loss value	Unexpected loss	Percentage difference
99.8	15 111 321	12.85	99.8	17 665 318	15.02	16.90
99.9	15 358 788	13.06	99.9	17 960 850	15.27	16.94

Source: Analysis conducted for this study.

a diversified than for an undiversified portfolio suggests that, in order to accurately reflect the actual risks that banks may face, Basel II should take account of this effect.

It is, of course, always possible to question the assumptions which underpin any simulation. We have attempted to ensure that our assumptions are as reasonable as possible. One aspect that we considered in detail was that the decision to assume no industrial diversification within countries might prevent the benefits of such diversification in developed countries –which generally have a greater range of industries than do developing countries– from being taken into account. We concluded, however, that the potential benefits of such diversification may have traditionally been overstated. This position is supported by recent empirical work produced by the Basel Committee on Banking Supervision (Acharya, Hasan and Saunders, 2002). Using data from 105 Italian banks over the period 1993-1999, these authors test empirically for evidence in support of the theoretical benefits of industrial, sectoral and geographical diversification. The results, although somewhat surprising, would seem to offer support for both the assumptions that underpin the loan portfolio simulation (i.e., no industrial diversification) and, crucially, the general findings of our empirical work.

From the combined results on bank loan return and risk, we conclude that increased industrial loan diversification results in an inefficient risk-return trade-off for the (Italian) banks in our sample, and sectoral diversification results in an inefficient risk-return trade-off for banks with relatively high levels of risk. Geographical diversification on the other hand does result in an improvement in the risk-return trade-off for banks with low or moderate levels of risk (Acharya, Hasan and Saunders, 2002, p. 5).

However, in order to be certain that the simulation results had not been biased by this assumption, a second series of simulations was undertaken. In this instance, both geographical and industrial diversification was assumed. As can be seen in table 4, this modification —which brings the simulation closer to real practice— has the effect of halving the level of unexpected loss in the portfolios; thus they are now closer to the 8% figure which is often encountered in the real world, and which forms the basis of the Basel Committee's stated capital requirements for the system as a whole.

The difference between the simulated unexpected losses in the two portfolios has also been reduced by this modification, although less so. At almost 17%, on average, the difference remains highly significant, and so offers further evidence of the robustness of our results.

Another issue that we have given consideration to is the fact that correlations are not constant over time. The danger, of course, is that correlations among emerging markets increase dramatically in crises, as contagion spreads the crisis from one country or region to another. In this instance, it is possible that a portfolio diversified across a range of emerging and developing regions might be hit simultaneously in each of them. However, while this may well be the common perception of emerging market behaviour in crises, it may only apply to a limited number of cases, which require specific preconditions to be in place; preconditions which at the current time —and indeed at most times— do not apply. Kaminsky, Reinhart and Vegh (2002) examine 200 years of financial crises, in both developed and developing countries, for evidence of contagion. They conclude that "fast and furious" contagion of the type described above may occur, but only under certain circumstances. Of the major

emerging market crises since 1980, the Mexican default of 1982, the Mexican devaluation of 1994, the devaluation of the Thai baht in 1997 and the Russian default of 1998 were all seen as instances where significant contagion did occur. However, with the exception of the Russian default, which affected all emerging and developing regions, as well as the developed world to a surprising extent (Davis, 1999), the resultant contagion was restricted to the same region. Consequently, a portfolio diversified across *all* emerging and developing regions would not have suffered simultaneous problems to the extent described above. On the other hand, more recent events, such as the Brazilian devaluation of 1999, Turkey's devaluation in early 2001 and the problems starting in Argentina towards the end of 2001, have been associated with far less contagion, and have not become an emerging market-wide phenomenon.

Kaminsky, Reinhart and Vegh (2002) suggest that for a crisis to spread beyond regional boundaries, an investment boom, or bubble, has to precede it. In this way, actors beyond the region become involved in events there, and so the crisis may spread —via common creditors to some extent— to other emerging, and even developing regions. The current environment is certainly not one of boom with regard to capital flows to emerging and developing economies. Furthermore, it seems unlikely that such circumstances will reoccur in the foreseeable future, which means that the preconditions required for system-wide contagion are not in place and the benefits of widespread diversification will remain a reality.

Kaminsky and Reinhart (2002) also emphasize this point. Their research suggests that financial turmoil in the "periphery" (developing countries) only has systemic implications, such as contagion beyond the immediate region, when asset markets in one of the major financial centres (developed world) are affected. "Thus," as these authors put it, "financial centers serve a key role in propagating financial turmoil. When financial centers remain safe, problems in an emerging market stop at the region's border" (*ibid*., p. 3).

V

Conclusions

The expressed purpose of the proposed new Basel Capital Accord is to better align regulatory capital with actual risk. This process, it is argued, will put bank lending on a sounder regulatory footing and remove the many distortions that have come to be recognized in the existing Accord. We have argued that the current proposals run the risk of causing an increase in cost and/or reduction in quantity of bank lending to developing countries, as a consequence of the sharp increase in capital requirements for lending to lower-rated borrowers. The response to this argument is that any changes in capital requirements are justified on the basis that, whilst the capital associated with lower-(higher-) rated borrowers is to rise (fall) significantly, relative to the existing situation, this merely reflects the more accurate measurement of risk.

However, as we have demonstrated in this paper, the failure of the proposals to date to take account of the benefits of international diversification suggests that, in this instance at least, risk is not being accurately measured. That is, by excluding the possibility that banks' capital requirements should take account of portfolio and diversification effects, the proposals effectively impose an inaccurate measure of actual risk, at the portfolio level. At present, the most sophisticated banks often *do* take account of the benefits of diversification in their international lending decisions. The fact that the proposals under Basel II will not allow these diversification benefits to be taken into account suggests that the regulatory capital associated with lending to developing countries will be higher than that which banks would —and currently do— choose to put aside on the basis of their own models.

The Basel Committee has already made a number of modifications to the original proposals of January 2001 (CP2), the most significant being the modifications to the IRB formula to take account of variable asset correlation as related to default, and those relating to SMEs. Following the release of CP2 there was widespread concern that lending to SMEs would be adversely affected by a large increase in the capital requirements associated with such lending. After intensive lobbying, the Basel Committee has reconsidered the issue. The general changes to the IRB

formula with respect to corporate lending, whereby the curve has been significantly flattened, will obviously be of benefit to SMEs. However, the Basel Committee has gone further. In July 2002 it released a document that highlighted major areas where agreement had been reached. This included the following in relation to the treatment of SMEs:

> *In recognition of the different risks associated with SME borrowers, under the IRB approach for corporate credits, banks will be permitted to separately distinguish loans to SME borrowers (defined as those with less than Euro 50 mn in annual sales) from those to larger firms. Under the proposed treatment, exposures to SMEs will be able to receive a lower capital requirement than exposures to larger firms. The reduction in the required amount of capital will be as high as twenty percent, depending on the size of the borrower, and should result in an average reduction of approximately ten percent across the entire set of SME borrowers in the IRB framework for corporate loans (Basel Committee on Banking Supervision, 2002).*

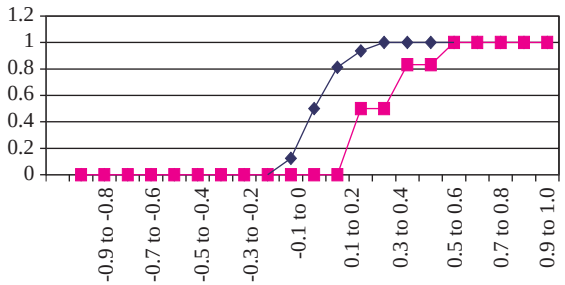
Thus, in the case of SME lending, the Basel Committee has recognized the impact that differential asset correlation can have on portfolio-level risk. Our results strongly suggest that a similar modification is justified with respect to internationally diversified lending.

The specific manner in which the Basel Committee might want to incorporate these findings is, of course, best left to them. Given the experience and expertise at their disposal we would not at this stage want to offer suggestions as to the means by which these modifications might be made. However, given the changes already made to the IRB formula with respect to SMEs, as well as the fact that the changes we propose would seem to have at least as solid an empirical basis, there are no theoretical, empirical or practical reasons why changes should not be made to incorporate the benefits of international diversification.

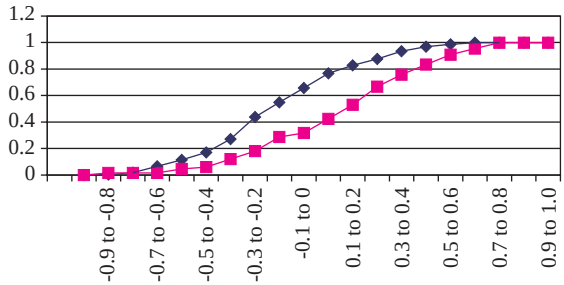
APPENDIX A

Cumulative distribution function tests[a]

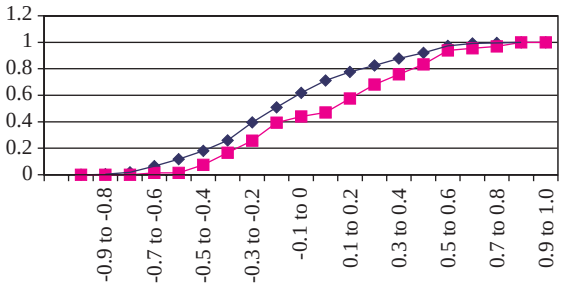
A.1. First-order stochastic dominance tests for correlations on syndicated loan spreads (1993-2002)



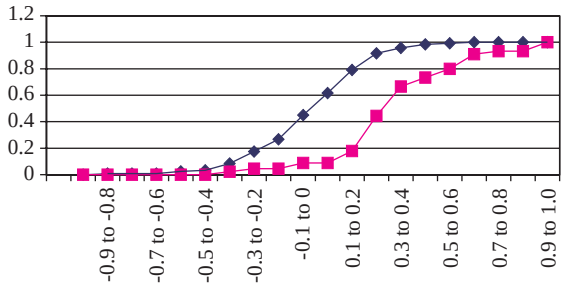
A.2. First-order stochastic dominance tests for correlations on banks' return on capital (1988-2001)



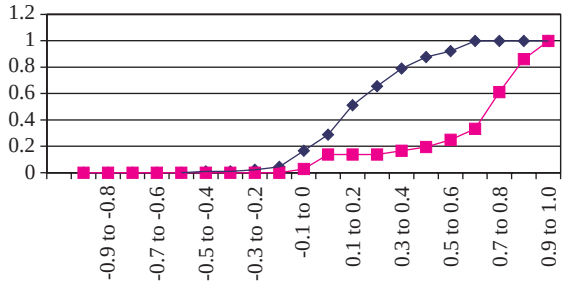
A.3. First-order stochastic dominance tests for correlations on banks' return on assets (1988-2001)



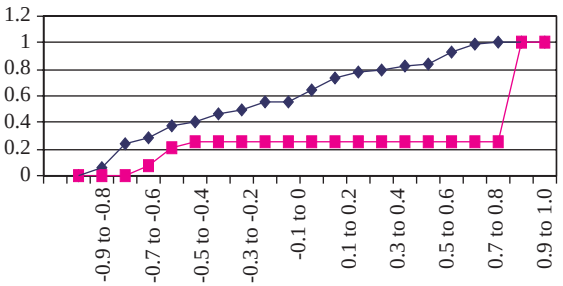
A.4. First-order stochastic dominance tests for correlations on GDP growth (1985-2000)



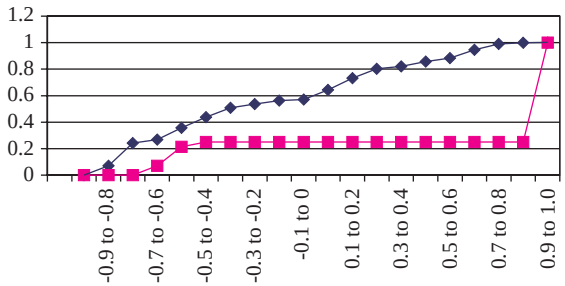
A.5. First-order stochastic dominance tests
for correlations on real short-term interest rates
(1985-2000)



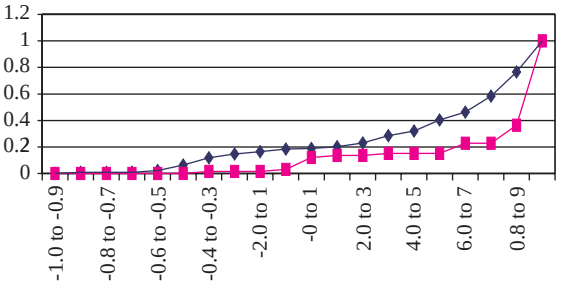
A.6. First-order stochastic dominance tests
for correlations on stock exchange movements
(IFC I-COMP: 1990-2002)



A.7. First-order stochastic dominance tests
for correlations on stock exchange movements
(IFC G-COMP: 1990-2002)



A.8. First-order stochastic dominance tests
for correlations on bond market movements
(GBI-EMBI+: 1991-2002)



Source: Analysis conducted for this study.

APPENDIX B

Computation of unexpected losses

Considering that the quality of the credit portfolio of any bank can change at any time in the future, there is a need to make frequent calculations of the expected losses that this portfolio could suffer under different risk situations. Given these constant changes in portfolio quality, it is unlikely that the computed expected losses will be the same for different periods. The difference between expected losses computed at different periods (due to changing credit quality) is the cause of potential losses to banks that could erode their capital in extreme situations. These losses are called "unexpected losses" and their estimation is the issue to be addressed in this appendix.

Unexpected losses arise because of joint credit quality changes among the credits that conform a portfolio. In order to model such quality changes, we adopted a portfolio approach.

This method[5] has been amply documented and adopted in diverse finance applications. Under this theory, investors formulate their investment portfolio, carefully considering the optimal risk-return relationship that a given portfolio has. With this in mind, credit risk modellers have already developed risk evaluation techniques that aim to take account of the portfolio diversification effect. Although such approaches might be subject to improvements, we do believe that portfolio diversification could and should be an integral part of credit risk valuation for regulation purposes.[6] As we have argued in the main body of the paper and in previous work, we believe that negative economic outcomes will be provoked by the fact that the proposed regulation framework only punishes high risk-taking and does not provide incentives for portfolio diversification.

In this appendix we present a modification to the CreditMetrics methodology that has been used to simulate unexpected credit losses in the portfolios analysed.[7] J.P. Morgan (1997) describes the CreditMetrics model as "a full portfolio view addressing credit event correlations which identify the costs of over concentration and benefits of diversification". The objective of this appendix is to present the modifications that were made to the CreditMetrics approach in order to make possible its implementation.[8] Hereinafter we shall refer to the modified version of the CreditMetrics methodology, which we have termed the Full Credit Risk Model (FCRM).

[5] See Markowitz (1959).
[6] It is not our intention at this point to analyse the possible improvements to each methodology.
[7] The choice of this model was dictated by considerations of modelling simplicity and the availability of data. It is not our intention to favour any specific credit risk modelling technique.
[8] See J.P. Morgan (1997) for a detailed exposition.

The Full Credit Risk Model

Empirical studies showing credit defaults to be correlated have been widely presented. Here we present evidence that credit risk can also be diversified. In order to calculate portfolio diversification, it would be necessary to know the probability that each of the credits making up a portfolio migrate jointly from their current rating (credit quality) to each of the possible ratings. For this, we would need to have a number of tables of joint probabilities equivalent to the number of pairs of credits making up a portfolio. This objective is unattainable given the lack of reliable data, the amount required, and the complexity of it.

The CreditMetrics approach makes use of two main elements: the Merton approach for modelling credit quality changes, and an indirect approach for modelling correlations among the credits that make up a credit portfolio.

Finally, once a correlations matrix among the creditors making up the credit portfolio is built, this methodology simulates the unexpected losses for the portfolio.

a) The Merton approach for modelling credit quality changes

The Merton approach assumes that equity can be viewed as a call option on the firm's assets with a strike price equal to the book value of the firm's debts (Merton, 1974). The intuition behind this assumption is that given the limited liability feature of equity, equity holders have the right but not the obligation to pay off debt holders and take over the remaining assets of the firm. This approach implies that the credit quality (rating) of a given creditor is related to the difference between the market value of its assets and its debt.

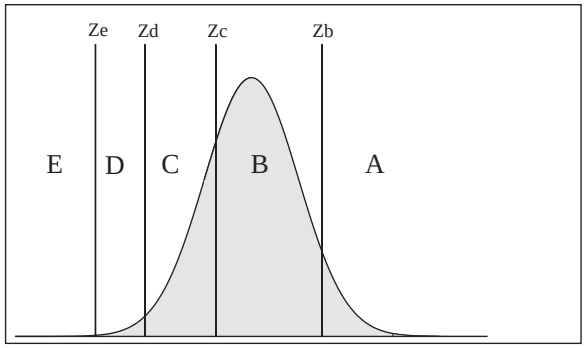
With this approach, the change in the value of the assets of a given company is related to the change in its rating. Therefore, the distribution of the company's asset returns can be used to calculate the distribution of probabilities of change in its rating. For the generalization of this model, it is necessary to include, in addition to the default state, different credit quality states.

The transition matrix is the variable that summarizes the probabilities of migration from one credit quality to any other. Knowing the probabilities of transition between different credit qualities and considering the Merton approach, it is possible to derive the market value of assets that represent the cut-off values between different credit qualities, as shown in figure B.1. These cut-off values fulfil the condition that if the change in the market value of the asset (r) is sufficiently negative (i.e., smaller than z_E), then the credit falls into default; if $z_E < r < z_D$, the credit is rated D, and so on.

Taking into consideration the empirical transition matrix, it is possible to estimate the probability of these

FIGURE B.1

Distribution of asset returns



Source: Analysis conducted for this study.

changes happening as follows (for a credit initially rated as *X*):

$$Prob(E|X) = Prob(r < ZE) = \varphi(ZE)$$
$$Prob(D|X) = Prob(ZE < r < ZD) = \varphi(ZD) - \varphi(ZE)$$
$$Prob(C|X) = Prob(ZD < r < ZC) = \varphi(ZC) - \varphi(ZD)$$
$$Prob(B|X) = Prob(ZC < r < ZB) = \varphi(ZB) - \varphi(ZC)$$
$$Prob(A|X) = Prob(ZB < r < ZA) = 1 - \varphi(ZB)$$

where:

r = implied market value of assets.

φ = cumulative distribution function for the normal distribution.

From this point of view, the correlation matrix of changes of credit quality between creditors can be computed by developing an explanatory model of the changes in the value of the borrowers' assets.

This approach presents several practical problems for implementation, the most important being the handling of very large correlation matrices. Additionally, it is not possible to obtain the changes in the market value of assets for each particular borrower, since it would be necessary to have specific information about the internal financial structure of each of them. These two disadvantages make it impossible to implement an ideal correlation matrix, and we shall consequently adopt an indirect (but more manageable) method of introducing the portfolio diversification effect.

b) An indirect approach to modelling correlations among the credits that make up a credit portfolio

Following the Merton approach, J.P. Morgan (1997) makes an *a priori* distinction between the factors that determine the changes in the value of borrowers' assets. This distinction comes from two basic components: the market component and the idiosyncratic component. By definition, the idiosyncratic component does not correlate with anything, since it refers to those factors that are unique to the borrower. But the market component brings with it all the elements needed for portfolio diversification.

$$r_{total} = W_M\, r_{market} + W_I\, r_{idiosyncratic}$$

where:

W_M = percentage of returns explained by the market component.[9]

r_{market} = market component of returns.

W_I = percentage of returns explained by the idiosyncratic component.[10]

$r_{idiosyncratic}$ = the idiosyncratic component of returns.

Conversely, the market component of returns is defined as:

$$r_{market} = H_A\, r_{GDP\ country} + (1 - H_A)\, r_{GDP\ economic\ activity}$$

where:

H_A = percentage of market component explained by the GDP of the borrower's geographical area. The Herfindahl index computes this parameter.

$r_{GDP\ country}$ = return on the GDP of the borrower's country.

$(1 - H_A)$ = percentage of market component explained by the GDP of the borrower's economic activity.

$r_{GDP\ economic\ activity}$ = return on the GDP of the borrower's economic activity.

The market component of returns is divided between economic activity and geographical area. Which is more relevant for a borrower? Is it his economic activity or the country where his business is carried on? The percentage of participation of these market factors in the borrower's systemic risk is exogenous to the model, so a methodology was designed to solve this problem in the most objective way possible (Segoviano, 1998).

This methodology was based on the fact that the greater the variety of economic activities in a country, the lesser the effect (on the value of assets of a borrower in that country) of a sudden change in the country's production. Within this framework it is possible to infer that in those countries where there are few economic activities (and thus a high economic activity concentration), the most important factor for the borrower's asset values will be his geographical location. The intuition behind this reasoning is the fact that if the country

[9] J.P. Morgan (1997) explains how these weights can be calculated. After empirical implementations, it is proved that an acceptable value of W is 70%. For our exercise, we assume this value.

[10] The idiosyncratic component weight is obtained with the following equation:

$$w_I = \sqrt{1 - w^2{}_M}$$

The objective of this equation is to be consistent with the change in the market value of the assets' standardized returns.

is affected by an economic shock, it is very likely that the borrower will experience a decrease in the value of his assets, since he is highly likely to belong to the economic activities that have been affected.

Following this reasoning, we computed a Herfindahl index with the following formula for each group of countries:

$$H_A \sum_{i=1}^{n} \left(\frac{X_{Ai}}{\sum_{j-1}^{n} X_{Aj}} \right)^2$$

where:

X_{Ai} = the participation of economic activity i in country group A.[11]

Once all the elements that compose the market component of asset returns have been considered, the next step is to calculate the correlations between the borrowers making up a credit portfolio.

Given a pair of borrowers X and Y, working in industrial activities B and V located in country groups A and E and with returns expressed in the following way:

$$r_X = w_{IX} r_{IX} + w_{MX} H_A r_A + w_{MX}(1 - H_A) r_B$$

$$r_Y = w_{IY} r_{IY} + w_{MY} H_E r_E + w_{MY}(1 - H_E) r_v$$

the problem of estimating the correlations between each pair of creditors in the portfolio is summarized in the following way:

$$\rho_{XY} = w_{MX} H_A w_{MY} H_E \rho_{AE} + w_{MX}(1 - H_A) w_{MY}(1 - H_E) \rho_{BV}$$ [12]

where:

ρ_{AE} = correlation between different country groups.[13]

ρ_{BV} = correlation between different economic activities.[14]

This equation is computed for each pair of borrowers making up the portfolio. The results of computing this equation are compiled in an (n x n) square matrix, where n is the number of creditors in the portfolio. This matrix is named the matrix of correlation between creditors and is unique for each portfolio. It is an extremely important variable for the simulation of unexpected losses, since it incorporates the elements necessary for quantifying the concentration/diversification of the portfolio.

With these elements, we show in the following section how quality scenarios for the portfolio are simulated. From these, we build the loss distribution from which it is possible to obtain the unexpected losses.

c) Simulation of quality scenarios for the credit portfolio

Combining the transition matrix with the matrix of correlation between creditors, we simulate quality scenarios from which the loss distribution for the credit portfolio is obtained.

As explained above, the transition matrix indicates the probabilities of quality changes that a creditor with a given rating might experience. Additionally, the correlations of quality changes between creditors is involved. Creditors with similar characteristics will tend to migrate jointly to different credit qualities when hit by economic shocks. Creditors with different characteristics will tend to migrate disjointly to different credit qualities when hit by economic shocks. This implies that credit portfolios concentrated in credits with similar characteristics will tend to have higher unexpected losses since they will not be diversifying the possible economic risks.

We programmed an algorithm to compute 10,000 possible quality scenarios for each of the (n x n) pairs of creditors that make up the portfolio. Each quality scenario shows a change in the market value of the assets of the creditors in the portfolio. This process is repeated 10,000 times. The quality changes of the members of the portfolio can be used to generate an amount of losses or profits that conform the loss distribution of the portfolio.

In order to generate these scenarios, the following process is computed:

i) Generation of random uniform numbers.

ii) Transformation of these random numbers into normal standard random numbers.

iii) Transformation of the normal standard random numbers into normal multivariated random numbers with variance equal to the matrix of correlation between creditors.

Since it was assumed that the process generating changes in the assets followed a normal distribution, we use normal random multivariated distribution to generate joint quality migrations, where credits with high correlation will tend to migrate jointly.

[11] The higher the Herfindhal index for a given country group, the less economic activity is diversified. Thus, the percentage of the market component explained by the GDP of the borrower's country takes on more importance.

[12] Since the correlations between idiosyncratic components and geographical components, between idiosyncratic components and economic activity components and between economic activity components and geographical components are assumed to be zero.

[13] These correlations were computed between the spreads of syndicated loans for each country group. We considered that such spreads represented the riskiness of the financial system in each country group.

[14] These correlations were computed between indexes for each of the economic activities considered in the exercise. Each economic activity index was built with the economic activity component of the GDP of a representative country for each country group in the sample.

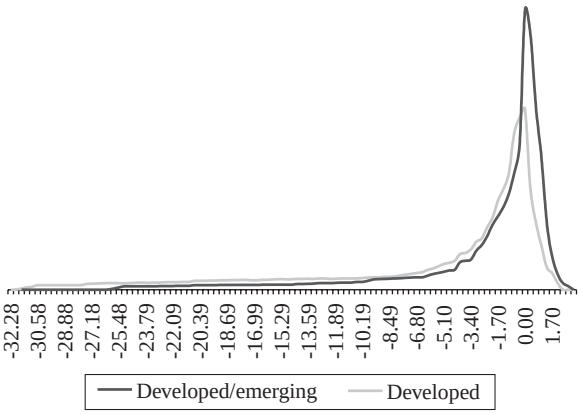
d) Unexpected losses

Once the credit portfolio quality scenarios have been simulated, it is possible to compute the losses/gains that come from the difference between initial and final credit qualities. The losses/gains obtained from the simulation process are used to build a histogram which summarizes the loss distribution of the credit portfolio.

Simulated unexpected losses must be ordered to generate the loss distribution. From this distribution a Value at Risk (VaR) is defined from which we obtain the amount of unexpected losses from the portfolio. The unexpected losses divided by the total amount of the portfolio represent the percentage that with a given probability (defined by the chosen percentile) could be lost in an extreme event. Thus, capital requirements should be such that they can cover such losses.

FIGURE B.2

Distribution of credit portfolio losses



Source: Analysis conducted for this study.

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