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BANQUE EUROPEENNE D'INVESTISSEMENT
EUROPEAN INVESTMENT BANK

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Special Issue:
Banking in an uncertain world



BANQUE EUROPÉENNE D'INVESTISSEMENT
EUROPEAN INVESTMENT BANK

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Preface



Massimo Ponzellini
Vice-President

During the last 25 years, the world of banking has been increasing in riskiness for a variety of factors. One dimension is simply a more volatile macroeconomic environment. With the break-down of the Bretton Woods system of fixed exchange rates in the early 1970s, followed by the oil price shocks, financial markets became much more volatile than they had been in the post-War period. Banks responded by entering the market for risk directly with products that help customers to manage their exposure to price movements. These evolved from futures contracts into the complex derivative products we see today.

The deregulation and internationalisation of financial markets has had an equally important impact. For several decades after the banking crisis of the 1930s the industrial structure of banking remained basically unchanged. Since the late 1970s, however, this structure has undergone significant changes as competition intensified on both the asset and liability sides of the business. In several European countries public sector involvement in banks has been falling, and nearly everywhere non-bank entities have entered the traditional markets of banks. Depositors have been drawn to money market funds that offer better returns than bank deposits, while the largest and most creditworthy corporate borrowers have turned directly to international capital markets. This has squeezed profits at a time when banks have had to look progressively to relatively smaller, and inherently more risky, corporations to maintain business.

Banks have responded with a more market-oriented approach. However, the trend to greater competition is far from over, and the introduction of the Euro will act as a strong catalyst to financial integration and further restructuring of the banking sector. With fiscal pressures on governments, there may also be accelerating privatisation of banking.

In this edition of the EIB Papers we examine the issue of risk management by banks in a more uncertain world. While there have been a number of highly publicised losses by banks due to trading activities, it is generally acknowledged that the main hazard that banks face remains that of credit risk. For this reason, loan diversification and monitoring are still the key pillars of bank controls.

However, risk valuation and mitigation is also essential, and it is here that there is more room for improvement. This is necessary not only for better risk management, but also to fully exploit longer-term market developments, such as securitisation of bank loans and more flexible loan portfolio management via credit derivatives. Clearly, the move to more sophisticated risk management will have to be coupled with professional training of staff and continued investment in Information Technology.

One possible outcome is greater specialisation in the banking sector, with some banks focusing on risk assessment and management services. EIB lending has been shifting rapidly from the public sector to the private sector. Since the majority of these loans involve commercial banks, either as a guarantor or intermediary, we follow these developments with the greatest of interest, and look forward to new forms of partnership in the future.

memmo Pirelli

Editor's introduction

Banks play a special role in the economy and, as a result, are heavily regulated. Perhaps the most serious policy issue is that a failure of a bank would have contagion effects, with the failure of one institution spreading through the entire banking system. This would have a severe effect on the real economy, since banks provide the payment services that underpin all transactions. In other words, some banks are simply too big to be allowed to fail. So if the banking world has become more uncertain, at one level this may be seen as a problem for regulators rather than for the banks themselves.

*This topic is discussed by **Edward Gardener** and **Philip Molyneux** (Institute of European Finance, University of Wales, Bangor). They examine the too-big-to-fail doctrine in the US, Japan and Europe. The evolution of US views on the matter is particularly interesting. Following the USD 150 billion Savings and Loan crisis of the 1980s, US legislation has been passed (in the early 1990s) that defines much more clearly when and how regulators should intervene. The idea is that "prompt corrective action" should be taken as the capitalisation of banks declines, and that an under-capital-*

ised institution, even though solvent, should be put into receivership.

Within EU there have also been a number of important bank bail outs. Throughout Europe the issue of "too-big-to-fail" is also complicated by that of "too-important-to-fail", i.e. the perceived negative effect that a bank failure would have on the reputation of its host financial centre. With significant state ownership of the banking sector, government bail-outs are also entangled with the different question of the state's responsibility as owner. The national relationship between regulator and banks may pose difficult questions for the smooth functioning of an integrated Single Market in financial services. The move to EMU and the removal of currency risks between members will accelerate cross-border banking and financial integration. A first reaction to increased competition may be that banks look for closer cross-border alliances or diversification into new products. However, this will only postpone the need for the restructuring of national markets. Gardener and Molyneux suggest that as a result the number of European banks may fall by at least one-third over the next five years. This will main-

ly come about through consolidation, but some bank failures cannot be ruled out.

The statutes of the future European Central Bank (ECB) do include a reference to prudential regulation. The task of "contributing to the smooth conduct of policies pursued by the competent authorities relating to the prudential supervision of credit institutions and the stability of the financial system"(1) is firstly given to the European System of Central Banks (i.e. the national central banks). However, the ECB is also called upon to ensure that these tasks are implemented through the adoption of appropriate guidelines.(2) What this will mean in practice has not been the subject of much debate.

Single Market legislation sets up the principle of mutual recognition of banking licences (or the single banking "passport"). Following this logic, national authorities would have the principal responsibility for regulating those banks based in their jurisdictions. There is some justification for supervision having a strong local element, since regulators must have the latest information on what is happening, and they can best obtain this with proximity. However, there is the risk that supervisors will be too keen to bail out their national banks. Indeed, Gardener and Molyneux believe it is likely that governments will consider their 'national champions' as too important to fail, even if regional operators

and local or specialised institutions will be provided with less support in the future.

Of course, any work-out plan for a bank in difficulty will have to be vetted by the Commission for its compliance with EU competition law. But this will come only after the fact, and it may be difficult for the Commission to require the complete closure of an institution. It certainly does not permit early intervention at the EU level for damage limitation (the "prompt corrective action" of US parlance).

Looking past the difficult transition period, one can predict that the number of banks which would genuinely be too-big-to-fail would be reduced in an integrated EU financial market. Moreover, improvements in the technology and management of the payments systems will further reduce systemic risks.(3) Thus, in the end, government support for banks is likely to be steadily eroded whatever national intervention takes place in the mean time.

It was mentioned in the Preface that there has been an increase in volatility of many economic variables over the last two decades. A further change to the European economic environment is that real long term interest rates have risen to historically high levels. The low, even negative, levels of the 1970s contrast with a figure of around 5 percent during the 1980s and 1990s.

1) Article 105 (5) of the Maastricht Treaty.

2) Article 9 (2) and 12 (1) of the 3rd Protocol of the Maastricht Treaty.

3) Such as strengthening risk management in net systems (i.e. through pricing or collateralisation) or by real-time gross settlement (RTGS) systems. RTGS systems are being implemented at the national level, while the TARGET system of the ECB will provide RTGS for cross-border transactions.

Since real long-term interest rates are above the rate of economic growth, this means that there is an on-going transfer of wealth from debtors to creditors. Clearly, the weakening of firm balance sheets due to higher debt service costs translates into a weakening of the asset base of banks. For example, high real interest rates helped bring to an end the world-wide real estate boom of the 1980s, with serious consequences for bank lending in several European countries, the United States, and especially Japan.

The issue of why real interest rates are at their present levels is examined by **Agnès Belaisch** (Chief Economist's Department, EIB). She finds two factors that explain long-term rates, which are largely driven by monetary policy. One is the impact of short rates, as a change in short-term interest rates are transmitted along the yield curve. The second, and related issue, is that of fiscal credibility. With high public indebtedness, the risk that governments will be tempted to lower the burden of debt service with a little inflation is ever present. Lenders incorporate a risk premium in the interest rates they charge in order to compensate for this.

In the future, this inflation risk premium may be eroded if the fiscal and monetary environment is perceived to be sound. Thus, if EMU goes ahead on time, fiscal discipline is imposed by the Stability Pact, and the European Central Bank credibly pursues price stability, real long-term interest rates may drop to a figure more in-line with economic growth. Aside from the economic benefits arising from greater investment, such a

general improvement of the environment would help banks to cope with greater risks at the level of the individual deal.

How can the risk of each loan best be analysed? The paper by **Pier Luigi Gilibert** (Credit Risk Department, EIB) examines the concept of "expected loss". If all goes well for the borrower the loan will be fully repaid, but if the borrower runs into problems, and there is a default, the maximum the lender can receive in repayment is the value of the company's remaining assets. The expected loss is thus equal to the present value at the risk-free interest rate of the sum of money the lender can expect to lose due to a default. Gilibert shows how this concept ties in with other risk measures.

For example, a risk-neutral lender, or one with a fully diversified portfolio, would require a risk spread that exactly covered this expected loss. Moreover, as originally pointed out by Merton Miller, this contractual arrangement is analogous to the bank selling the borrower a put option on the price of the company's assets. When the value of the company falls below that of the loan, the company exercises this option by going bankrupt, and "putting" the company to lenders. The value of such an option is equal to the expected loss, since this must be equivalent to the amount that the bank receives to enter into the contract. Also recall from theory that the value of an option depends upon both the current price of the underlying asset, and the volatility of this price. Therefore, an estimate of the expected loss also gives a measure of the volatility of the firm's value (to the

lender). There are thus parallels with the techniques used to measure the exposure of banks to traded instruments. It is clear that if information is available on the expected loss of a particular operation, the capital required by the bank as a financial buffer against default can be estimated with some accuracy. Under current EU directives, banks have to set aside capital equivalent to 8 percent of the nominal amount of a corporate loan. It would only be by chance that this regulatory capital requirement would be equal to that obtained from a more accurate risk calculation. This may have important consequences for the future of banks and the banking system. Indeed, if regulatory requirements are set much too high, there could be a form of "adverse selection" with only poorer quality borrowers turning towards banks. Thus, regulatory issues could accelerate the trend of disintermediation of the best corporate borrowers mentioned above. Rules set up to ensure bank safety could, in the end, have a perverse effect.

Jacques Girard (Project Department, EIB) and **Christopher Hurst** (Chief Economist's Department, EIB) also look at the risk of default, but this time for private infrastructure projects. For most large corporations there are detailed credit ratings by third-party rating agencies. Historical data on the default rates of different credit classes are also available, and these default rates can be updated continually as new data becomes available. With this data it is relatively easy to have a first assessment of

what the likely default rate of a particular company will be. Indeed, in terms of overall risk management of assets it makes sense to consider loans by credit group in this way. However, infrastructure projects that are financed on a limited-recourse basis usually fall outside this framework since there is no established institutional setting in which to consider the project, and each one is *sui generis*. What can banks do to get a quick idea of the appropriate grading of such projects?

Girard and Hurst, making a number of simplifying assumptions, develop a model that looks at how the probability of default varies with different gearing levels. Each project produces an uncertain cashflow that can be summarised as the mean and standard deviation of the project's rate of return. With this information and a target risk-free interest rate, one can assess the probability of default within the life of the loan, the expected loss to the lender, and hence calculate a suitable risk premium (along similar lines to those laid-out in the paper by Gilibert). One simple point to emerge from this analysis is that rate of default depends upon the premium that is charged. This is perhaps obvious, but it is often overlooked when risk-premia are calculated solely on the basis of historical default probabilities. In other words, charging a high risk premium may drain sufficient cashflow from the project to actually knock it into a lower credit category. Then an even larger risk premium would be needed.

Until established institutional frameworks exist for private infrastructure investments, and good data on project performance becomes available, specific techniques to analyse investment proposals of this type will be required.

The two previous papers have looked at the risks that arise from lending, i.e. the risks on an institution's "banking book". However, in recent years there have also been a number of spectacular losses due to trading activities. Examples include Barings (ECU 1.2 billion losses due to derivatives), Daiwa Bank (almost ECU 1 billion due to bond trading), and Kidder Peabody (ECU 0.3 billion, also due to bond trading). This raises the question of how much capital should be put aside by banks as a financial buffer for their "trading books". The paper by **Kristian Kjeldsen** (Danmarks Nationalbank (4)) picks up this topic, and returns to regulatory questions.

The Capital Adequacy Directive (CAD) sets the current regulatory framework in the EU. The CAD requires that capital be set aside against position risk, settlement and counter-party risk, and large exposures arising from trading book activities. The trading book is marked to market daily, and off-setting positions in the same instrument may be netted. As with the loan book, exposures are converted into a capital requirement with fixed coefficients.

The proposals for a new EU Capital Adequacy Directive follow those of the BIS (a new amendment is due to become effective at the end of the year) in that they per-

mit the use of internal Value-at-Risk (VAR) models. These are statistical models that use historical data on price movements to determine the maximum loss that can be expected (for a given confidence level and over a given period), and thus the capital that should be set aside.

However, VAR models are far from perfect. The probability distribution of asset price movements must be estimated from historical data, and the results depend upon the period considered. Extreme events (i.e. very large price swings) occur more often than are predicted by the normal probability distribution used by the models, and different weighting of historical data can give quite different results. For this reason, the results from VAR models are multiplied by a safety factor of three when capital requirements are calculated.

Acceptance of internal VAR models as the main instrument for supervision of bank trading books represents a significant change in philosophy. It reflects a recognition that supervision based upon product and customer types has become almost meaningless in a volatile environment where the structure of portfolios can be substantially altered in a very short period of time. This shift has two implications. One is that the main task of regulators will no longer be to check that the rules are adhered to, but rather to validate risk measurement methodologies. Secondly, there may be more interest for banks to relocate to more lenient "model-friendly" jurisdictions (so-called regulatory

4) At the time of writing Kristian Kjeldsen was with the Chief Economist's Department of the EIB.

arbitrage) since the assessment of risk management might become an increasingly subjective matter.

Could the VAR methodology be used to quantify capital requirements for financial institutions' lending as well? As Gilbert noted, a fixed 8 percent charge can hardly always be correct for an individual loan. It is also unlikely to be always appropriate for a portfolio of loans. For example, a bank with a diversified portfolio must still put aside the same capital as one with its assets concentrated in a only few areas. (5)

A major initiative to model more accurately the risks on a loan book has been the launch of CreditMetrics by JP Morgan together with a number of other banks. (6) It builds upon the earlier RiskMetrics VAR model (which was introduced in 1994). Unfortunately, applying such a VAR-type model to loans requires not only an assessment of the default probability of each credit class, but also each loan's likely recovery rate in the event of a default, and the correlation of the probability of default with that of other assets on the lender's books. We have noted that detailed information exists on the historical default rates of corporations.

However, data bases on the last two items - recovery rates and default correlations - are not well developed.

Nonetheless, the data needed to estimate the correct capital backing for loan portfolios will be collected, and the growth of loan securitisation and credit derivatives (7) will reduce the line between traded instruments and illiquid loans. The shift to using formal quantification methods does not necessarily reflect a blind faith in such techniques. Indeed, VAR models say nothing about mismanagement and defective internal controls. Many of the most highly publicised bank losses have been due to these rather than technical errors in estimating risk.

Instead, this shift complements a weakening of the idea that banks are special institutions whose failure must be prevented at all costs. The risk of contagion has always been very low. With the reduction of the importance of "core" banks, and improvements in the safety of settlement systems, these risks can only be further reduced. If bank failure is no longer an unthinkable catastrophe, then market solutions, such as control by shareholders and creditors, will become increasingly

5) Taking this to the extreme, a bank with 100 loans of ECU 1 million all with AAA-rated companies that are diversified by sector and region must at present put aside the same capital backing as a bank with one loan of ECU 100 million to a sub-investment grade company. (Ignoring for the moment additional regulations on large exposures.)

6) See "Introduction to CreditMetrics" and "CreditMetrics-Technical Document", JP Morgan, New York, 2 April, 1997.

7) Credit derivatives were introduced in 1992. These allow lenders to hedge against changes in a borrower's creditworthiness in the same way that interest rate and exchange rate derivatives enable them to hedge market fluctuations. In effect a bank pays an insurance premium in return for compensation if the borrower defaults or if its credit rating is downgraded.

important as a way of disciplining bank management. (8)

Of course, there will always be the need for a lender of last resort to inject liquidity when there is a system wide crisis (such as 1987's Black Monday on the New York Stock Exchange). Indeed, in this case only the central bank can intervene rapidly. It should be mentioned here that the responsibility for providing lender of last resort facilities within EMU is also something which has yet to be fully resolved. Regulators must have information for making decisions, calling for involvement by national central banks. However, there may be extreme situations - the ones where systemic risks are most likely - where rapid and decisive action by the European Central Bank will also be necessary.(9)

The main theme to emerge from this edition of the Papers is that sophisticated risk control practices will simply become a normal part of the overall management of banks. These techniques will migrate from financial institutions' trading books to their banking books as the barriers between these two activities fall away. The result will be that banking supervisors will be called on to take a view on the quality of risk assessment models and the risk analysis process in general. Paradoxically, this may become a progressively subjective review of the general soundness management practices rather than the micro-managing risks. But to ensure that this uncertain and subjective world remains fair, clear rules for intervention and bank bail-outs should be determined at the EU level, and rigorously applied.

Christopher Hurst
Chief Economist's Department

*8) In a way, this is turning back the clock to the turn of the century when illiquid or insolvent institutions were largely left to the harsh judgement of the market-place (see, for example, David Kynaston, *The City of London*, vol. 2, *The Golden Years: 1980-1914*. Chatto & Windus, London, 1995). There will still remain the issue of protecting small investors, many of whom have a significant part of their wealth held in bank deposits. However, a number of more market-oriented solutions to deposit insurance are also possible (such are relating the deposit insurance fee paid by banks to their capital structure).*

9) See, for example, Schinasi G.J. and A. Prati, "European Monetary Union and international capital markets: Structural implications and risks", IMF, Washington, DC, March 1997.

The TBTF doctrine revisited: Core banks and the management of bank failures



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1. Background

Banking experiences throughout the world from the early 1980s have underscored the importance of the key link between bank soundness and macroeconomic policy: see, for example, IMF (1996, p165). A sound banking sector is not only important for general macroeconomic stability, but macroeconomic and structural policies themselves impact on the soundness of the banking system. A recent, detailed study for EC DG XV (Economic Research Europe Ltd/IEF, 1996) also emphasised the importance of bank soundness and supervisory (prudential) re-regulation in capturing the economic gains from banking (structure and conduct rules) deregulation; (see also Molyneux et al, 1996). At the same time, there has been a growing recognition and debate in the international banking and financial system literature that global allocative efficiency (secured by the perfect freedom of capital movements as well as free trade in goods and services) may not be compatible with adequate financial stability: see, for example, Gray and Gray (1981) and Gray (1996). Within this latter literature the need is argued for a hegemon to ensure inter alia the stability of the international financial system. Kindleberger (1977), for example, has long argued for an international lender of last resort.

Some important dilemmas and practical policy issues emerge in this general area. One important dilemma is that more general allocative and bank internal efficiencies (like improved productive efficiency) targeted by deregulation may not necessarily be consistent overall with banking system stability. Practical market characteristics like deposit insurance, the too-big-to-fail (TBTF) doctrine and even the lender of last resort (LLR) do not seem to fit in with this strict free-market view. The latter is consistent with a banking world where the incentives for banking market allocative efficiency and bank productive efficiencies are not constrained by market 'failures' like deposit insurance and TBTF.

From a practical policy perspective, though, these kinds of market 'failures' or 'imperfections' are apparently necessary and even desirable. Their practical necessity seems to be vindicated by the simple fact that world-wide banking deregulations have been inevitably accompanied by equally dramatic re-regulations of supervisory rules, especially in key areas like capital adequacy. This kind of re-regulation appears to be necessary from a practical policy perspective in order to keep banking systems sound (reduce systemic risk potential) during a deregulation. In short, the targeted economic gains from a deregulation are secured in part (perhaps somewhat paradoxically) through the corresponding re-regulation of bank supervisory rules. Whether this is a transient need in deregulating financial systems remains, of course, an open question.

This paper arose from a draft working paper submitted by the authors within a research project conducted by Mini-Forum at the University Paris-X Nanterre, Paris, which was funded by the French government (by the Commissariat Général du Plan). The paper also draws on other recent work by the authors reported in Gardener in Norton (1991, ch6) and in Norton et al (1994, ch6).

This new, more competitive and increasingly complex banking environment poses many challenges. There have been several recent instances where the practical importance and role of the TBTF doctrine, the practical relevance of core banks and different central bank approaches towards managing bank failures have occupied centre stage. This paper focuses on these aspects and considers some recent experiences.

Why are some banks rescued and some not? The answer is that banks have traditionally performed critical roles (like operating the payments mechanism and lending) in the domestic economy. As a result, the failure of some banking institutions could have (or are perceived to have) serious systemic implications. To head off a systemic risk event, some failing banks (that is, their retail customers but not their owners, top managers and all of their creditors) may be rescued. Which bank failures could set off a wider disaster depends partly on circumstances at the time and partly on where a bank figures in the domestic pecking order. This, of course, raises a whole host of awkward issues of equity. For example, which groups of depositors and bank stakeholders generally should be protected in the event of failure?

Does this mean that some banks are 'too big to (be allowed to) fail'? The answer is yes (at least for practical policy purposes), but with some doubt on the margin as to what counts as 'too big'. Uncertainty is essential if market discipline on bank executives to perform responsibly is not to be weakened. If some banks are too big to be allowed to fail, then it naturally suggests that those banks are 'safer' than others. Clearly banks which are part of a country's 'core banks' and banking institutions which dominate the local banking market are more likely to attract a rescue (were one needed) than some fringe operators offering, say, more attractive deposit rates. Mutually-, communally- or nationally-owned banks are also likely to attract possible rescue packages; recent examples of such rescues include Bavaria's Raiffeisen-Zentralbank and France's Cr dit Lyonnais.

2. Emergence of core banks

A core bank can be broadly defined as a banking institution whose failure would jeopardise the stability of the domestic banking system as well as the national economy: (see Revell, 1987 for a survey). Core banks have a number of implicit privileges, but these are balanced, and can often be outweighed, by duties. Because the authorities regard the continuance of the core banks as essential to the safety of the whole banking system, they are likely to take extreme measures to prevent them from failing. No central bank has ever put this on record (because of the moral hazard problem), but 'everybody knows' that the outright failure of one of the core banks is virtually unthinkable because of the (hypothesised) damage to public confidence in the whole banking system.

The failure of core banks on a few occasions has usually been due to legal restrictions on the amount of help that a central bank may give.

The actual failure of core banks on a few occasions has usually been due to legal restrictions on the amount of help that a central bank may give; the Big Three German banks in the early 1930s were a case in point, the banks quickly ran out of assets that could be pledged for loans from the Reichsbank. Because core banks are so large, their difficulties cannot be covered by deposit insurance funds or by voluntary help from other large banks; the inevitable response to failure of a core bank has been nationalisation, which is usually temporary (e.g. the Big Three German banks case cited above, the US Continental Illinois 1984 and Bank of New England in 1991), but which may prove to be permanent (the three Italian banks of national interest). At times of fragility of banking

systems, this treatment is extended to banks well outside the core group (e.g. Johnson Matthey Bankers (JMB) in London in 1984).

The other privilege afforded to core banks is that of influence on official decisions. This may come about in either or both of two ways. Central banks always prefer banks to be tightly organised in associations so that they can easily find out a representative view on a particular issue or secure the informal agreement of all important banks to a particular policy without issuing specific regulations (moral suasion). If there are several associations, representing different categories of banks, the one covering the main commercial banks is likely to be the most important, and within that association the core banks will have a dominant position. The second channel of communication between the core banks and the central bank is that of informal access to the governor of the central bank, either collectively or singly.

Core banks have other important distinguishing characteristics. In some systems (especially in Continental Europe and Japan), for example, core banks have been deemed responsible for sustaining and rescuing large firms at times of economic recession and crisis. They also have been singled out traditionally as the main transmission mechanism for monetary policy. Historically, they have in some systems been expected (often obliged) to lead in other measures, like lending to favoured sectors. Core banks are also expected to play their part in dealing with bank failures by acquiring failed banks and in the provision of liquidity to banks in trouble. In certain countries, the distinction between core institutions and large second-tier banks is becoming increasingly blurred and the future distinction between core and second-tier institutions will continue to become less clear.

3. The 'too-big-to-fail' (TBTF) doctrine

The TBTF doctrine implies that all deposit obligations would be met by some form of government guarantee or pledge.

Tirole (1994) has noted that the TBTF doctrine 'is one of the most serious issues in banking.' The TBTF doctrine is understood to mean that, if a bank were big enough, it would receive financial assistance to the extent necessary to keep it from failing. More specifically, the TBTF doctrine implies that all deposit obligations - both insured and non-insured - would be met by some form of government guarantee or pledge. Professional creditors would probably also be protected in such a scenario but would rank after depositors. In other words, the taxpayer would bail out the failing core-bank, although it is generally accepted that shareholders, bondholders and senior management would not be 'guaranteed' protection in any sense.

In most cases of bank failure, the complete disappearance of an institution is rare - a major exception being BCCI - but in most cases some type of institution emerges after some form of rescue package and restructuring has taken place. When a liquidation takes place it is very rare that uninsured depositors will be protected, although this did occur in the case of Canadian Commercial Bank in 1985. [The reason why (some suggest) uninsured depositors were protected in this case was because the federal government had encouraged depositors not to withdraw funds and presumably they felt obliged to repay all creditors].

On the other hand, when a core bank is in trouble then government guarantees are stretched to cover all creditors from losses, excepting shareholders and bondholders, of course. This was the case, for

example, with the major bank failures in Finland, Norway and Sweden between 1991 and 1993 (for example see Lindblom (1992) and Nyberg and Vibrialä (1994)). Here the systemic implications of major bank failure led the authorities to guarantee the obligations of the main banks to all creditors. The same can be said about support provided for the Austrian banks *Österreichische Landesbank* and *Creditanstalt Bankverein* during the 1980s and more recently the French state bank *Crédit Lyonnais*. Even when *Continental Illinois* failed in the US in 1984 all classes of depositors were protected. This again was primarily because the authorities had encouraged certain wholesale depositors to maintain funds at the bank when prudence would probably have dictated withdrawal. Even in the case of other large bank failures, uninsured depositors have not always suffered full losses.

Three noteworthy patterns for present purposes emerge from recent bank failures:

1. When serious systemic effects are believed to result from potential bank failure (i.e. failure of a core bank) then government guarantees and/or obligations will lead to all creditors (but not shareholders and bondholders) being insured against loss. These guarantees would be made prior to failure to ensure/promote a safe and sound banking system.
2. Liquidations rarely lead to uninsured depositors and other professional creditors being repaid and if they are reimbursed, it is hardly ever in full.
3. When troubled banks are supported by the banking system or by emergency liquidity assistance from the central bank, and are then taken over, uninsured depositors and professional creditors seem rarely to lose their funds. If a bank has had significant support from the central bank then relevant suitors are usually given some form of guarantee or backing from the authorities to mitigate against any losses. Even when the private banking system acts to support a troubled bank it is usually at the behest of the authorities and therefore implies some form of guarantee.

The failure of *Banesto* in Spain (1993) clearly illustrates the importance of the 'core bank' concept and the TBTF doctrine. The central bank encouraged the other 'core banks' not to deliberately attract deposits away from *Banesto*. The Bank of Spain also indicated that it would support *Banesto's* liquidity and capital requirements although Spain's 'core banks' were expected to provide *Banesto* with the bulk of financial support: see Morgan Stanley (1993, 1994).

More recently, the bailouts of the Italian *Banco di Napoli* (1996) and *Crédit Lyonnais* (1997), the latter's third rescue package in four years, illustrates the extreme lengths which authorities will go to in order to support ailing core banks and to protect depositors and other professional creditor's obligations.

4. Too-big-to-fail in the United States

Tough US legislation appears to have led to a substantial weakening of the TBTF doctrine in that country.

Legislation enacted by the US authorities in the form of the *Financial Institutions Reform, Recovery and Enforcement Act of 1989 (FIRREA)* and the *Federal Deposit Insurance Corporation Improvement Act of 1991 (FDICIA)* were designed to prevent any recurrence of the commercial bank and S & L (Savings and Loans) financial collapses of the 1980s. In addition, it aimed to limit the use of tax-

payers money to bail out bad banks and imprudent lenders. This tougher legislation, appears to have led to a substantial weakening of the TBTF doctrine.

To achieve the statutory goal of resolving the problem of troubled banks and S & Ls at the lowest possible long-term cost to the deposit insurance funds, the grounds for putting a depository institution in the US into receivership have been significantly expanded and the regulators' options have been made more restrictive. For example, now a receiver (generally the FDIC) may be appointed if there is any violation of any law or regulation, or any unsafe or unsound practice or condition that is likely to:

- cause insolvency or substantial dissipation of assets or earnings
- weaken the institution's condition
- or otherwise seriously prejudice the interests of the bank's depositors or one of the deposit insurance funds.

A receiver may also be appointed if the institution is undercapitalised and fails to submit an acceptable capital restoration plan or fails to implement the plan.

An institution is undercapitalised under FDICIA if its risk-based capital ratio is less than 8 per cent, or if its leverage ratio is less than 4 per cent (1). In such a case, it has to file its capital restoration plan within 45 days after being ratified by the regulators that it is undercapitalised. The plan needs to set out the ways in which the bank will become adequately capitalised and performance of the plan must be guaranteed by any company which controls the institution. (However, the guarantee is restricted to 5 per cent of the undercapitalised institution's total assets.) An undercapitalised institution is subject to restrictions on growth, acquisitions and entry into new areas of business. Most important, its critical ability to assure liquidity by borrowing from the Fed is significantly restricted.

In addition, an institution is defined in FDICIA as critically undercapitalised if its ratio of tangible equity (2) to total assets is less than 2 per cent. When that happens, the relevant federal regulator must appoint a receiver unless the regulator and the FDIC certify that the institution is 'viable and not expected to fail'.

In summary, the above prompt corrective action means that an undercapitalised institution may be put in receivership and a critically undercapitalised institution, even though solvent, must be put into receivership. The US bank regulatory scheme is nowadays heavily weighted in favour of receivership despite the fact that professional lenders generally believe that private work-outs have a better chance of preserving the going concern value of a weak borrower than bankruptcy. Prompt corrective action may be important for reducing the incidence of bank failure in the US, however, it is the new legislative provisions which focus on the least cost solution to problem banks that question the whole TBTF doctrine.

Prior to the 1989 and 1991 legislation the FDIC, acting as receiver, had considerable flexibility in determining whether to: (a) liquidate the institution; (b) enter into an agreement with another institution to buy certain assets of the institution in receivership and assume all or most of its insured and

1. The leverage ratio is defined as the ratio of tier 1 capital (generally including equity and non-cumulative perpetual preferred stock minus goodwill) to average consolidated assets.

2. Defined as common equity plus perpetual preferred stock minus intangible assets.

non-insured liabilities, followed by a liquidation of the insolvent institution; or (c) grant financial assistance to the institution usually on the condition that new investors must contribute significant capital to the institution and the old stockholders must be substantially diluted. The FDIC often chose to avoid liquidations of banks - especially large regional banks - when it believed the action would be in the best interests of the community (this was known as the essentiality doctrine (3)).

However, now the FDIC is required by FDICIA to minimise the cost to the insurance funds and is not permitted to incur any cost to benefit an uninsured claim. In other words, the new legislative structure does not allow for a repeat of the Continental Illinois experience. (This may be difficult to enforce if any of the money centre banks or super-regionals failed!) The change in legislation has probably made liquidations of small banks and S & Ls more common. This view can be supported by the FDIC statement that, for a bank to obtain financial assistance, it must request it at least one year before probable failure. Since, as a condition of giving the assistance, the FDIC probably will insist on wiping out most of the interest of old shareholders and sacking senior management, it appears very unlikely that many boards of directors will strive to make such requests early. Furthermore, since FDIC assistance probably also will be conditioned on substantial concessions from bondholders, it appears unlikely that institutions generally will be able to obtain the bondholder consent necessary for assistance. Counterparties to foreign exchange and derivatives business will also be affected because they will not be able to unwind their positions rapidly. As derivative business is carried off-balance sheet and no principal exchanges hands, bank failure will result in unanticipated foreign exchange and interest rate exposures occurring. Given that regulators appear reluctant to meet all on-balance sheet obligations of the failed bank (apart from core institutions) it seems highly unlikely that off-balance activities will be guaranteed. This will only occur if the failure of counterparties to derivatives transactions will lead to systemic collapse of derivative markets and/or third party banks.

This change has substantially weakened the TBTF doctrine in the USA. The only remaining remnant of the doctrine is the 'systemic risks' exception. This allows the FDIC to take any action and provide any assistance even if it is not the least cost alternative if, on the recommendation of the Federal Reserve Board, the FDIC and the Secretary of the Treasury (in consultation with the President) determine that the least cost resolution of problems of an institution would have 'serious adverse effects on economic conditions or financial stability'. It has been argued by various commentators that, during President Clinton's term of office, no-one should rely on this systemic risk exception - not even the largest money centre banks and certainly not the largest super regionals. Failure of some of the largest banks may also be viewed by free-market economists as an acceptable way of reducing excess capacity in the system - so long as the systemic risk element can be limited. This is the current view in the US, but for all practical purposes, it is unlikely that the federal authorities would have the resolve to sit out a money centre bank failure, especially if they have encouraged uninsured depositors to stay with such a bank and especially if the history of Continental Illinois repeats itself.

Given current trends, then, it looks likely that within the United States the TBTF doctrine will increasingly be questioned and the concept of 'core' banks further eroded by the rapidly advancing regionals and second-tier financial service firms.

3. See Sinkey (1992) pp.198-199

5. Too-big-to-fail in Japan

If the TBTF theory could be applied anywhere, it seemed that it could be applied across the board in Japan with certainty.

Up until 1994 no major Japanese bank had reported a net loss since 1945. It was almost a universal belief in banking circles that the Bank of Japan would not allow any of the major banks to go bankrupt. If the TBTF theory could be applied anywhere, it seemed that it could be applied across the board in Japan with certainty. Although this policy stance appeared to weaken, with the failure of Hanwa Bank in November 1996, the authorities re-affirmed their commitment to the TBTF doctrine following two large bank rescues in April 1997. Concerns about the soundness of the Japanese system have been increasing since the end of March 1996 when the biggest 20 banks announced combined net losses of JPY 71.6 trillion - the worst results ever in Japanese banking history. Even the half-yearly results reported in November 1996 weren't much better despite various accounting devices used to disguise the true picture. Bad-loans for the top 20 banks were officially estimated to be about JPY 23 trillion although most analysts believe the true figure to be at least 40 per cent larger. Many commentators still believe that the authorities may well have to stand aside and let a large bank fail despite the gallant attempts to prop up the banking system.

So far the authorities have done a lot - at massive cost - to avoid major bank failure. Typically, the Japanese authorities have encouraged the banks to earn and to cost-cut their way out of their debt problems. This main strategy was initially underpinned by fiscal packages which indirectly helped to stabilise equity and real estate prices by stimulating macroeconomic activity. The kind of measures taken in the early 1990s included:

- a supplemental budget in 1992 included JPY 1.6 trillion (0.3 per cent of GDP) for government purchases of land and JPY 1.1 trillion (0.2 per cent of GDP) for equity investments by the Postal Savings Corporate, the Postal Life Insurance Welfare Corporation and public pension funds (4)
- a gradual reduction in the discount rate since July 1991 from 6 per cent to 2.5 per cent has allowed banks to increase net interest income
- government announced measures in August 1992 which helped to stabilise equity prices and also assisted banks in managing their bad loans:
 - (i) The MoF (Ministry of Finance) reaffirmed that banks could omit reporting in their end-of-September (interim) accounts the valuation losses on equities whose market values had fallen below their book values
 - (ii) The MoF relaxed its limit on the dividend payment ratios of banks (5)
 - (iii) The MoF has asked the tax authorities to demonstrate greater flexibility in allowing banks to make tax-deductible loan-loss provisions.

In addition to these government initiatives, in February 1993, 162 financial institutions (129 banks, 32 insurance companies and Norinchukin) launched the Co-operative Credit Purchasing Company (CCPC). It had total paid-in capital of JPY 7.9 billion, of which the 21 major banks gave JPY 4.8 billion. The authorities were highly supportive of this initiative, as illustrated by frequent statements by Bank of Japan officials urging institutions to use CCPC to get rid of their problem loans. The authori-

4. The ceilings on the proportion of the assets of these funds that could be invested in equities were also removed.

5. Some banks in the past avoided reducing dividend by realising capital gains on some of their equity holdings to raise net profits. Historically, revaluation reserves remain a volatile element of bank capital. The Ministry of Finance announced in February 1993 that banks should not rely on revaluation of reserves on stocks held to achieve capital standards.

ties, however, were inclined to leave the funding of the agency to banks themselves. CCPC would purchase from its members and their non-bank affiliates problem loans collateralised by real estate (6). Loan purchases were at a discount to the face value of the assets with the precise value being evaluated by third-party assessment of the market value of the collateral. In general, the main benefit created by this company was to enable member institutions with problem loans to make faster write-offs.

The success of the CCPC critically depended on sustained bank operating profits which was clearly linked to a variety of cyclical and structural developments. Beattie et al. (1995) noted that banks were also encouraged to handle their troubled loans in ways that did not require recognition of losses or disclosure of a non-performance. In February 1994 the MoF also further modified its loan write-off policy. Other reforms hastened by the fragility of the domestic banking system have included moves to allow banks to engage in securities and trust activities through majority-owned subsidiaries which came into effect on 1 April 1993, and the gradual liberalisation of deposit rates. These reforms have been introduced to generate a more favourable operating environment for Japanese banks and indicate the extreme lengths the authorities would go to so as to prevent bank failure. During this period the Japanese authorities continued to restate that the difficulties would not interrupt progress toward the creation of a more competitive, transparent and efficient banking system.

The authorities clearly bent over backwards to preserve the solvency of their banking system in the early 1990s and this policy of forbearance was essentially a means of buying time, and, as the Bank of International Settlements (1993) has observed, bore a close resemblance to the handling of the US S & L industry's problems in the 1980s. While this support package bought the troubled banking system time to restructure it could not prevent the 'relative' downturn in the Nikkei index and collapse of commercial real estate values that has decimated the loan books of Japanese financial institutions in 1995 and 1996. In August 1996 the government set up the Housing Loan Administration Corporation (HLAC) to take over the assets and liabilities of seven failed *jusen*, or mortgage companies. Other *jusen* have since been added to the list. The Ministry of Finance also stated that the 21 largest banks had lent JPY 30 trillion to finance companies, and analysts estimate half of this has gone bad. The spectre of non-performing loans continues to haunt the wobbly Japanese banking system. In Japan the TBTF doctrine was increasingly being questioned, especially since the Ministry of Finance closed the regional Hanwa Bank in November 1996 and stated its commitment to let weak banks fail. The issue came to a head in early 1997 when the country's 17th largest bank, Nippon Credit Bank and another large institution, Hokkaido Takushoku Bank, reported bad loans of some USD 11.4 billion and USD 5.7 billion respectively. During February and March 1997 it was reported that the state bailout of these institutions would be 'politically unacceptable' as the full cost to the Japanese taxpayer would be too burdensome. Other avenues for rescue, such as acquisition by healthy private banks or support from the Deposit Insurance Corporation, were also seen as unlikely.

Despite the widespread market view that these banks would be allowed to fail, the Finance Ministry announced at the beginning of April 1997 that it was to rescue Nippon Credit Bank, the smallest long-term credit bank, with a package injecting USD 2.4 billion of new capital from various

6. The first tranche of non-performing loans of JPY 681 billion face value was bought by the CPCC at 66 per cent of face value on average in March 1993.

sources. In return the bank will have to reduce its assets substantially, sell property and reduce staff by 20 per cent. It will also write-off three troubled non-banking affiliates, which have already filed for bankruptcy. In addition, the ministry has also announced that Hokkaido Takushoku is to merge with the regional Hokkaido Bank. The merged entity has to cut staff by 25 per cent and non-interest costs have to be reduced by 30 per cent by 2000.

In announcing these rescue packages, the director-general of the Ministry's banking bureau stated that Nippon Credit Bank was too big to be allowed to fail. It was also intimated that the government was continuing its policy of guaranteeing the survival of the top 20 banks until 2001 allowing time for deregulation of Tokyo's capital markets. While these statements, made in early April 1997, were clearly designed to boost confidence in the banking sector, especially in the run-up to the reporting season in May, they again confirm the authorities commitment to a TBTF policy - at least up until 2001.

The government guarantee protecting the top 20 banks disappears in 2001. The authorities also intend to have completed fully their major deregulation of capital markets by then. This will almost certainly involve mergers between some of the country's biggest securities houses and banks, particularly as the former are well capitalised compared with their banking sector counterparts. While protection of the big-banks is guaranteed, the fate of medium-sized operators is much more uncertain. Overall, widespread consolidation is expected in the financial services sector as a whole.

Attempts to increase competition and efficiency in the system will force a more market-orientated approach, will lead to greater exit and entry in the banking sector and will culminate in a universal banking system by 2001. As exit (or failure) is not permitted for the largest banks, then one would expect the bank merger movement to accelerate with a possible consolidate of the City banks down to say, around five, by the end of the decade. While the TBTF doctrine is a stated policy aim it seems unlikely that this position can be indefinitely sustained post 2001.

6. Too-big-to-fail in Europe

In Europe the TBTF doctrine is complemented by a TITF ('too important to fail') set of banks for whom size alone is not the dominant concern.

The TBTF doctrine has widely been held to be the case across all European banking markets for the following reasons. Firstly, in many of the smaller countries the banking systems are dominated by a handful of core banks which are noticeably larger than the second-tier institutions: for example, Belgium, Denmark, Finland, Ireland, Sweden and Norway. Any failure of the core banks would clearly have major systemic implications for the respective economies and banking systems.

In the larger countries the gulf in size between the core and second-tier banks is not so noticeable, apart from in Spain, Switzerland and perhaps the UK (if only the three largest banks are viewed as core institutions). However, the definition of core banks in the larger countries stems just as much from tradition as size. In the UK, for example, Lloyds, the fifth largest bank, is probably more likely (we suggest) to be protected from failure compared with, say, Abbey National. Lloyds has a long tradition in UK commercial banking and has been regarded as a core bank for over thirty years; Abbey National is a recently converted building society that undertakes predominantly mortgage-based business. In a similar vein, HSBC Holdings' Overseas business may not be protected by the UK autho-

rities in the event of failure, although Midland's domestic business is much more likely to be protected in the event of failure - mainly because of Midland's well-established commercial banking tradition and former status as a UK core bank. The TBTF doctrine, is complemented by a TITF ('too important to fail') set of banks for whom size alone is not the dominant concern if failure threatens.

Turning to Continental Europe, the safety of large banks in Italy, however, has been long assured through the tradition of State ownership in the banking sector - despite the current privatisation programme. Even when (1982) the private Banco Ambrosiano got into difficulties, obligations of the subsidiary Luxembourg holding company were not honoured, but a consortium of mainly State-controlled institutions set up the Nuovo Banco Ambrosiano to continue with domestic business. As the recent Banco di Napoli rescue illustrated, in terms of protecting large- and medium-sized banks, Italy is more akin to Japan than the US.

France also has a tradition of State ownership within the banking system and the core banks, Credit Lyonnais, BNP and Société Générale have at some time, or still are, State-owned and run. By the end of 1996 over 40 per cent of French banking sector assets were still under State ownership. Despite the level of government ownership, the approach taken toward banking problems in France has traditionally relied on co-operative efforts from within the banking system (including loss sharing arrangements) to prevent problems from spilling over into other sectors. The French authorities believe this approach may again be used successfully to deal with current difficulties, mainly pertaining to relatively small institutions, although the recent bailouts of Credit Lyonnais highlighted the limitations of the co-operative approach (see de Boissieu and Bliman (1995) for a detailed exposition). The concerted on-going efforts to support Crédit Lyonnais also reflects the authorities strong adherence to the TBTF doctrine, although the issue is entangled with the slightly different issue of public ownership.

In Germany it is not so much the relative size of the largest banks which defines their core status, rather their long tradition in industrial financing. While publicly-owned Westdeutsche Landesbank is the third largest bank by asset size this bank is not viewed as a core institution. In Germany industrial finance is dominated by the three banks: Deutsche Bank, Dresdner Bank and Commerzbank, along with their Berlin subsidiaries and these are rather the core institutions. Given the universal nature of banking business in this country, the banks' massive involvement in corporate finance and capital markets activity, it is a certainty that failure of any of these banks would be a threat to the economic system. In the event of potential failure, the rescue of these institutions seem to be almost assured given they are too important to be allowed to fail due to their dominance of the corporate finance and capital markets business. The same also applies to the three largest Swiss banks, which of course, are much larger than any of their domestic competitors.

In the smaller European countries, the successful role that governments played in protecting crisis-ridden Scandinavian banking markets in the early 1990s illustrates the typical regulatory response:

Norway: in 1990 the banking crisis widened to include one of the country's largest banks, Fokus Bank, which received an equity capital guarantee from the commercial banks deposit insurance fund. Increasing demands on the two industry-sponsored deposit insurance

funds grew so rapidly that the Government established a new fund in March 1991 to provide loans to the two industry sponsored funds. In August 1991 funds were injected into Christiana Bank and Fokus Bank. (The preference capital was provided after the existing shareholders agreed to substantial write-downs of their shares.) Christiana Bank received extra capital in November 1991. A Government Bank Investment Fund was set up to invest in banks on a commercial basis. In late 1991 a fund was also created at the Norges Bank to provide deposits from the central bank on special terms. Further capital injections in Christiana Bank, Fokus and Den Norske Bank (the country's largest commercial bank) were made. The Government eventually held controlling interests in the three largest banks in Norway which together held around 85 per cent of total commercial banking sector assets.

Finland: In May 1992 the Government responded to declining bank capital positions and, fearing a credit crunch, announced a plan of injections of preference capital totalling 1.6 per cent of GDP. The capital was offered to all banks regardless of their capital ratios and in proportion to their risk-weighted Basle (1988) ratio. The capital was offered in two rounds. First, in August 1992 when 4 commercial banks and 53 savings banks raised Fmk 4.6 billion in capital. Second, in December 1992 when 2 commercial banks, 14 savings banks and 57 co-operative banks received FMK 3.3 billion in preference capital. The Finnish authorities also set up a Government Guarantee Fund in April 1992 with resources amounting to 4.1 per cent of the country's GDP (FMK 20 billion). The fund acquired Skopbank from Bank of Finland for FMK 1.5 billion in June 1992. In February 1993 the Finnish Parliament passed a resolution that required the Government to guarantee that Finnish banks were able to fulfil their commitments. Other funds were earmarked by the Government to save the banking system. Total support amounted to 4 per cent of GDP.

Sweden: The Government intervened to support Nordbanken (a 71 per cent State-owned bank in 1991) on various occasions between 1991 and 1993. Two other institutions also benefited from State support. In early 1992 Nordbanken was split into two components. A new State-owned company, Securum, took over most of the banks' bad assets. Nordbanken was also provided with equity capital as was Securum. The latter was also provided with substantial loan guarantees. In December 1992 the Swedish Parliament voted through legislation which guaranteed that banks' and certain credit institutions' contractual obligations - other than those to holders of equity and subordinated debt - would be met. A separate agency was set up to monitor government support of the banks. The support programme cost the Government somewhere in the region of 3 per cent of GDP.

All the above clearly illustrates the extremes to which small countries' governments will go in order to protect their core banks and banking systems. In all cases funding was provided by: the deposit insurance schemes; central banks (emergency liquidity assistance); and the government. No other class of claimants was asked to provide support.

One of the latest and most highly publicised bank failures relates to the Barings crisis of 1995. Once the scale of Baring's derivatives losses became apparent, the Bank of England did investigate with a group of UK institutions whether a rescue package could be constructed. At an early stage the Bank of England had apparently decided that Barings did not fulfil its own criteria for providing

financial assistance. Nevertheless, the Bank of England attempted to organise a private sector rescue given the potential damage to London's reputation. In the event, however, Barings was placed under administration because it proved impossible to cap its derivative positions. The businesses of Barings were subsequently acquired by Internationale Nederlanden Group (ING), the Dutch bank, for the nominal sum of GBP 1. Immediately following the Barings collapse some of the smaller UK merchant banks experienced a funding squeeze and the Bank of England provided (through the clearing banks) lender of last resort (LLR) facilities.

These events confirm that the Bank of England generally applies its LLR facilities only when there is a perceived systemic risk arising from the possibility of contagion, contagious financial disorder. The Bank, in this judgement, considers financial conditions at home and abroad, together with the nature of the bank threatened. An important point to note is that size and the TBTF doctrine have not really figured in Bank of England LLR events during recent years. Dale (1995, p. 11) puts it that "The Bank therefore favours the 'too-important-to-fail' principle rather than the 'too-big-to-fail' doctrine". The Bank of England also looks to the potential, damaging impact of a bank collapse on London's reputation as a financial centre.

7. Too-big-to-fail and Emu

The European banking industry has been transformed within a decade from an industry characterised by a high degree of government control, protection and limited competition, to an industry where nowadays the focus is increasingly based on market tests of efficiency, risk-adjusted returns and more efficient cost control (see Economic Research Europe Ltd./IEF 1996). As we move towards EMU (in whatever form) and the remaining regulatory differences continue to be eroded, the focus on shareholder value, cost minimisation and other tests of market efficiency are expected to intensify across European banking markets.

These forces will, of course, have the most significant impact on sectors of the European banking industry which are still, in some way, protected from full market forces. For example, mutual and public banks in many European countries benefit from various fiscal advantages that make it difficult for commercial banks to compete on equal terms. Some of these banks have traditionally been able to operate with low capital ratios because of government guarantees which ensure bail-outs in the event of failure. Given the increased emphasis on market forces, the recent trend towards demutualisation and privatisation, pressure on government finances and limited domestic banking growth prospects, it is believed that many of these mutual and public banks will consolidate and/or come to the market in the run-up to EMU and thereafter. Substantial consolidation is also expected in the private commercial banking sector. We suggest that over the next five years the number of European banks will fall by at least a third as a result of these forces.

The increased focus on shareholder value and cost minimisation is also expected to continue to impact significantly on all sizes of banks. In the major European markets the projected revenue growth from mainstream deposit and loan business is limited, hence the recent diversification into areas such as bancassurance and (for the largest banks) into investment banking. These are simple indications that the banking sector is diversifying in an attempt to add shareholder value in markets characterised by high levels of competition and increased market tests of efficiency. Greater ratio-

Over the next five years the number of European banks will fall by at least a third.

nalisation and restructuring will occur between banks that find it difficult to diversify - typically those that have regional and/or local franchises.

Pressures will intensify over the coming years because of the advent of a single currency and the expectation of pressures of EMU. As barriers continue to be eroded, the transactions costs of doing cross-border business should decline. Greater political pressure will be put on national governments to reduce or eliminate uncompetitive fiscal treatment of certain types of financial institutions and these forces will greatly intensify in those systems that are in EMU from the beginning. In addition, banking systems and financial markets will have to restructure in anticipation of the potential benefits afforded by the introduction of a single currency. EMU and the single currency are seen as critical developments in the creation of a 'level-playing field' across European banking markets. Having said this, however, banking markets (especially retail ones) are still typically national, with few institutions having a market presence outside their countries of origin. Deutsche Bank, Commerzbank and (until recently) Credit Lyonnais had the most substantial cross-border EU operations. Obviously, if banks increase their market presence across borders through, say, substantial cross-border mergers, then bank failure may not only be a national, but also a continental phenomena. At the moment the responsibility for bank supervision rests clearly at the door of the home regulator, but with the moves to EMU, this may change. The question of state support providing unfair competitive advantage within the EU has also been an important issue regarding the recent bail-outs of Cr dit Lyonnais and Banco di Napoli.

The establishment of the European Monetary Institute (EMI) in Frankfurt at the beginning of 1994 begs the question as to whether banks will be supervised at an EU level. Supervision may well be co-ordinated in the future at the EU level from Frankfurt, but it is highly unlikely that all tasks of EU bank regulation will be centred here. This is because regulators need market information which they can only get from being close to market participants. Information about banks in trouble will always first come to the ears of regulators through informal routes - market contacts, undercover regulators, etc. - rather than through formal channels. This is clearly the case if systematic fraud is being perpetrated where monthly bank returns to the supervisors reveal nothing suspicious. Having, say, Portuguese bank supervisors predominantly based in Frankfurt is hardly going to be an efficient or effective way to regulate the Portuguese banking system. As such, it seems unlikely that EU supervision will be centralised. Such centralisation would also cloud the issue of the TBTF doctrine: for example, which banks would be TBTF in an EU context? Our general expectations are that the co-ordinatory role of EU supervision will be increasingly enhanced at the centre, but monitoring and day-to-day prudential regulation of banks will in the future continue to be in the control of national authorities. The question of the role of state-subsidy in supporting troubled banks will also continue to rest firmly in the control of national authorities although the EU will be able to continue to enforce limited sanctions.

The increasing emphasis on market tests of efficiency and heightened levels of industry restructuring brought about by EMU will put increasing pressure on banks that have limited/protected banking franchises. While it still seems more than likely that the national regulatory bodies would try to bail-out core banks, the situation for regional and/or local operators is much more uncertain. Fiscal pressures placed on national governments, along with EU competition rulings will also restrict banking authorities' ability to undertake more than a handful of large rescues. This probably means that

Fiscal pressures placed on national governments, along with EU competition rulings, will restrict banking authorities ability to undertake more than a handful of large rescues.

the TBTF or 'too-important-to-fail' policy will be applied to banks that have a significant national presence but not for those banks that have substantial regional and/or local market franchises. Or to put it another way, governments are likely to rescue 'national champions', but there will be much less scope for bailing out 'regional champions' or/and local or specialist operators. (Especially given that these bail-outs will have to be ratified by the Commission in one form or another). Many of the regional banks in Europe are either local government owned (eg Deutsche Sparkassen or the Italian Cassa's), mutual and co-operative in nature. In the latter case, the usual response is to call upon sector support in the likelihood of bank failure. Given the increased pressure on these banks to meet market efficiency tests, this type of support is also likely to decline in the future.

Overall, the above factors point to a European banking market where state-support is used less frequently to rescue troubled banks. The intensification of competition, and pressures to increase efficiency, will lead to widespread industry restructuring and this will increase the likelihood of bank failure. This will prompt national regulators and the ECB to further coordinate rules and regulation regarding the supervision and bail-out of problem banks.

8. Candidates for protection

Central banks are likely to continue to maintain a policy of ambiguity associated with the provision of emergency liquidity assistance. They will still be strongly averse to making guarantees explicit *ex ante* because no regulator will wish to avoid weakening market discipline (moral hazard) and they will not want to commit themselves to future courses of action which they subsequently might prefer not to take. This policy of ambiguity will continue to provide (some may say an unwarranted) *ex ante* competitive advantage to the largest banks.

Depositors (and 'the market') will still formulate their own expectations regarding the banks that are likely to be rescued in the event of difficulties. Depositors will know that while the authorities will consider many factors including: the condition of the bank; why the bank is in trouble; prospects for recovery; and the state of the economy, the overriding consideration will be the potential spill-over costs if support is not forthcoming. What would be the effect on public confidence in banks generally? Which banks might be threatened? And would an abrupt closure cause foreign depositors to suffer loss and jeopardise the country's external financial position? The outcome is very clear. Depositors will still be most likely to be protected at a large bank. This case is neatly illustrated by the authority's response to the failure of Continental Illinois in 1984. In early 1984 prior to the run on Continental Illinois the FDIC had introduced a new programme that was designed to increase market discipline by placing uninsured depositors at risk. Between 16 March and 4 May 1984, seven small US banks were closed using a new procedure which did, in fact, impose losses on uninsured depositors in the cases where the failed bank's assets did not cover its liabilities. But when faced with the consequences of imposing losses on depositors of Continental Illinois (at that time the eighth largest US bank), the resolve of the regulatory authorities crumpled. This has been explained by the fact that the authorities had encouraged uninsured depositors with Continental Illinois and therefore felt obliged to cover their losses.

The most important objective of any central bank is to provide the operation of a safe and sound banking system based on public confidence. Tirole (1994) and Dewatripont and Tirole (1995) have

suggested that a partial solution to reducing the TBTF problem may be to introduce limits or co-insurance to cover counterparty risk in the interbank markets. Even so, central banks are invariably expected to come to the aid of any institutions whose failure would lead to systemic repercussions. The posturing suggested by US legislation and similar views being echoed in the majority of European banking systems, as well as in Japan, gives a message to the smaller- and medium-sized banks that public money will not be used as frequently as in the past to bail out ailing institutions.

9. Conclusions

This paper has focused on the role of central banks in managing bank failures. It is clear that central bank reactions to these failures encompass both 'too-big-to-fail' and 'too-important-to-fail' doctrines or policy considerations. The reputation of a financial centre or domestic financial system may also be a factor in these kinds of support activities. In all countries, systemic risk considerations are an important (but not necessarily exclusive) policy consideration in central bank support decisions. In the US there does seem to be a definite policy move to de-emphasise regulatory 'bailing out' of large troubled banks. There are fewer signs of this type of policy change in the main continental European banking markets although in the UK there has been a stronger movement towards a greater market orientation in handling bank failures. In Japan, the TBTF policy seems assured up to the year 2001.

This paper has not explored the causes of bank failures (eg. see Williamson (1988), Heffernan (1995)), the causes of bank runs (eg. see Jacklin and Bhattacharya (1988)), and the explanations of (broader) financial crises (eg. see, for example, Portes and Swoboda (1987) and Davis (1990)). Nor has any attention been focused on preventive supervisory techniques, like capital adequacy. More rigorous work (and not explored in this paper) has also been undertaken in other related areas, like emergency liquidity assistance in banking markets (see Herring (1993)).

The focus of attention has been on how central banks in a practical sense manage failures. In this final note we can begin to pose some related policy and normative questions. The first and probably most fundamental issue is that recent reviews (eg. see Kaufman (1994)) suggest that bank contagion risk, systemic risk, is more of a myth than a reality. Kaufman (1994, p. 143) concludes: ...'there is no evidence to support the widely held belief that, even in the absence of deposit insurance, bank contagion is a holocaust that can bring down solvent banks, the financial system, and even the entire macroeconomic in domino fashion'. Most European and Japanese central bankers might appear not to support fully this US view through the practical evidence of their respective policy actions.

The reason for these different perceptions may be due in part to the US system of deposit insurance. This institutional feature of the US banking market has perhaps made US banks less exposed to contagious runs than banks in Europe and elsewhere. Dale (1995, p. 15) goes on to suggest that another factor in this US view might be that 'the academic literature has for some reason failed to capture the risk characteristics of banks and their propensity to contagious collapse'. We will not move into this particular debate, however, it is germane to observe that effective preventive supervision should *inter alia* reduce the probability of systemic risk. Lack of empirical evidence for systemic risk and bank contagion events *ex post* may merely be evidence of effective, preventive (*ex ante*) supervision (of which TBTF and TITF are a policy component). By definition, systemic risk events are low probability ones.

The TBTF and TITF doctrines may have a different interpretation in a wider regional and/or global market place.

Within all banking jurisdictions, the managing of bank failures and the related TBTF and TITF doctrines are key policy issues. Market discipline clearly requires that the LLR is not used as a lender of first resort; this is one basic function of effective (and efficient) supervision. As banking markets become more integrated, there will be a continued blurring of the demarcation lines between the core and second-tier banks. The TBTF and TITF doctrines may have a different (from individual State's) interpretation in a wider regional and or global market place. Domestically big and important banks may not have the same recognition, say, at an integrated EU level. In a future integrated EU system of central banks, for example, it seems unlikely that individual countries would want to allow their own core or important banks to go under for the 'greater good' of EU market discipline although many banks with more limited franchises, such as the regional and/or local banks are likely to lose the protection that has historically been afforded to them.

Another key issue for present purposes is that the existence of deposit insurance, the TBTF and TITF central bank policies at national government levels, and the lack of an effective market in bank corporate control within many banking markets all conspire to weaken potential market discipline on banks. In particular, they operate to reduce the incentives towards greater productive efficiency in banking (7). Moral hazard dangers become an integral part of the system. Since these efficiency gains are a key economic objective of deregulation, a rather obvious policy dilemma emerges. This is an area where policy makers will increasingly have to question whether banks are becoming 'less special' and, therefore, less subject to these kinds of regulatory interventions. In the meantime, Goodhart and Schoemaker (1994, p.2) argue 'our maintained assumption is that such bank rescues will continue to be done'. This is also the practical, pragmatic policy view that seems to emerge from the present survey.

7. Allocative efficiency may, of course, still obtain under these conditions. However, as we saw earlier (Gray, 1996), allocative efficiency may not necessarily be compatible itself with banking stability.

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High real interest rates in Europe: A long-term risk?



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1. Introduction

In European countries, real long-term interest rates have been high in the past several years. They have been high with respect to two criteria. The first one is standard, it refers to the historical evolution of real interest rates. The low, even negative, levels of real long interest rates in Germany, France, the UK, as well as the US of the Seventies contrast sharply with the stable higher levels of the next decade. The second criterion is less often brought up, even though it relates to one of the oldest arguments of neo-classical growth theory. According to the "Golden Rule", the rule which, if followed, brings about the highest level of consumption per capita, the level of interest rate should be equal to the growth rate of the economy. In this case, the rate of capital accumulation is exactly sufficient to accommodate the depreciation of capital and the increase in labour force, and to make the economy grow at a steady rate, equal to the growth rate of productivity in the economy. Most strikingly since the end of the Eighties, the level of real interest rates in France, Germany and the UK has been almost consistently above the growth rate of the economy. This evolution raises two questions that we propose to investigate in this paper. The first one concerns the reasons for this high level of real interest rates, the second examines the conditions under which this level can be expected to move down.

When the long-term real interest rate is high relative to the growth rate of an economy, the increase in the stock of capital is insufficient to ensure the steady growth of economic activity. Solow's standard growth model shows that, in this case, it is necessary to reallocate resources from consumption towards savings in order to converge, in the long-run, to the optimal growth path with the highest level of consumption per capita. Most European economies face this stringent adjustment path at a time when they have been experiencing rising unemployment and restrictive public policies. High interest rates increase the cost of capital, discourage investment, and reduce firms' participation to the growth of the economy.

High real interest rates also make the economy more fragile by increasing credit risk. Indeed, high real interest rates induce a transfer of wealth from debtors to creditors. When this occurs at a time of low output growth, it makes it harder for borrowers to fulfil their debt payment requirements. The rise in the share of interest payments in firms' balance sheets increases the risk of default in the economy at large and the risk of financial instability. As their names indicate, financial intermediaries stand just in the middle of this flow of payments, so that a higher risk of default from debtors weakens their asset base. This is all the more threatening for banks that they face a tougher competition on the market for finance. Since the beginning of the Eighties, several industrialised countries have implemented a financial deregulation that has led way to more liberalised capital market. Banks cannot easily adapt to this heightened competition and maintain their profit margins for two reasons. First, while banks have to offer com-

Real long-term interest rates have been at historically high levels and consistently above the growth rate of the economy. This exposes banks to serious credit risk.

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petitive returns on their liabilities, they also are forced to align their prices with market conditions on the asset side of their balance sheet. Second, when real interest rates are positive and relatively high, increasing the price of debt is hard for lenders and might even be counterproductive, as a result of adverse selection. This weakening of banks' asset base, if real rates are systematically above the real return achieved by borrowers, exposes banks to serious credit risk. It also rekindles the risk of systemic instability for the entire financial system. All these factors represent as many reasons why determining the factors responsible for the high level of real interest rates, and the conditions for its reduction, is important. Answering this question becomes a necessary condition for understanding the nature of the risk, in terms of growth, that European countries are taking by not implementing the appropriate structural policies.

The present paper analyses the evolution of real interest rates between 1980 to 1996. This evolution has taken place in a context dominated by public commitments to deficit reduction, as well as persistently tight monetary policies despite low levels of inflation. To examine the factors behind long-term real rates in Germany, France, the United Kingdom and the United States, an Error Correction Model (ECM) is estimated to determine which fundamental variables explain the long-term, "equilibrium" level of real interest rates, as well as the short-term fluctuations around it. In a second part, these fundamental variables are included in a Vector Autoregression model of each country, to investigate what type of changes in long-term fundamentals would lead to lower interest rates, and with what consequences on economic growth, unemployment and inflation.

We start with a look at the historical evolution of long-term interest rates in Germany, France, UK and the US.

2. The historical evolution of real interest rates

The real interest rate is defined as the nominal interest rate, noted i_t , adjusted for expected inflation, π_t^e , between the present period (t) and the date of maturation of the debt instrument. Accordingly, the Fisher equation defines the real rate, r_t , as:

$$r_t = i_t - \pi_t^e$$

Because future anticipated inflation cannot be directly measured, any empirical measure of real interest rates is only an approximation. The difficulty becomes bigger when the long run is considered. The standard approach to this problem consists either in referring to statistical surveys on business expectations published by different organisations (e.g., *Consensus Forecast*, etc.), or in approximating inflation expectations using the past history of inflation rates. Because our concern here is only to reproduce the broad movements in real rates over time, we choose a simple method following Howe and Pigott (1991), Galati (1995), and others. π_t^e is approximated as the rolling average of domestic consumer price inflation over the past two years. Since, in the long run, investors' expectations of future inflation should on average coincide with its actual trend (if they are "rational"), the proxy of real interest we construct should equal the realised real rate. To a first approximation, this appears satisfactory. Using inflation forecasts based on forecasts from an estimated autoregressive process of inflation (see Barro and Sala y Martin, 1990, Blanchard and Summers, 1984) does not affect the results, as mentioned later in the paper. Table 1 below presents the average monthly real long-term interest rates on government bonds since the mid-1970s.

Table 1 - Real long-term interest rates

| | Germany | France | UK | USA |
|------------|---------|--------|------|------|
| 73:8-96:6 | 4.0 | 3.2 | 2.4 | 3.1 |
| 73:8-81:12 | 3.1 | -0.3 | -1.5 | -0.1 |
| 82:1-96:6 | 4.5 | 5.2 | 4.6 | 4.9 |
| Memo | | | | |
| 1963:1969 | 4.1 | 2.8 | 3.2 | 2.7 |

The sample period is split in 1982 to shed light on the negative level of average real long rates, before inflation rates begin to fall to single-digit figures. This split also allows to make an interesting comparison of real long rates across the four countries over the two periods. The convergence of real rates in the later period results from the liberalisation of capital flows and the integration of financial markets that took place in the Eighties for the countries examined. It is worth noticing also, that German rates were not negative in the Seventies, and have remained somewhat high over the whole 30 years period.

The most intriguing feature of table 1 is however the unusually high levels reached by real rates over the second period. Even if part of the increase results from the return of inflation rates to normal levels after the oil shocks, the average level of real rates in the recent past remains above their levels in the 1960s.

Figure 1 - Real Long-Term Interest Rates

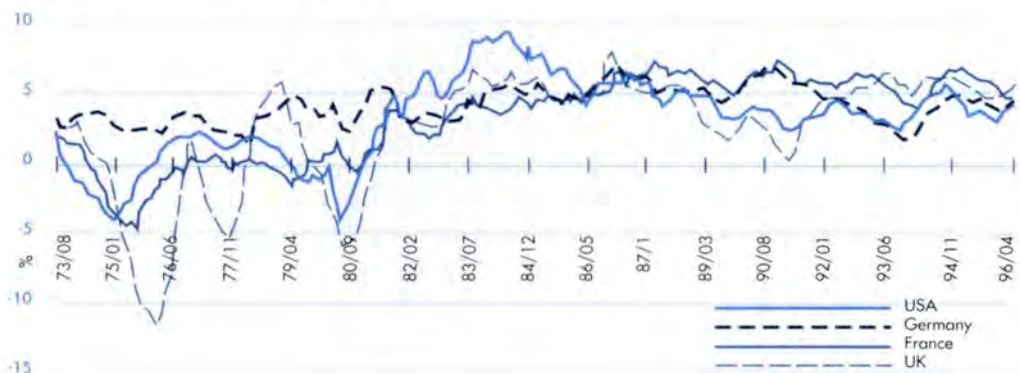


Figure 2 - Nominal Long-Term Interest Rates

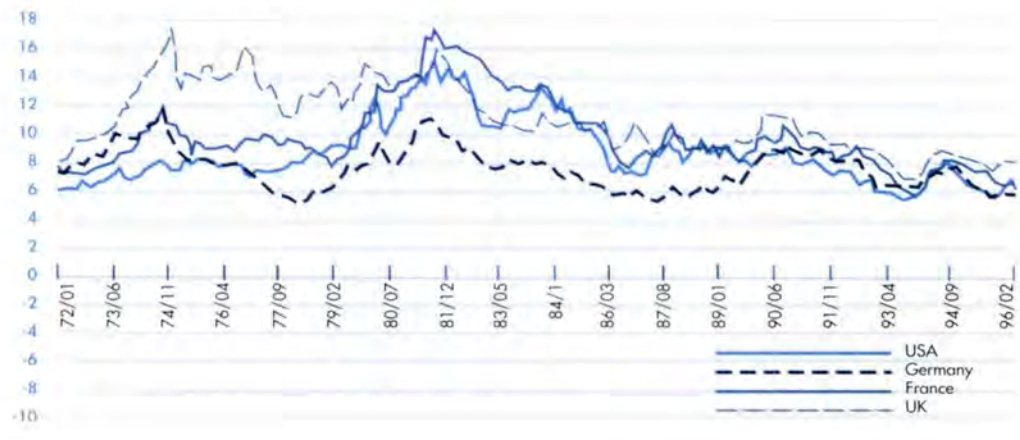


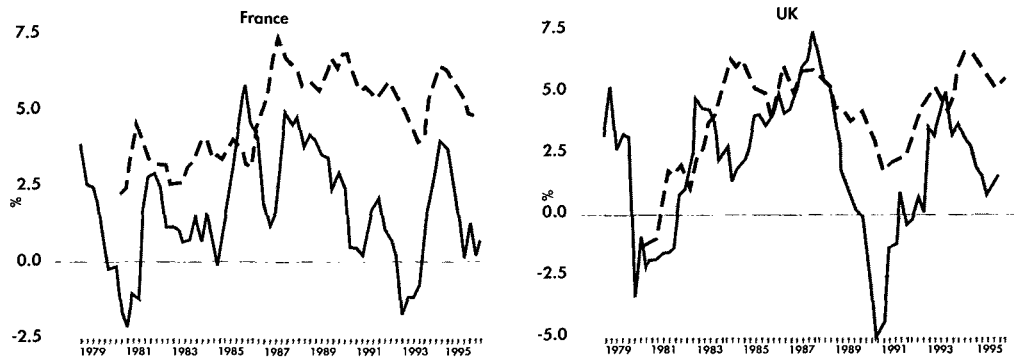
Figure 3 - CPI Inflation Rates (annualized)



Figure 1 shows the movements in the long real rates proxies for each country since the mid-1970s. Movements in nominal long-term interest rates appear in figure 2, inflation rates are represented in figure 3. The first two plots allow to compare movements in real and nominal long rates. Both appear to have varied a lot over time, and in fact by nearly as much. This implies that nominal rates have moved more than to offset inflation. The figures also show that nominal and real rates have moved in different directions: nominal rates have tended to fall over time, reflecting a general decline in inflation in the 1980s, while real rates have risen over time, as noticed before. Figure 4 shows that real long rates also remain well above real growth rates of European economies since the end of the Eighties.

Figure 4 - Real growth and Real long rates, quarterly, annualised.



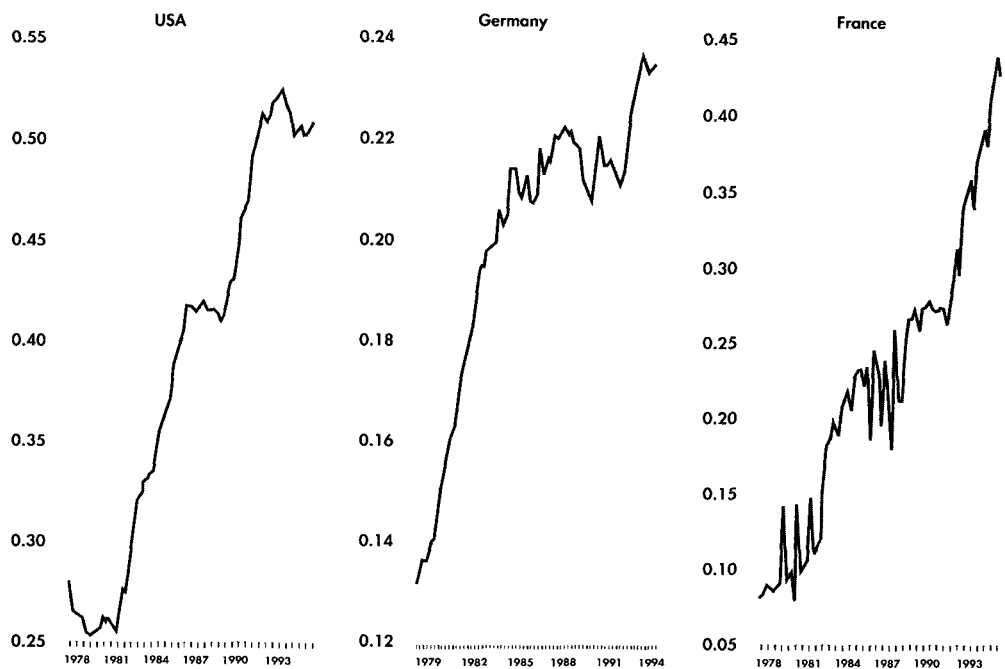


The risk premium compensating investors for expected inflation has not followed the actual downward path of inflation.

The data points therefore to the role of inflation expectations in the high level observed for real interest rates over the period examined. If the fall in inflation is credibly imbedded in expectations, inflation expectations are offset by a risk premium included in the nominal rate, so that the real rate is independent of inflation (Fisher effect). Instead, the parallel upward movements of both real and nominal rates observed in the data show that the risk premium compensating investors for expected inflation has not followed down the path of realised inflation.

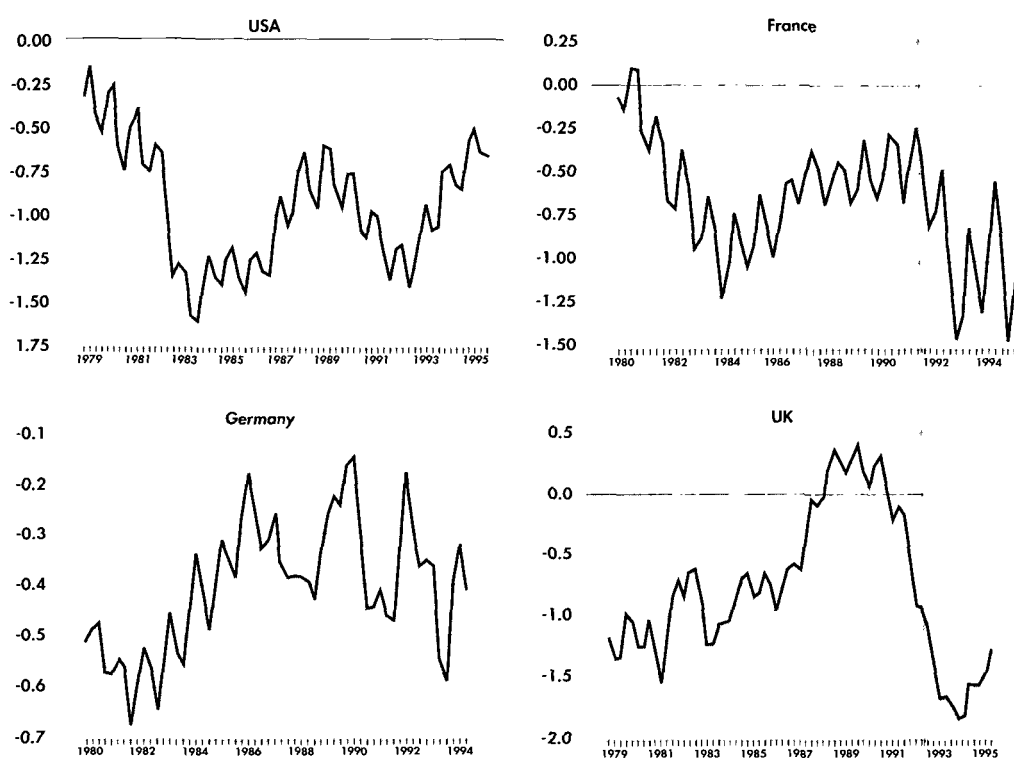
Several factors can explain the existence of an inflation premium. When investors think that public debt reaches a threshold level which increases the risk of default of the government (default in the sense of using an inflation tax, or "seignorage" to lower the burden of the debt repayment), the risk premium demanded in compensation by investors would tend to raise. Figure 5 plots the ratios of central government debt to GDP for each country.

Figure 5 - Public debt/GDP (quarterly)



It shows that these ratios have risen throughout the last decade, and may have increased the perceived risk of default of governments. Second, if agents expect high future deficits, their anticipation of future inflation may remain high even if current inflation is low. To capture the role of government fiscal deficits (or surplus) on the price of funds in the following econometric analysis, a proxy for fiscal credibility is constructed by taking the 6-quarter moving average of the ratio of public deficit (surplus) to GDP. (1) The mean level of public deficits over the past year-and-a-half acts as a signal to investors of the size and persistence of the adjustment in fiscal policy. Persistently high deficits increase the burden of the debt and affect expectations about the solvency of the government (Giavazzi and Pagano 1996). Figure 6 plots this proxy for each country. The credibility of monetary policy also determines how much of the decline in inflation is embedded in expectations about future inflation and propagated down the yield curve.

Figure 6 - Fiscal credibility (quarterly)



3. Econometric analysis of real interest rates

We turn now to the estimation, country by country, of the role played by each fundamental variable in the determination of the long-run equilibrium (or "natural", in Fisher's terminology) level of real long-term rates. Given that the actual, or market, level of the long real rate may differ from this value, a second relationship is estimated that explains the fluctuations of real long rates around this fundamental level. These fluctuations represent the adjustment of the real rate to changes in its fundamental determinants.

1) That is to say, $FC = \sum_{i=1}^6 (def / gdp)_i$

3.1 Determinants of long-term real interest rates

To identify the variables that describe well the long-run equilibrium level of real long rates, a linear equation describing the relationship between real long rates and seven fundamental determinants is estimated. These variables are the ratio of public debt to GDP, the proxy for fiscal credibility presented in section 2, the short-term rate as an index of the stance of monetary policy, real GDP, the US and German real long-term interest rates, as well as their spread as an index of the external constraint. For a given country i , the long-term real interest rate regression equation is the following:

$$R_t^i = \alpha_0 + \alpha_1 Y + \alpha_2 r_t^i + \alpha_3 FC + \alpha_4 GM_t + \alpha_5 US_t + \alpha_6 SPR + \alpha_7 D + u_t^i$$

where Y is the country's GDP in volume, r is the 3-month short rate, FC is the index of fiscal credibility, GM is the German long rate, US is the US long rate, SPR is the US-German real long rates spread, and D is the ratio of central government debt to GDP. u denotes the residuals from the regression. All variables are expressed in real terms (deflated by the CPI). Data is quarterly and runs from 1978:1 to 1996:2. The data is extracted from the IFS database of the IMF. The equation is estimated using OLS with Newey-White corrected errors. Table 2 below shows which variables matter for domestic real long interest rates by reporting the coefficients significant at least at the 5% level for each country. (2) T-statistics are given in parenthesis.

Table 2 - Cointegration regression estimates

| | Germany | France | UK | US |
|------------|-----------------|-------------------|------------------|------------------|
| α_0 | 1.32 (1.98) | -17.01 (-9.32) | -9.24 (-7.54) | 9.77 (6.91) |
| α_1 | | 0.32 (11.4) | 1.86 (6.52) | -0.48 (-6.20) |
| α_2 | 0.58 (10.96) | 0.16 (4.52) | 0.29 (3.28) | 1.31 (10.13) |
| α_3 | 1.87 (2.90) | -1.10 (-4.59) | -0.93 (-3.33) | |
| α_4 | | 0.39 (5.82) | -0.29 (-3.00) | |
| α_5 | 0.36 (4.51) | | 0.64 (6.20) | |
| α_6 | | 0.47 (5.45) | | |
| α_7 | | | | 39.70 5.50 |
| R^2 | 0.78 | 0.84 | 0.91 | 0.78 |
| DW | 0.29 | 1.10 | 0.70 | 0.75 |

2) The T-statistic value at the 5% significance level is 1.96 and 2.57 at 1%.

These empirical relationships provide an estimate of the role of each fundamental variable in the determination of equilibrium interest rates. (3) As Table 2 shows, the long-term real rate is significantly related to the index of fiscal credibility for all countries. For France and the UK, the estimated coefficient is negative. This means that, when one of these countries' fiscal deficit decreases, the long rate decreases. Two interpretations of this result are possible. The change in the average size of the fiscal deficit over the past year-and-a-half may influence the long rate through a credibility effect (and a change in the inflation risk premium) or through a simple supply and demand effect (as in the IS-LM framework). However, the fact that the ratio of the debt-to-GDP is not independently significant for any of the three European country, while the fiscal credibility proxy is, argues in favour of the first interpretation. For the US, the (positive) significance of the debt-to-GDP ratio captures, on the contrary, the second effect. This difference may be explained by the fact that the commitment to deficit reduction in the US is a political commitment (dating from the election of a republican majority in the Congress). For the European countries, deficit reduction is a strict condition for entering the Monetary Union. The inflationary risk of this commitment may then be perceived more acutely, and influence the risk premium component of real long rates.

Fiscal credibility represents a means to reach a lower level of long rates.

This result provides an answer to the question of what kind of change in fiscal policy matters to improve economic conditions. First, since this index of fiscal credibility is computed over the year-and-a-half preceding each period, the persistence of the fiscal change seems to be the key factor to build credibility for the government. This is important since fiscal credibility represents a means to decrease the perceived inflation risk and reach a lower level of long rates. Second, the finding that a fiscal tightening is associated with lower long rates is consistent with the non-linearity result on the real effect of a tightening of fiscal policy proposed by Giavazzi and Pagano (1996). According to them, a small increase in government expenditures is expansionary, in agreement with traditional Keynesian arguments. On the contrary, a large one contracts the economy because it affects investors' expectations on government solvency and increases the risk of future inflation. The subsequent increase in interest rates demanded by investors counteracts the positive effects of an expansionary fiscal policy on the economy. Given the high levels reached by public debt but the slow pace of growth in the countries under study, the negative relationship between real rates and fiscal credibility found in this paper provides further evidence that public finances have reached a level that concerns investors.

The analysis of Table 2 reveals also the importance of the role played by the short interest rate on long rates. This effect is particularly strong in the UK, Germany and the US. A rise of 1 percentage point in the short rate is associated with a long rate increase of roughly 0.3 to 0.6 point in the UK and Germany respectively, and of 1.3 points in the US. These magnitudes are consistent with the view that investors use the stance of monetary policy as a signal about future inflation. It enters the risk premium they require on interest rates. (4) The robustness of the results is tested by re-running the regressions using different forecasts of inflation. First, following Blanchard and Summers (1984), new inflation forecasts are constructed, based on an estimated autoregressive process for inflation. This method also gives an important weight to past observations of inflation and the conclusions of the paper are not affected. Second, a shorter range of past inflation rates is used to extract a trend inflation rate from short-term interest rates (half of that used for long rates). The results of the long rate regressions are not modified either.

3) It has to be kept in mind that these regressions do not allow for causal inference.

4) The large size of the effect for the US reveals a strong cointegration relationship between short and long term rates. This is examined next.

There is an interest rate linkage between European countries tied by exchange rates arrangements.

Table 2 confirms the presence of an interest rate linkage between European countries tied by exchange rates arrangements. First, the German long rate is significant and positive in the equation determining the French long rate. Second, the significance of the US-Germany interest spread for France (the US rate alone is not independently significant) captures the pressure put on French rates when interest rates differentials between the US and Germany threaten the value of the German currency. The significance of the US long rate in the German equation captures the same effect. The US rate matters directly for United Kingdom which is less tied to the European constraints. The negative correlation between the UK and the German long rates reveals their different cyclical patterns.

In all the previous regressions, the Durbin-Watson values indicate the presence of serious positive serial correlation in all cases. The second stage of this analysis consists therefore in removing the bias it implies in the coefficients estimates. Augmented Dickey-Fuller (ADF) tests are then performed, to test for the presence of a unit root in the residuals of each regression. A rejection of the presence of unit roots argues in favour of cointegration between the long rate and the set of independent variables in each equation. These tests are performed on the residuals of univariate regressions among all variables of each cointegration equation reported in Table 2. Because of their number, the ADF test statistics are not reported here to save space, but the results are the following. For France, the tests lead to accept that the real long rate has a common trend with real GDP and the US-German spread. However GDP and real short rates share also a common trend, and short rates are cointegrated with all other variables. There is therefore some fundamental linkages between all the significant variables explaining long rates in France. In the case of Germany, the real long rate is fundamentally related to the proxy for fiscal credibility. In the UK, the long-term rate, real GDP, the short-run rate and fiscal credibility share a common trend. Finally, in the US, the long-run, short-run rates, the debt-to-GDP and real GDP variables appear fundamentally linked. As usual, these tests have to be taken with caution as evidence of cointegration (See, for example, Blough 1992, Cochrane 1991, Stock 1990).

3.2 Short-run fluctuations in real long rates

This model is tested for the presence of a cointegration relationship, i.e., a common trend, tying the explanatory variables with real long rates. (5) To do so, the equation is rewritten as an Error Correction Model, where the cointegrating relationship enters as an error correction term. This second equation represents a better specification for analysing real long rates movements and their short run dynamics. (6) It explains the change in real long rates in terms of past differences between previously realised values and the equilibrium rate (the error correction term, or ECT), and current and past changes in the set of explanatory variables from the first (or "cointegrating") equation presented in Table 2. These are changes in interest rates and shifts in macroeconomic policies. Fiscal policy changes are introduced in the form of current and past changes in government deficit or surpluses. Monetary policy changes appear indirectly through changes in the short-term real rate. The dynamic equation for the long-term interest rate estimated for each country has the form:

$$\Delta R_t = ECT_{t-1} + \sum_{j=1}^4 \alpha_j \Delta R_{t-j} + \sum_{j=0}^4 \Delta X_{t-j}$$

5) This is necessary since the existence of a cointegrating vector between the explained variable and the explanatory ones would bias the value of the coefficients (towards being significant) in the long rate estimation.

6) The Error Correction Model produces consistent and efficient estimates of parameters. It is often the preferred instrument for estimating long series, even in the absence of cointegration (See LeSage, 1990).

where X is a vector of explanatory variables containing all the variables described before, and Δ is the first-difference operator.

Incorporating this information improves the explanation of real long rates over time. Relative to the movements captured by the equilibrium relation, the dynamic model reproduces history with approximately 30 (France) to 60 percent (US) less errors. The main goal of this model is however to assess the relative contributions to movements in the actual real long rate of the equilibrium long rate and changes in macroeconomic policy variables. Table 3 reports the variables explaining changes in the real long rate in each country (the coefficients are not reported here to save space). All variables reported are significant at least at 5%, two stars denote the 1% significance level.

Table 3 - Determinants of changes in real long rates

| Germany | France | UK | USA |
|--------------------|-----------------------------------|-----------------------------|-----------------------|
| $ECT_{.1}^{**}$ | $ECT_{.1}^{**}$ | | $ECT_{.1}^{**}$ |
| $\Delta R_{.3,-4}$ | $\Delta R_{.1,-3}$ | | $\Delta R_{.2}^{**}$ |
| $\Delta Y_{-1,-4}$ | $\Delta Y_{.4}$ | $\Delta Y_{-1,-4}^{**}$ | $\Delta Y_{-1,-2}$ |
| | ΔFC | $\Delta FC_{-2,-3,-4}^{**}$ | |
| Δr | $\Delta r_{.3}$ | $\Delta r_{0,-1,-3}^{**}$ | Δr^{**} |
| ΔUS^{**} | $\Delta GM^{**}, \Delta SPR_{.4}$ | ΔUS^{**} | $\Delta GM_{.3}^{**}$ |

In this table, r represents the short rate, FC , the index of fiscal credibility (6-quarters average deficit/GDP), GM , the German long rate, US , the US long rate, SPR , the US-German rates difference. Subscripts denote the lag at which a variable is found significant.

The dynamics of the long rate exhibit mean reversion.

The ECT term captures the long run "equilibrium" level of real interest rates on long bonds. It is significant at 1% in all regressions. The fact that it appears negative in all countries' regressions means that the dynamics of the long rate exhibit mean reversion. A positive deviation from its equilibrium level will force a negative change in the real long rate in subsequent periods to correct for this "error". This is also the reason why the estimated lags of the long rate appear negative in the regressions.

The other variables presented in the table are those which change determine short-term movements in the real long rate. In all four countries, shifts in monetary policies (proxied by the short rate) contribute to explaining changes in domestic real long rates (the short rate is even significant at 1% for the US). It appears from the estimation that the contemporaneous coefficient on the short term rate for all countries has a positive sign (whether the coefficient is significant or not), but lagged short rates enter negatively in all countries' regressions. This is consistent with the idea that monetary policy affects inflation expectations credibly but only with some lag. It takes time for a tightening of monetary policy to affect the inflation risk premium demanded by investors and lead to lower real long rates.

The estimation also reveals that changes in fiscal policies matter in France and the UK, although with some lags for the latter. Short-term fluctuations in the German and US long rates are not sensitive to this variable. Finally, changes in the German long rate determine contemporaneous movements in the French real long rate, at the 1% level of significance. The US long rate plays this role for the United Kingdom and Germany. Short-term movements in real long rates seem therefore to emphasise an international linkage of financial markets, where US macropolicies influence the German and English rates, to which the French rate is anchored. They appear however transitory deviations from a long-run "equilibrium" level.

4. Is there a margin to decrease real interest rates?

If it was possible to calm down inflation fears and attain a lower level of real long rates, would that relaunch economic growth and reduce unemployment?

The analysis of the previous sections pointed to public commitments to fiscal deficit reduction and to the tightness of monetary policies in Europe as the reasons for the inclusion of a high term premium in long rates. The question of the influence of these high interest rates on real economic activity can therefore be reformulated: if it was possible to calm down these inflation fears and attain a lower level of real long rates, would that relaunch economic growth and reduce unemployment? Or would the situation be worsened because cheaper credit creates inflationary pressures, costly for the stability of the European currencies? This section tries to answer this question by estimating the dynamic response of the economy to a downward shock to long-term interest rates and their determinants.

4.1 A Vector Autoregression model of the economy

To examine the role of long-term interest rates on the rates of growth and unemployment in Germany, France, and the United Kingdom, a reduced form Vector Autoregression model is estimated for each country. Such a model summarises the dynamics of the economy through a set of linear equations describing the interaction in time of several key variables. This approach is adapted to the present issue by including the long term interest rate and a measure of fiscal policy to a standard set of variables usually considered for macroeconomic policy investigation. (7) These variables are a measure of real activity (GDP or the unemployment rate), prices and the short term interest rate. Foreign long rates are added to domestic Vector Autoregression models for countries where such variables were found to matter for domestic long rate in section 3. The addition of a fiscal policy variable results from section 3, where its role in the determination of real long term rates was estimated significant. Having both inflation and fiscal policy variables in the model allows to investigate the response of the economy not only to long rates but also to changes in the variables that determine the level of long-term rates. Note that all domestic interest rates variables are in nominal terms, so that the dynamics of the price level can be examined separately. The model for each country is estimated using quarterly data from 1980:1 to 1996:2. All variables enter the model with 4 lags. GDP and prices are expressed in growth rates. (8)

Each country model is used to derive impulse response functions (IRF). These IRF illustrate the response of each variable (fiscal credibility, output growth, inflation, the short-term and the long-term rates) to a 1% positive standard deviation shock to each of these same variable. (9) Figures 7

7) See Sims (1972, 1980), Bernanke and Blinder (1992), Litterman and Weiss (1985) for example.

8) Unit root analysis in the previous sections rejected the assumption of cointegration between these variables in level and long interest rates. Fiscal expenditures are in logs following Doan, Litterman and Sims (1984).

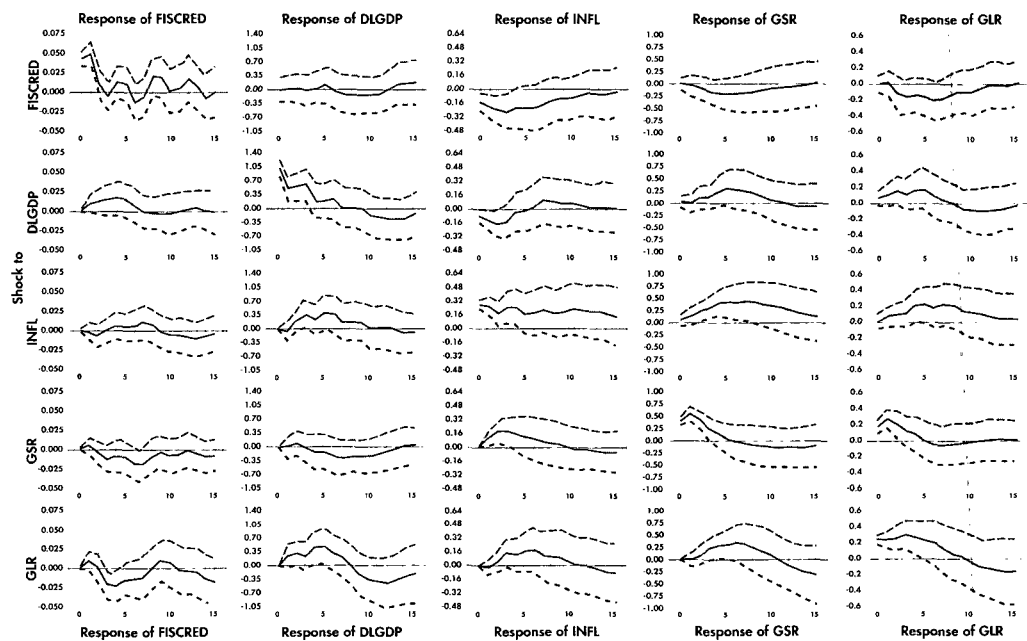
9) In the remaining of the paper the terms "shock" will refer to a 1% standard deviation shock.

to 9 present these systems of response functions for each country, estimated over a horizon of 16 quarters with two standard deviation confidence bands (dotted lines). Each row presents the response of all variables to a shock to the column variable, as indicated in the margins. Note that since the system of equations is linear, positive and negative shocks are represented as symmetric lines relative to the horizontal axis. Consequently, to see the response to a negative shock, it is sufficient to inverse the response functions relative to the x-axis. The results obtained for each country are now presented.

4.2 Germany

The IRF for Germany are presented in Figure 7.

Figure 7 - Impulses responses - Germany



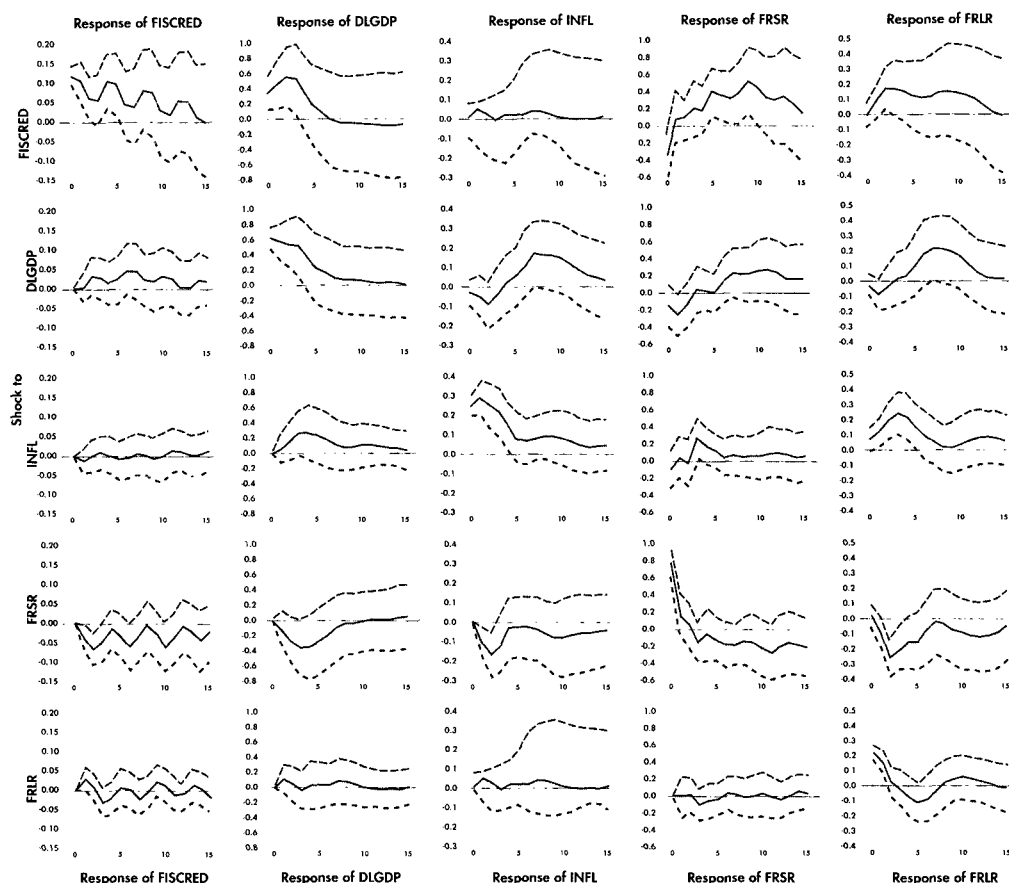
In Germany, reducing the deficit lowers long-term interest rates and helps reduce unemployment at no cost in terms of inflation.

They produce the following conclusions. The level of long rates depends on fiscal deficits and inflation. Reducing the deficit lowers long-term interest rates with only one quarter lag. This helps reducing unemployment, at least in the short-term. It has no cost in terms of inflation. Reducing the inflation rate directly (through tighter monetary policy) does not appear beneficial. Reducing it through an increase in fiscal credibility (due to persistently lower deficits) works by reducing the risk premium content of long-term interest rates. It allows to generate the positive effects of low long rates for the economy.

4.3 France

Figure 8 shows the IRF plots for France.

Figure 8 - Impulses responses - France



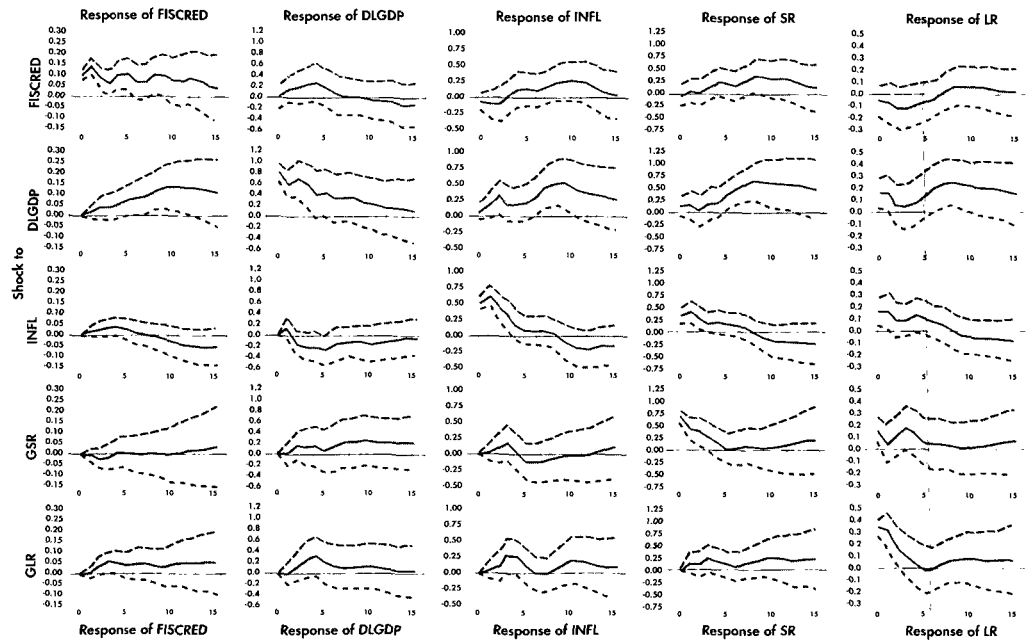
The following conclusions can then be drawn from this analysis. To the question of how to reach lower levels of long-term rates in France, the answer would point to a reduction in inflation (or an increase in short rates), since the dynamic reaction of long rates to public deficits appears weak. However, the benefit of lower long rates in terms of GDP growth is zero since an exogenous negative shock to inflation generates a drop in GDP growth (similarly for a rise in short rates). It appears therefore that relaxing inflation control in France seems a more appropriate measure to support economic growth than a lowering of the level of long rates per se. It would raise short and long rates, but it would also spur GDP growth and lower unemployment persistently. These two results could also be attained by reducing budget deficits, although the responses of both variables die out more quickly. As in the case of Germany, this would not trigger inflation.

Relaxing inflation control in France seems a more appropriate measure to support economic growth.

4.4 United Kingdom

Figure 9 shows the IRF for the UK.

Figure 9 - Impulses responses - UK



In the UK, deficit reduction helps lower long interest rates and favour economic growth. Inflation picks up as GDP grows.

It suggests that deficit reduction helps lower long interest rates and favour economic growth, but at the cost of triggering higher inflation (a 1% increase in fiscal credibility increases GDP growth by 0.25 percentage points after one year and increases inflation over the next years). However inflation only picks up as GDP grows, and the graph confirms that a positive shock to GDP growth is inflationary. When the unemployment rate is used instead of GDP growth, the positive shock to fiscal credibility reduces the unemployment rate for 14 quarters, and by up to a quarter of a percentage point after one year. These are the benefits to be compared to the inflationary cost of deficit reduction in the UK.

Finally, it is worth noticing that when the US real long rate is introduced in this set-up (not shown), a positive shock to this variable increases domestic long rates and unemployment (0.16 points), and reduce GDP growth. The level of the US long rate seems therefore to represent a constraint for UK growth, independently of domestic fiscal and monetary policies.

5. Conclusion

According to the analysis, two variables explain the long run level of real long rates. The first one is the tight stance of monetary policies, which is perceived by agents as a sign that inflation may still be around the corner. The second is the risk premium demanded by investors when, in front of strong public commitments to deficit reduction, they become afraid that governments become tempted to monetize their debt. The short-term dynamics of real long rates around their long-run

trends are mainly the result of an international linkage of capital markets, where US macro-policies influence English and German bond rates, to which the French rate is anchored.

The impulse response estimation shows that reducing public deficit has positive effects on the German economy. This is consistent with our knowledge of the inefficiency of public investment in East Germany since the reunification: Enormous amounts of public spending are directed towards East Germany with no result in terms of growth and employment. For France, the analysis points to a relaxation of the tight control of inflation as the path towards a growing economic activity. This brings up the well-known conflict that France has been facing along its path towards European Monetary Union. The constraint of tight inflation control, with its long-term expected benefits in terms of European integration, is closely associated with its costs in terms of growth, since such a policy hampers the natural adjustment of the country to its specific problems. In a more market-driven economy like the UK, a tightening of monetary policy is found to reduce long rates and increase GDP growth and employment. The different results between these countries come from their differences in terms of economic history and organisation. These determine the motivations behind their respective public policies and the forces composing their engine of growth.

If the European Central Bank is considered credible with respect to the no-bailout clause, the build-up of credibility could bring the level of real interest rates more in line with economic growth rates, as in the US.

What factors will lead high real long-term interest rates to persist? If EMU goes ahead on time and the European Central Bank is considered credible with respect to the no-bailout clause, and/or if the Stability Pact is imposed rigorously, one could expect the risk premium content of long-term interest rates in participating countries to decrease. This build-up of credibility could bring the level of real interest rates more in line with growth rates, as in the US.

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The expected loss as a credit risk measure

*"An inability to assess and put into comprehensible perspective the hazards we face generally leads to unfounded and disabling personal anxieties or to unattainable and economically paralyzing demands for a risk-free environment".
J.A. Paulos, "Beyond Numeracy, 1992, p.191.*



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1. Introduction

Considerable progress has been made in devising methods for better assessing and managing a wide array of financial risks. Concepts such as "duration" or "value-at-risk" are prominent examples of how such research has been transferred into everyday market practice. However, credit (or default) risk incurred by banks in their lending operations has so far received less attention. Though awareness of this shortfall is spreading (The Economist [1996]), many financial intermediaries might still be ill-prepared to deal consistently with crucial banking issues such as credit-enhancement valuation and loan-loss provisioning. Equally, bank solvency rules appear to lag behind recent regulatory innovations in the area of market risks, both in theoretical sophistication and in practical accuracy. The aim of this article is to introduce a simple and intuitive framework designed to promote the understanding and the measurement of certain aspects of credit risk.

2. Credit risk and lending terms

A risk-neutral lender considering a loan to a client subject to default risk will set the lending rate so as to break-even with respect to an alternative investment in a riskless security of the same tenor as the loan. To illustrate, take a loan of ECU 1, and a 1-year maturity. Call R the riskless rate (e.g., the yield on a 1-year Treasury bill), P the borrower's one-year default probability (e.g., the historically observed default frequency for a class of borrowers to which the main obligor belongs) and RR the loan's recovery rate (i.e., the fraction of the loan which is expected to be salvaged in case of bankruptcy of the borrower). Then, assuming risk-neutrality, the break-even condition is:

$$P.(1+R^*).RR + (1-P).(1+R) = (1+R)$$

where R^* is the risky lending rate we want to find. (1) Extracting R^* from the above expression, we have:

$$R^* = (1+R)/[P.RR + (1-P)] - 1.$$

Thus, unless $P = 0$ and/or $RR = 100\%$, $R^* > R$. (2)

Many thanks to Enrico Barone of IMI for helpful comments. The author only is responsible for the opinions expressed, as well as for any remaining errors

1) The following conventions are used: capital letters denote variables having a time dimension (e.g., interest rates and default probabilities, as well as time itself), while small-case letters stand for quantities which are expressed as absolute monetary values (e.g., expected losses; bond, guarantee and option prices). However, as traditional, the standard deviation of variable X will be expressed as $\sigma(X)$, while the correlation between X and Y as $\rho(X, Y)$.

2) In principle, loan pricing should not only take into account the risk of individual operations assessed on a stand-alone basis, but their contribution to the overall risk of the lender's loan portfolio as well. In other words, what also matters is the correlation between the returns on the individual exposures and those on the existing portfolio. This "complication" is not considered here, and loan (guarantee) risk will be analysed on a stand-alone basis.

Next, define the loan's expected loss (e^*) as the sum the lender can actuarially anticipate to lose. It is thus the present value of the product of the loan's end-of-period contractual value ($1+R^*$) (3), the borrower's default probability (P), and the loan's loss severity ($1-RR$):

$$e^* = (1+R^*) \cdot P \cdot (1-RR) / (1+R).$$

That R^* is indeed the correct lending rate for a risk-neutral lender can be seen from the fact that the difference between the future value of the expected loss (namely $e^* (1+R)$) and the loan's end-of-period contractual value ($1+R^*$) is equal to $(1+R)$. In other words, the credit spread ($R^* - R$) is such that the revenues from it are barely sufficient to cover the expectation of loss, leaving the lender with a risk-adjusted (i.e., expected) return on the loan equal to the risk-free rate. Therefore, expected loss and risk spread are two different ways to measure the same concept (i.e., a present value sum and a periodic percentage charge, respectively), namely what a lender anticipates on average to lose on a loan.

Expected loss and risk spread are two different ways to measure the same concept.

As an example, consider an ECU 100, 1-year loan. The risk-free rate is 7%, the borrower's one-year default probability 1.65%, and the recovery rate 40%. Then, the lending rate is 8.07% and the expected loss is ECU 1, or 1% of principal. The expected loss is thus an intuitive measure of the credit risk embedded in the lending operation. It incorporates all the main risk factors: the borrower's default probability (e.g., its credit rating), the loan's recovery rate (a function of debt seniority and collateral), and its maturity. This framework can be generalised to the case where the loan covers several periods, there is a whole risk-free yield curve, and default probabilities vary according to maturity (see Box 1). (4) However, as an indicator of credit risk, the expected loss has other appealing, if less obvious, properties. To perceive them, it is necessary to introduce the notion of credit insurance.

3. Loan guarantees and option pricing

The lender in the above example has basically two choices. He may collect ECU 100 from depositors promising a 7% return, and lend ECU 100 at 8.07% to his client. At maturity he repays ECU 107 to depositors, and uses the extra ECU 1.07 (= ECU 108.07 - ECU 107) to cover the future value of the expected loss. However, he may also disburse the loan at ECU 99 at the riskless rate of 7% (on a face value of ECU 100), thus earning a promised yield of 8.07% [(107-99)/99]. (5) In so doing, he would withhold an amount equal to the expected loss which, invested in risk-free securities, provides "self-insurance" against credit risk. At maturity, the client will return ECU 105.93 (ECU 107 less the future value of the expected loss, or ECU 1.07). This sum, and that from the release of the risk-reserve, will be used to repay depositors ECU 107.

3) It is useful to distinguish among three types of end-of-period loan values (or, rates of return): the contractual or promised (here, $1+R^*$), the expected or risk-adjusted (here, $1+R$), and the actual or realised value. The first definition provides the upper limit for the other two.

4) Notice, however, that the expected loss approach as described in this paper does not apply to off-balance sheet instruments such as swaps. This is so because swap credit exposures may fluctuate in favour of one or the other of the counterparties, and the probability that, at any one time in the life of the swap, the latter is an asset or liability has to be taken into account. This renders the quantification of default risk in swaps a more difficult exercise (and explains why risk mitigation via collateral or rationing is a generally preferred route to risk-pricing). On this see: E. Sorensen & T. Bollier [1994].

5) It should be clear from this example that the often-used term "loan pricing" may have two meanings. According to the first, it refers to the determination of a per annum percentage "premium" to be added to the corresponding riskless rate, while the loan is disbursed at par. Second, it can be understood as referring to the "discount" at which a loan is disbursed below par, while its coupon rate is set at the riskless rate level. We have argued that the fair value of this discount is equal to the loan's loss expectation.

Box 1 - The expected loss in multi-period loans

Consider an ECU 100 junior subordinated loan with a 3-year maturity, to be paid back in two equal instalments (c1 and c2) at the end of the second and third years. The borrower is rated Ba1. The risk-free par yield-to-maturity (YTM) curve starts at 7% for 1-year loans, and steps up by 0.25% for each additional year. The corresponding one, two and three-years zero-coupon rates, computed with the bootstrapping method, and thereafter used for discounting purposes, are therefore: Z1 = 7.00%, Z2 = 7.26% and Z3 = 7.53% respectively. The loan's Macauley duration is 2.363 years.

The historical default frequencies for a Ba1 borrower (see Carty & Lieberman, [1996], Table 9) are 0.85%, 1.83% and 1.78% for the 1st, 2nd and 3rd years. The respective survival probabilities are therefore: S1 = (1 - 0.85%) = 99.15%, S2 = (1 - 2.68%) = 97.32% and S3 = (1 - 4.46%) = 95.54%. Due to the low seniority of the loan, the recovery rate is conservatively assumed to be zero. Following Fons [1994], the risky lending rate is found by solving for R* the following expression:

$$100 = 100 R^* S1/(1+Z1) + (100 R^* + c1).S2/(1+Z2)^2 + [(100-c1).R^* + c2]. S3/(1+Z3)^3$$

Then, R* = 8.94% and, setting S1 = S2 = S3 = 1, R = 7.40%.

As can be seen from column (ii) in the table below, were the lender to grant this loan at 7.40%, she would in effect lend out ECU 100 while entertaining the actuarial expectation to be repaid ECU 96.68 only (in present value terms, including both capital and interest). This is so because the riskless rate would not allow for the recovery of the anticipated loss of ECU 3.32. Thus, the fair market price of the loan disbursed at the risk-free rate of 7.40% (that is, b*) is ECU 96.68 only. Therefore, the loan can either be disbursed at ECU 100 at 8.94%, or at ECU 96.68 but with a coupon of 7.40% (and serviced on a face value of ECU 100).

| Year | Yields | P | PV of Expected Loan Cash-flows Discounted at: | | |
|--------------|--------|--------------|-----------------------------------------------|--------------|-------------|
| | | | 8.94% | 7.40% | e* |
| | | | (i) | (ii) | (i)-(ii) |
| 1 | 7.00% | 0.85% | 8.28 | 6.86 | 1.42 |
| 2 | 7.25% | 1.83% | 49.86 | 48.55 | 1.31 |
| 3 | 7.50% | 1.78% | 41.86 | 41.27 | 0.59 |
| Total | - | 4.46% | 100.00 | 96.68 | 3.32 |

For a riskless loan valued at b and promising to repay ECU 1 at maturity (T), we have: (*)

$$(i) \quad b = 1/(1+R)^T$$

while an analogous relationship holds between the fair value of the risky loan b*, its interest rate R* and T. From (1) in the text, we may thus derive the expected loss as:

$$(ii) \quad e^* = b \cdot \{1 - [(1+R)/(1+R^*)]^T\}$$

For example, a 3-year Treasury bond is quoted at par (b = ECU 100) for a yield (R) of 7.50% and a duration (T) of 2.795 years. A 3-year corporate bond trades at a yield (R*) of 9.00%. We may then conclude that, abstracting from any liquidity consideration, the market is quoting the bond at an implied expected loss of ECU 3.80.

Finally, noting that g = (b° - b*), and using (i), we obtain the value of the guarantee:

$$g = b^{\circ} \{1 - [(1+R^{\circ})/(1+R^*)]^T\}$$

which reduces to zero if R° = R* and to (ii) if R° = R.

(*) For ease of exposition, coupon-bearing loans are here transformed into their zero-coupon equivalent, and their durations (T) used in place of final maturity. As a consequence, the expressions showed in this box are approximations only.

To highlight a different interpretation of the expected loss, it might now be useful to take a step back and consider what is now a standard result from modern option theory. Namely, that "stockholders have the equivalent of an option on their company assets. In effect, the bond holders own the company's assets, but have given options to the stockholders to buy the assets back" (Black & Scholes, [1973], pp. 649-650). Just as the stock in a company can be viewed as a call option held by shareholders, a corporate loan can be seen as embedding a short position in a put option.

Indeed, shareholders will default on the firm's debt whenever their company's net asset value falls below the nominal value of its debt. In such a case, the borrower "will not make the [debt] payment and default the firm to bondholders because otherwise the equity holders would have to pay in additional money and the (formal) value of equity prior to such payments would be [negative]" (Merton, [1974], p. 453). Put differently, when a firm's equity reaches zero, shareholders will transfer its ownership to the lenders via default, and lenders will suffer a loss equal to the difference between the nominal value of debt and the defaulted firm's market value (the recovery rate, using previous terminology). The risky loan can thus be seen as a portfolio of a long position in an "equivalent" riskless loan (call it b) and a short position in a put option. If b^* is the current market value of the risky loan evaluated at the riskless interest rate, we have:

$$(1) \quad b^* = b - e^*$$

where e^* is the put option's price sold by the lender to the shareholders. With respect to the example above, one might think that: $b = \text{ECU } 100$, $b^* = \text{ECU } 99$ and $e^* = \text{ECU } 1$. (6)

To see that this intuition is indeed correct, and to appreciate the link between expected loss, option pricing and bank solvency, consider a first-demand, full and irrevocable loan guarantee. Following Merton [1977], a loan guarantee (g) is a put option (a "credit derivative") sold by the guarantor to the lender. Hence the value of the guaranteed loan (b°) can be seen as the combination of it and the unsecured loan:

$$b^\circ = b^* + g$$

But, in analogy with (1), one may also write:

$$b^\circ = b - e^\circ$$

where e° is the expected loss of the guaranteed loan. It then follows that the value of a loan guarantee is the difference between two expected losses:

$$(2) \quad g = e^* - e^\circ$$

If the guarantor is risk-free (e.g., a government, a triple-A bank or credit insurer), then $e^\circ = 0$, $b^\circ = b$, and the guarantee's value is equal to the expected loss of the unsecured loan. Hence, the loss

6) The separation of a risky asset's value into components affected by default risk and variables independent from it carries through to derivative contracts that can only take on non-negative values (e.g., options). See Hull & White [1992].

expectation is the market price of a put option which, once purchased, eliminates credit risk entirely (as the guaranteed loan is risk-free). In the example above, the guaranteed lender would thus disburse the loan at ECU 99 (on a face value of ECU 100), charge a lending rate of 7%, and pay an up-front ECU 1 guarantee fee to the risk-free guarantor. Note the analogy between this procedure and the one described above based on self-insurance: the guarantor simply invests the guarantee fee in riskless securities "on behalf" of the lender. Alternatively, the loan can be disbursed at ECU 100 with a coupon rate of 7%, while the borrower replaces the lender in paying the ECU 1 guarantee fee. In either case, if the lender is satisfied that the guarantees obtained on his loans are such as to make them perfectly safe, he would be totally correct in applying the riskfree lending rate indiscriminately to all his clients.

If the guarantor is not free of risk, that is if the default probability of the guaranteed loan is positive, then the value of the guarantee will be less.

But if the guarantor is not free of risk, that is if the default probability of the guaranteed loan is positive, then the value of the guarantee will be less than ECU 1. Suppose the default probability of the guarantor is 1% over one year, and that the relationship between the borrower and the guarantor (e.g., parent/subsidiary; client/supplier) is such that a default correlation of 0.5 is retained. Then the default probability of the guaranteed loan (that is, the possibility that borrower and guarantor shall both default within the relevant time frame) is 0.65% (see Box 2). All else being equal, this default probability originates an expected loss of ECU 0.40 (and a credit spread of 0.42%) for the guaranteed loan. Hence, the guarantee's "fair" value is ECU 1.00 - ECU 0.40 = ECU 0.60 only (or 1.07% - 0.42% = 0.65% per year paid in arrears). The lender may then grant a below-par loan worth ECU 99 at 7.00% (to be paid back at ECU 107.00 in one year's time, for a promised yield of 8.07%), pay an up-front guarantee fee of ECU 0.60, and invest the balance of ECU 0.40 in riskless securities to self-insure for the residual expected loss on the guaranteed loan. The expected rate of return of the three operations combined would still be the 7% riskless rate.

Notice that a logical condition on an option's value would be:

$$(2)' \quad g = \text{Max} [(e^* - e^0); 0]$$

However, two common-sense restrictions on default correlations (see Box 2), impose that e^0 be non-negative and not larger than e^* . Hence, for all practical purposes, formulae (2) and (2)' are the same. Either one or the other can be interpreted as the price of a put option when the option writer may not be able to pay the exercise price (here: ECU 100) against the delivery of the underlying asset (here: the defaulted loan). (7) More generally, formula (2) shows that the guarantee value is equal to the difference between two put option prices with the same exercise period and strike price, but written on underlying assets with different volatilities.

It could be useful, for the sake of clarity, to transpose the concepts discussed above in the graphical format familiar from elementary option theory. The horizontal axis of Figure 1 measures the borrower company's net asset value (NAV). Since the loan's amount is ECU 100, the borrower is solvent if his NAV is higher than that. Shown on the vertical axis are the values of the variables we are interested in, namely the riskless loans (which, by definition, is insensitive to the borrower's

7) In this case, both the underlying asset (the loan) and the option writer (the guarantor) may default. This is reflected in formula (2) where two expected losses appear. There are however cases where only the first (e.g., an exchange-traded call on a corporate bond), or only the second (e.g., an over-the-counter put on a commodity price index), is subject to credit risk.

chances of becoming bankrupt), the risky loan, and the expected loss. The latter, represented by the line labelled e^* , is nil if the NAV is equal to, or higher than, ECU 100, while increasing in absolute terms (i.e., moving towards larger and larger negative values) when the NAV falls below ECU 100. The reader will recognise that the line describing the expected loss has the same general shape (abstracting from the premium received by the option seller - here, the lender) as that portraying a short position in a put option with an ECU 100 strike price. The combination of the (fixed) value of the riskless loan and that of the short option position gives the value of the risky loan b^* . Graphically, b^* is represented by a broken line, with its horizontal part (i.e., for NAV values over ECU 100) coinciding with the riskless loan.

Figure 1 - The Risky Loan

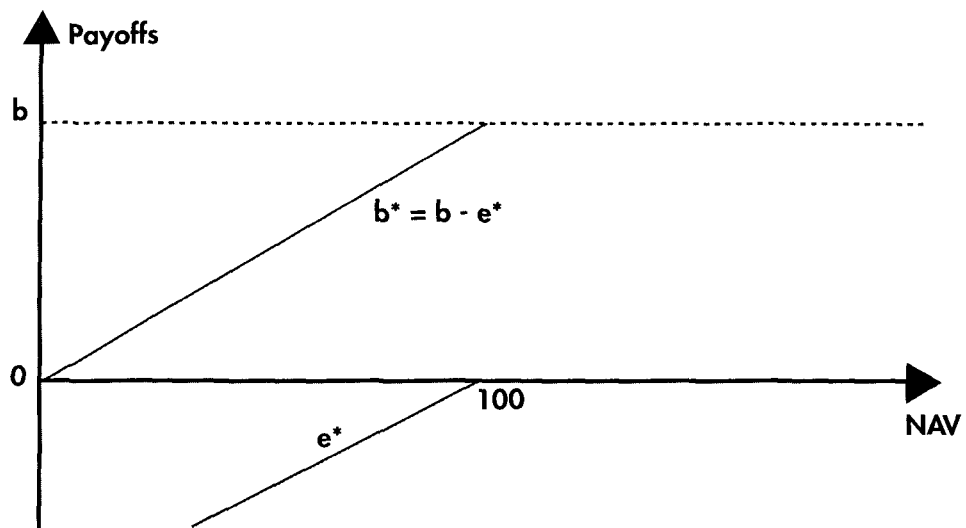
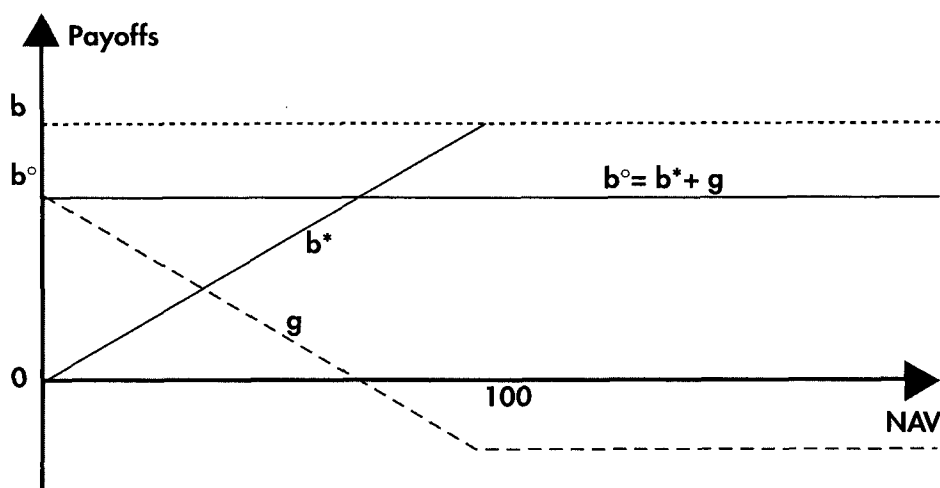


Figure 2 adds a third party guarantee. As argued above, obtaining a loan guarantee is the same as holding a long position in a put option with a strike price of ECU 100. This position is graphically represented by the broken line labelled g . It goes through and below the horizontal axis to highlight the option premium (the fair cost of the loan guarantee). The vertical sum of the two sloping parts of the lines b^* (derived from Figure 1) and g yields the value of the guaranteed loan, which is here shown as lying below that of the riskless one. To make the two coincide, the guarantee should become stronger, that is the sloping part of the line g would have to rotate clockwise till its point of contact with the vertical axis coincides with the value of b . (8) Finally, the vertical distance between b and b° is the value of the expected loss on the guaranteed loan (denoted above with the symbol e°).

8) The flatness of the b° line is due to the fact that the guaranteed loan is generally little sensitive to the solvency of the principal obligor. Although this is an intuitive proposition, Gilibert [1997] provides a more complete argumentation for this. The same paper contains a discussion of the "unexpected" loss, as well as a more general definition of the expected loss than that provided in paragraph 2 above.

Figure 2 - The Guaranteed Loan



4. Credit risk and optionality

The described analogy between expected loss and option value suggests a few observations. As originally noted by Merton [1974], it would in principle be possible to recast the process of pricing risky loans as an exercise in valuing out-of-the-money put options. For instance, if the borrower is initially solvent (its NAV is well above the nominal value of the new loan), the expected loss of the loan will be "low". This is equivalent to say that the put option implicitly sold by the lender to the borrower, being out-of-the-money (strike price well below the current value of the underlying), is lowly priced. Should the financial position of the borrower deteriorate in the course of the loan, then its NAV will fall towards the nominal value of debt, and the option will move into the money. This explains why the pay-offs from traditional lending activities have similarities with those faced by a put option seller: against the modest, but certain, revenue represented by the option premium (i.e., the discount to par at which the loan is disbursed) and no upside potential (at best the borrower will pay back the face value of debt), there is the possibility of large losses if the option goes in the money and is exercised (the borrower defaults).

Similarly, risk-mitigation could be interpreted either as a way to reduce the value of the put option the lender is short of (e.g., by reducing loan maturity, that is the option's exercise period) or as a hedging operation designed to match the short option position (e.g., by acquiring a guarantee, that is buying an offsetting put option). Two additional insights one may draw from this analogy are briefly illustrated in this paragraph.

The implied "volatility" of a bank loan can be inferred from its expected loss. This may be a useful concept for pricing credit derivatives or more generally for devising bank-wise risk monitoring systems.

First, let us start from the observation that, as indicated by relationship (1), the higher the default risk of a debt instrument (loan or bond), that is the higher its expected loss, the more its sensitivity to interest rate changes will depend on its option's component. That is:

$$\delta b^* / \delta R = \delta b / \delta R - \delta e^* / \delta R$$

where both $\delta b / \delta R$ (the loan's duration with sign reversed) and $\delta e^* / \delta R$ (the put option's "rho") are negative. Therefore, the market price of high-yield (high-risk) bonds should fall less sharply when

interest rates increase than that of "equivalent" riskless securities. This conclusion, however, is subordinated to the proviso that an increase in interest rates does not raise the default probability of the borrower (that is, in the symbols used above, that $\delta P/\delta R = 0$).

A second remark one may draw from the analogy between expected losses and put option valuation is that, similarly to the case where the future volatility of an option's underlying asset can be computed from the current option price, the implied "volatility" of a bank loan can be inferred from its expected loss. This volatility, it should be added, does not refer to the changes in the "fair" price of the loan caused by interest rate movements, but only to the volatility that is generated by the possibility of a borrower's default over the loan's life. One might call it the "default volatility". (9)

To see how it could be computed in a highly stylized case, take a loan guarantee which can only be exercised at maturity: that is, if at maturity the loan is in default, the guarantor will pay the lender the loan's principal plus all interest and capital instalments not received. Consider also that the price p of a European put option with an exercise period of length T , trading at-the-money-forward (that is, when the present value of the strike price is equal to the current price of the underlying asset), can be approximated by the following simple expression (see Brenner & Subrahmanyam, [1994]):

$$p = 0.4 a \cdot \sigma(A) \cdot \sqrt{T}$$

Any risk management system is based on the premise that the user knows where risk exposures reside.

where a is current value of the underlying asset and $\sigma(A)$ is the annualised volatility (i.e., standard deviation) of its return, denoted as A . Substituting e^* for p in the above formula, and solving for $\sigma(A)$, one obtains:

$$\sigma(A) = e^*/[0.4 \cdot a \cdot \sqrt{T}]$$

where now a is the loan's value (here, ECU 100), and T is its maturity (expressed in number of years). For instance, in the example of Box 1, where the loan's expected loss is ECU 3.32, the annualised default volatility is 4.80%. This measure can also be interpreted as an indication of the "business risk" embedded in the lending operation. Although, as presented here, the default volatility is nothing else than a simple transformation of (i.e., another name for) the expected loss, it might still be a useful concept for pricing credit derivatives and designing the related hedging strategies, or more generally for devising bank-wide risk monitoring systems. (10)

In addition to loan and guarantee pricing, the expected loss framework could have important applications in several domains of banking activity where issues of credit risk are involved. Two of such applications are illustrated below: risk-transfer accounting, and bank solvency.

9) Notice that a loan's default volatility is bounded by the fact that, at maturity, a loan's value cannot exceed par nor fall below its expected recovery value. Due to higher ranking and tighter covenants, recovery experiences after default have been higher for bank loans than for bonds. Bank loans' default volatilities (and expected losses) should thus be lower than for equivalent bonds.

10) For instance, by using default volatilities, it might be possible to integrate credit risk into a bank-wide Value-at-risk (VAR) approach, even though bank loans are meant to be kept on the balance sheet to final maturity. E. Barone & A. Bragho' [1996] highlight the analogy between the approximate price of an at-the-money-forward European put option computed as above and a 2-standard-deviations (97.72% confidence level), 10-day VAR. Hence, one might conclude that, as a first approximation, risk-provisioning according to expected losses is analogous to using a 97.72% (against a generally recommended 99%) confidence level VAR.

5. Risk accounting

Any risk management system is based on the premise that the user knows where risk exposures reside. On the strength of this knowledge, the risk-manager can then plan the appropriate hedging strategies. Take the guaranteed loan described above, and ask to what or whom the lender is exposed. The expected loss framework supplies the answer.

Start first with the unsecured loan where the recovery rate is set at zero (e.g., a junior subordinated credit with no collateral). This ECU 100, 1-year loan with a 1.65% default rate and a 100% loss severity has an expected loss of ECU 1.68. It would require a lending rate of 8.80% to break even. Add a collateral (e.g., real estate) conservatively valued at 40% of par. As we saw, the expected loss falls to ECU 1, a 40% reduction. In other words, 40% of the total loan exposure of ECU 100 is transferred on the collateral. Add now the guarantor with a 1% default probability, and a 0.5 correlation, over one year. As argued above, the expected loss of the collateralised and guaranteed loan further falls by ECU 0.60 to ECU 0.40.

To sum up, of the original ECU 100 exposure, 40% has been shifted on the real estate collateral, 35.7% (or ECU 0.6/ECU 1.68) on the guarantor, while the balance remains with the borrower. From a credit risk point of view, the lender has now a ECU 40 exposure to real estate, a ECU 35.7 exposure to the guarantor, and one of ECU 24.3 to the borrower. Risk limits would have to be imputed accordingly. Clearly, had the guarantor been risk-free, then no exposure would have been left with the borrower.

6. Bank capitalisation

In a world of certainty, where nothing unexpected happens, there is no need for equity capital (in the sense of a financial buffer to be held against unforeseen adverse circumstances).

In a world of certainty, where nothing unexpected happens, there is no need for equity capital (in the sense of a financial buffer to be held against unforeseen adverse circumstances). The lender would simply price the loan at its actuarially "fair" level (e.g., at 8.07% in the first example), and count on the revenues from the risk-spread to cover the expected (and actual) loss. The guarantor would reinvest the guarantee fee in riskless securities. Neither the lender nor the guarantor would have "to precommit" any capital, their cost of debt and equity would be the same, and the degree of leverage immaterial. Now add uncertainty to this ideal scenario and assume that the actual loss can be different from what was originally expected. Clearly, then, "some" equity is needed. But how much?

A starting point could be to assume that the expected loss is a suitable candidate for the role of ex-ante capital requirement. (11) The reason is that, as argued above, the expected loss is equal to the "fair" price of a hedging operation capable of transferring credit risk from the lender to a default-risk free guarantor. To exemplify, let us start with the example introduced in paragraph 2 above of an ECU 100 loan (with an ECU 1 expected loss) which the lender backs with ECU 1 of equity capital. Assume also that market conditions allow for an effective lending rate of 8.07% to be charged. This is done via a disbursement discount of ECU 1 and a coupon of 7%. The bank borrows ECU 100 from depositors promising to pay them back ECU 107 after one year (a deposit insurance fund lends credibility to this promise) and invests ECU 2 (ECU 1 worth of equity and the ECU 1 loan discount) in risk-free securities. Accounting-wise, the lender shows ECU 1 as loan-loss provisions, while an equal sum is booked as equity.

11) Similar ideas are now being introduced in actual banking practice. See Swiss Banking Corporation [1996].

Box 2 - The default correlation

A default event can be described by a Bernoulli distribution, a probabilistic law which applies to discrete random variables which can only take on two values: either "0" (e.g., a default occurs) with probability P , or "1" (e.g., the borrower survives) with probability $(1-P)$. The mean of this distribution is P and its variance $P(1-P)$. If P is the probability that the borrower defaults over a given period, and S is the corresponding probability for the guarantor, the joint-probability of both defaulting over the same period (i.e., the default probability of the guaranteed loan) is Q :

$$Q = P.S + \sigma(P).\sigma(S). \rho(P,S)$$

where $\sigma(X)$ is the standard deviation of X (the square root of the variance as defined above), while the symbol $\rho(P,S)$ is the correlation between the default probabilities of the borrower and guarantor.

Statistically, the correlation can vary between -1 (when the two default probabilities always move in perfectly opposite directions) and $+1$ (when their correlation is equally perfect, but positive). In the special case of total independence, the correlation is nil, and $Q = P \times S$. However, in financial terms there is an upper bound to correlation (see Lucas [1995]), as the default probability of the guaranteed loan cannot be higher than that of the better rated of the borrower and guarantor. Put differently, the expected loss of the guaranteed loan cannot be larger than that of an equivalent loan extended to the more creditworthy between the principal obligor and the guarantor. This implies:

$$\rho(P,S) < [\min (P,S) - P.S]/[\sigma(P).\sigma(S)]$$

Moreover, the same probability (expected loss) cannot be negative. This imposes the following lower bound to default correlation:

$$\rho(P,S) > - P.S /[\sigma(P).\sigma(S)]$$

In paragraph 3 of the text, where P is set at 1.65%, and S at 1%, these two limiting correlation values are -0.01 and 0.78 respectively. If, as assumed, the correlation is 0.5 , then $Q = 0.65\%$.

In conclusion, given the characteristics of the loan, the value of the guarantee depends on two variables: the creditworthiness of the guarantor, and the nature of his ties with the principal obligor.

As currently measured, the loan's capital ratio would be 1%. In reality, however, the combined effect of the loan pricing (in the form of a disbursement discount) and of the equity pre-commitment is to create a solvency cushion worth twice the expected loss. Put differently, an "unexpected" loss of up to ECU 1 would be covered by own funds. Naturally, the two types of equity may not be of the same quality, especially if the loan is disbursed at par and the risk premium is included in the lending rate to be paid at maturity. One could call them tier-1 (the equity raised from shareholders) and tier-2 capital (the one locked in the loan) respectively.

Now, should the loan's actual loss be lower than ECU 1, then equity holders will obtain a return higher than the 7% risk-free yield. If equal to ECU 1, they will receive a 7% return. If the loss is equal to ECU 2, they will lose all their money. Finally, if the loss is larger than ECU 2, the bank's net worth is wiped out, while the deposit insurance fund (or the public budget) picks up the difference. That private errors of judgement may burden the public purse is of course a matter of great concern for authorities, which thus justify capital requirements whenever publicly supported deposit insurance is offered.

A flat capital requirement could hardly be always satisfactory, being more than necessary in some cases, and less than prudent in others.

Therefore, what is "adequate" (i.e., prudent) in terms of bank solvency will depend both on objective and subjective considerations, that is: (a) on the volatility of the credit loss (12), and (b) on the degree of risk aversion displayed by bank managers, or by their supervisors. Irrespective of this, a flat capital requirement (e.g., 8% as in the BIS solvency rules and EU capital adequacy directive) would hardly be always satisfactory, being more than necessary in some cases, and less than prudent in others. Only by chance it will be about correct for a bank loan portfolio as a whole. Some multiple (maybe fixed, maybe geared to the volatility of loan returns) of the expected loss would seem more appropriate as a required capital buffer to be pre-committed against the hazards of individual lending operations. This would take into account that the actuarially "fair" lending rate may not always be achieved.

From the above, we have seen that bank shareholders may face total loss. Hence, they cannot be simply promised the risk-free rate of return, but would require something more. Assume this excess return (the equity-premium) is 5%, so that the cost of bank equity is 12%. With a 1% capital ratio, the average cost of funds for the lender would be 7.05% and the break-even lending rate 8.12%. This would produce the actuarial expectation that bank deposits yield 7%, bank stocks 12%, and that the loan's expected loss is covered.

Now suppose the required capitalisation is 8% instead, that is 8 times the expected loss in this example. Then, with the bank's average funding cost up to 7.37%, the break-even lending rate would have to increase to 8.44%. If the market does not allow such a level, then either bank shareholders will have to settle for a lower remuneration, or less lending will be made because not sufficient capital will be available to support it. In sum, assuring higher and higher degrees of safety and soundness of the banking system has a cost which society has "to pay", either with lower lending volumes or with higher lending rates, or with both. (13)

7. Conclusions

Following on the heels of what occurred, in the last few years, to the operational and regulatory treatment of market risks, credit risk assessment too seems ripe for an overhaul featuring a strong injection of quantitative and analytical methods. A few major banks, appear to be interested in applying these new ideas as a supplement to the traditional judgmental/legal approach. Meanwhile, market trading in loans and in credit derivatives has already started. Should these developments take root, then supervisors too will need to reconsider how bank solvency issues are to be approached.

This article has illustrated the concept of expected loss, and proposed its use as a simple and intuitive credit risk measure. A parallel between loan and option pricing has been drawn, which has allowed both to interpret the expected loss as the "fair" cost of a hedging operation designed to

12) For instance, if the expected loss of a loan portfolio is ECU 1 and its volatility is of the same amount then, provided the distribution of the random variable portfolio "credit loss" is normal, a capital of ECU 2 would be statistically sufficient in covering credit losses in about 84% of cases.

13) Another possible consequence of flat bank capital ratios is that they may encourage a lowering of bank asset quality. Indeed, banks lending to less (more) risky borrowers may be required to set aside more (less) equity capital than needed on the basis of pure actuarial considerations. If bank equity is more expensive than debt, it becomes more rewarding to offer funds to less creditworthy borrowers, while more solid ones will turn to non-bank lenders, a sort of "adverse selection". This may, in addition, increase competition among banks for the more risky segment of borrowers, thereby lowering lending rates below their actuarially "correct" levels.

Risk-adjusted rates of return can be computed based on expected losses. Loan portfolios can be mark-to-market whenever interest rates move, borrowers are upgraded or downgraded, or collateral values change.

shift credit risk to a risk-free counterpart, and to derive from it a measure of the borrower's default volatility, an indicator of "business risk". A few schematic applications in the area of risk-accounting and bank solvency have been outlined. Other uses, however, are equally possible. For instance, risk-adjusted rates of return (e.g., RAROC) can be computed based on expected losses, and performance-measurement systems for lending desks put in place. Loan portfolios can be mark-to-market whenever interest rates move, borrowers are upgraded or downgraded, or collateral values change. Internal loan grading systems can be constructed based on loans' expected losses. On a broader level, the separation of a loan's value into a riskless part and a risky one justifies bank reform proposals aiming at segregating liquidity provision from credit risk taking.

One disadvantage of the simple methodology presented in this paper is that it applies to individual transactions assessed on a stand-alone basis, while one of the main conclusions of modern portfolio theory is precisely that risk should be appraised and priced with respect to the existing asset portfolio, that is taking into account the contribution an asset purchase gives to portfolio diversification. Once the difficulty represented by lack of data on loan volatilities and correlations is overcome, there is little doubt that considerable advances in loan portfolio management will be achievable.

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The capital structure of private infrastructure projects and the risk of default



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We consider the consequences of capital structure on the probability of default of a project, and hence determine the fair risk-premium that would be needed to compensate a lender with a fully diversified portfolio of loans.

1. The growing demand for limited-recourse finance

Preparing for EMU has put strong pressures on governments to reduce public spending, including expenditures on public infrastructure. In this environment it is natural that the private sector should become involved in areas that were previously thought to be the domain of the state. One consequence is that limited-recourse financing of infrastructure is likely to expand. Indeed, over 100 projects with a total cost of some USD 100 billion have been identified for future private sector financing within the European Union. (1) This is triple the level of projects that have already been funded.

The trend to private infrastructure is not limited to Europe. Indeed, from the mid-1980s to the mid-1990s a total of some USD 700 billion of private sector infrastructure investment took place world-wide, one-half due to new greenfield projects, and the other half due to privatisations. Throughout the world some 1000 projects with a total cost of USD 600 billion have already been proposed for future private sector involvement. (2)

In this note we discuss a simple methodology for assessing the impact of the capital structure (i.e. the debt/equity ratio) on the probability of default of such projects, and hence on appropriate loan pricing. Screening models of this type allow a rapid categorisation of projects prior to a more detailed credit analysis if necessary.

2. Financing infrastructure on a non-recourse basis

Many factors may influence the capital structure of companies. (3) However, we make a number of assumptions to simplify the analysis. Firstly, we restrict the project considered to a one-off investment where all future cash-flow is used to repay investors (i.e. to pay dividends or to service debt rather than to finance future investments by the same corporate entity). This means that the cash flow of the corporation can be assessed with some degree of confidence at the time the loan is made. Secondly, we assume that the investment is capital intensive. In other words, the gross profit margin is large and the possibility of temporary liquidity problems is very low. Finally, we assume that the asset created has a dedicated purpose and so a limited re-sale value to other investors. Examples would be transport and environmental infrastructure, satellites, etc. We thus assume lenders are unsecured by collateral and dependent on project revenues. That is not to say some risks are not borne by other parties. For example, project completion risks may be covered by constructors, political risks from investment in other countries may be covered by insurance schemes, and there may be some limit to market risks through off-take agreements and the like. Nonetheless, we assume that there remains some residual uncertainty to project returns that must be shared between investors and lenders.

1) Data taken from the "1996 International Major Projects Survey", *Public Works Financing*, Volume 100, October 1996. By far the most important sectors are toll roads and railways (some two-thirds of the total) followed by power and airports.

2) See Klein and Roger (1994) for a discussion of the potential of private infrastructure.

3) There is large literature on this topic. See, for example, Froot (1995), Leland (1994), and Miller (1988).

For this type of investment we consider the consequences of capital structure on the probability of default of the project, and hence determine the fair risk-premium that would be needed to compensate a lender with a fully diversified portfolio of loans. (4) We look only at the position of senior debtors for a range of gearing ratios, without attempting to calculate the final optimal gearing that would result from taxation, stock market inefficiencies, and all the other factors that could influence this result.

With this framework, consider a project where the distribution of the after-tax return is known. The project will default when the net present value of the project's cash flow is less than the net present value of contracted loan repayments. Let us define the following variables:

$B(i)$ is the present value of the project's profits before depreciation, interest and tax at the risk-free interest rate i ;

$L(i, j)$ is the present value, discounted at rate i , of loan repayments, where the implied yield of the loan is j ; and,

j equals the riskless interest rate plus an additional premium, d , i.e. $j = i+d$.

Since we do not consider temporary liquidity problems, the actual loan coupon is irrelevant to this analysis - all that matters is the implied loan yield vis-à-vis the actual project outcome. (5) The assumption is that $B(i)$ is distributed to senior debtors, to the tax man, and to other investors, in that order. Thus, the expected default rate on loan repayments, q , is given by the probability that $B(i) < L(i, i+d)$. The annex shows that this happens when the project has a rate of return, z , given by:

$$z = (1/n) \cdot \ln(a) + j$$

where a is the proportion of project costs financed by debt, and n is the life of the loan.

If it is further assumed that the return of the project has a normal distribution (δ) with known mean, m , and standard deviation, s , then the risk of default, q , comes directly from the cumulative standard normal distribution, $N(\cdot)$; i.e.

$$q = N((k-m)/s),$$

Typically the parameters m and s would be derived from Monte Carlo simulations of the project's cash-flow. (7)

The expected income for a lender from such a project would be equal to the loan yield times the probability that all goes well, less the chance of default times the resulting shortfall in the project's return, i.e:

$$ER(i, d) = L(i, i+d) \cdot (1 - q) - S \cdot q$$

4) The methodology used here is similar in approach to that presented by Fons (1994).

5) As mentioned, the risk of temporary liquidity problems should be low for capital intensive infrastructure projects. An alternative is to suppose that any need for liquidity could be met through short-term borrowing at the interest rate, i . In the theoretical extreme this implies that there would be no role for loan monitoring, since the lender can take no discretionary steps before the loan is either fully repaid or the borrower is insolvent. This simplified situation is unlikely to exist in practice.

6) That is the continuous return, r , is normally distributed. The corresponding discrete return has a log-normal distribution. It has a minimum value equal to -100%, so that the maximum loss (in discounted terms) is equal to the value of the investment. This assumption could be easily modified, to, say, a minimum IRR of -50% or -30%, or whatever. This means that the severity of loss for the lender in case of a default would be limited (for example through some collateral).

7) See Girard (1987).

where S is the average severity of loss in the case of default.

$$S = E[L(i, i+d) - B(i) \mid z < j]$$

One can also think of an equivalent loan premium, d_e , assuming that there is no default, that is the premium that solves the following equation:

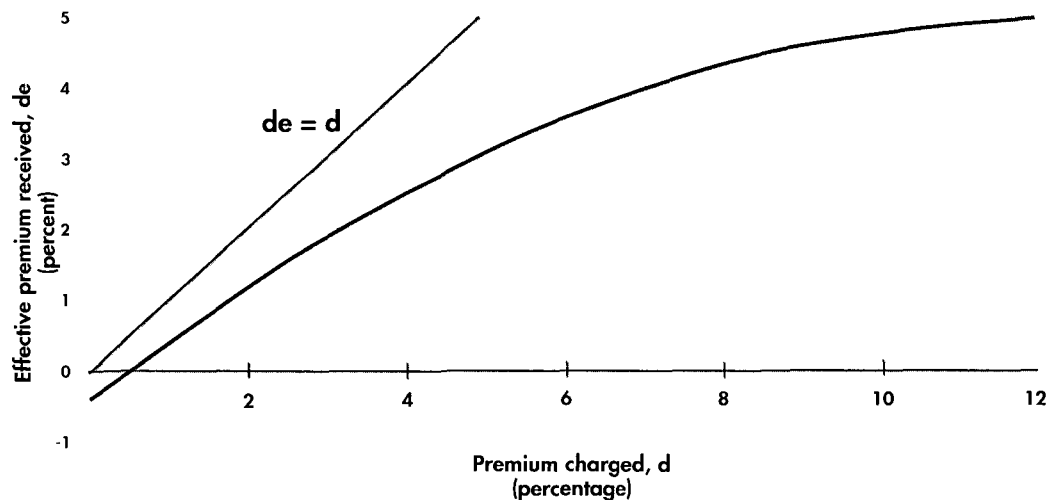
$$L(i, i+d_e) = ER(i, d)$$

An obvious point, but one that is often overlooked, is that the rate of default depends upon the premium charged by the lender and this reduces the effective return.

An obvious point, but one that is often overlooked, is that the rate of default depends upon the premium charged by the lender and this reduces the effective return. The relationship between d and d_e is shown in figure 1 for a project having a rate of return with a mean of 10 percent and a standard deviation of 5 percent. In this example, the risk-free interest rate is set at 8 percent, and it is assumed that the project is financed 80 percent by debt.

This figure shows that there is a limit to the expected premium that can be captured, since the creditor can receive no more than the expected cash-flow of the project. Perhaps more importantly, the effective premium is significantly below the straight-line, $d_e = d$, for low values of d .

Figure 1 - The effective margin as a function of the premium charged



Note: For a project with a mean rate of return of 10 percent, and a standard deviation of 5 percent. The riskless rate is set at 8 percent, while the loan life is 10 years, and the investment is financed 80 percent by debt.

A risk-neutral lender would accept a risk premium, that, on average, covers expected losses. In other words the lender's premium would be set at a level where $d_e = 0$, equal to the intercept of the horizontal axis in figure 1. The process can be thought of as an iteration: for a given capital structure a risk of default is estimated; based upon this a default premium is estimated; this increases the probability of default; a new default premium is estimated; etc. The process may not always converge.

In equation form, the risk premium, d_o , is given by solving:

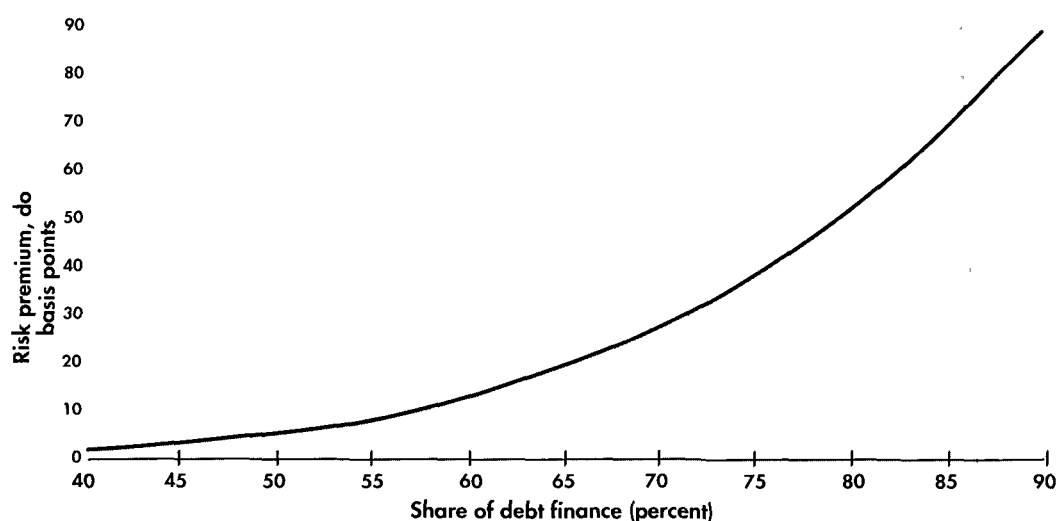
$$\begin{aligned} L(i, i+0) &= ER(i, d_o) \\ &= L(i, i+d_o) \cdot (1 - q) - S \cdot q \end{aligned}$$

A lender could use the information to ensure that the planned capital structure of the project provides a sufficient equity cushion to lower the default rate to a level consistent with lending policy.

where S and q are also functions of d_0 . The full derivation of this equation as a function of the mean return of the project and its standard deviation is also given in the annex.

Figure 2 shows how the risk premium varies as the project's gearing changes (with the same assumptions regarding the rate of return and the risk-free interest rate as before). The figure shows how the premium increases from some 5 bp when the project is 50 percent debt financed, to over 50 bp when debt accounts for 80 percent of project costs. Figure 3 shows the resulting probability of default. (8) Again this rises quite rapidly from only 0.2 percent when debt accounts for one-third of projects costs, to 2 percent at one-half debt, to over 15 percent when debt finance rises to four-fifths of the total.

Figure 2 - The relation between debt levels and the required risk premium



Note: For a project with a mean rate of return of 10 percent, and a standard deviation of 5 percent; the riskless rate equals 8 percent, while the loan life is 10 years

3. Using the results

A lender could use the information calculated above in two ways. One approach would be to ensure that the planned capital structure of the project provides a sufficient equity cushion to lower the default rate to a level consistent with lending policy. For example one could estimate an equivalent rating for the project's debt through comparing the predicted default rate with historical default rates for rated-bonds. In this way it is possible to give an indicative credit-rating for the project's debt. (9) This allows a rapid pre-selection of projects into risk categories for further detailed analysis if necessary.

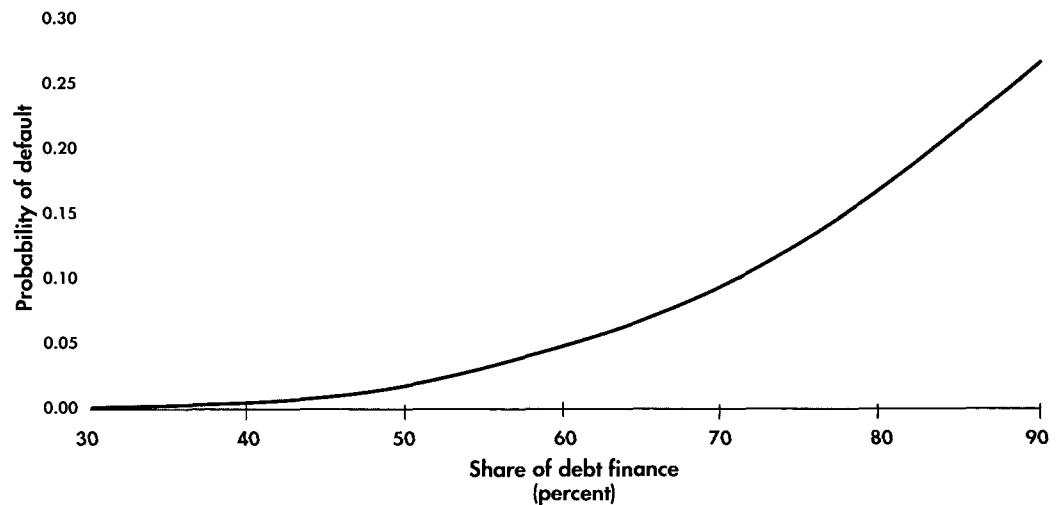
Information on the expected default rate may be useful even when residual risks are covered by third parties or collateral. Often exercising such guarantees will entail significant costs for the lender (a large number of conditions may have to be verified before guarantees can be called, or collateral may have

8) As mentioned before, the default rate depends upon the risk premium that is charged. Figure 3 is calculated assuming that the lender is risk neutral, and that the risk premium of figure 2 is applied, i.e. $j = i + d_0$.

9) Such historical information is available from the rating agencies. Few limited-recourse projects have been rated, thus the value of giving some idea of equivalent ratings. We pick up this point again later in the paper.

to be up-graded before it can be sold, during which time there will be a short-fall in interest revenues). The probability of incurring these costs should be included in the overall assessment of the project.

Figure 3 - The relation between debt levels and default probability



Note: Assumptions as for figure 2.

A second approach would be to use the results to estimate an appropriate risk premium for a particular loan. The major problem is that the risk premium presented above assumes the lender is either risk neutral or has a perfectly diversified portfolio. In reality no lender will be risk neutral, while lowering risks through diversification may be difficult since some infrastructure projects are very large and a default would have a significant impact on the lender's balance sheet. Other approaches, such as loan syndication, would have to be considered.

When uncertainty is high, the risk premium on unsecured long-term debt becomes excessive, and other less costly solutions must be found.

When uncertainty is high, the risk premium on unsecured long-term debt becomes excessive, and less costly solutions must be found. For example, lenders may offer continuously renewable lines of credit in which the borrowing amount and interest rate is fixed at inception. These loans are only rolled-over if the firm has sufficient asset value to repay the loan's principal. (10) Obviously, this implies a significant loan monitoring effort.

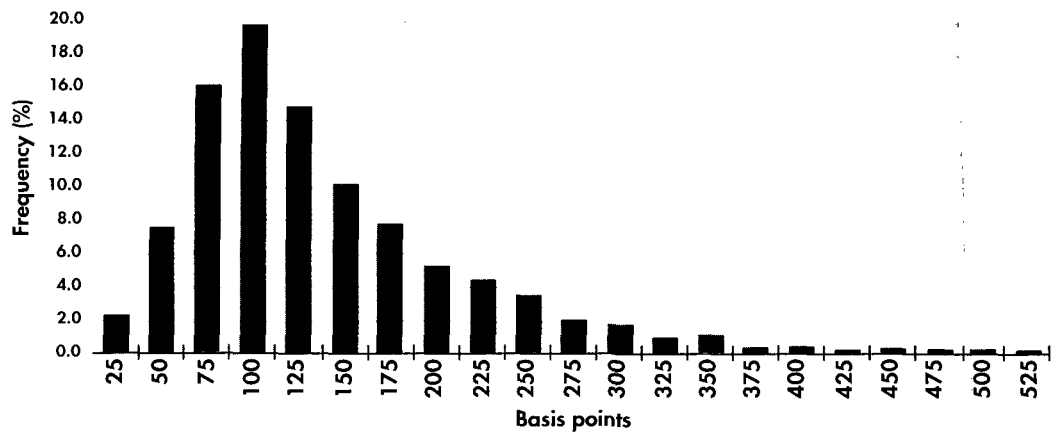
The model works best in rather specific cases - most notably when there is a one-off investment (or a programme of technologically similar investments over a relatively short time horizon) and where the capital structure is essentially fixed at the start of the project. This means that the lender can meaningfully assess the distribution of the returns to the investment. When applied to larger, more diversified corporations it is much more difficult to construct the expected rate of return of the company's assets and the standard deviation of this return (two variables needed for the model developed above).

Moreover, the assets of a normal company vary over time as new investments are made. It is quite possible for these investments to have very low returns and to reduce the net worth of the company.

10) Essentially, this imposes a positive net worth covenant on the borrower. Other solutions include falling risk premiums as the project achieves certain pre-set milestones.

Thus, with time, gearing may change and a company may migrate from one credit category to another. Different perceptions regarding the future migration of a company across risk categories is no doubt one reason for the wide range of yield spreads charged to companies falling within the same credit group (see figure 4 for the example of A-rated US corporate bonds). This issue is particularly relevant for lenders that offer funds at relatively long maturities.

Figure 4 - Historical yield spreads, A-rated US corporate bonds



Note: Compiled by Foss (1995) with data from Moody's Bond Record for October, 1971, to January, 1994. Foss (1995) gives similar data for other risk groups and also shows that the average EBITDA interest coverage ratio varies significantly with credit rating category.

In many sectors standardised institutional frameworks have yet to be established. Thus, with the growth of limited-recourse finance, methodologies for the rapid screening of investment proposals will become increasingly useful.

However, there are usually credit assessments of corporate borrowers by third party rating agencies, and a "market price" for corporate bonds that can be used as a benchmark. In some sectors, such as private power, where an established institutional framework exists, a few limited-recourse projects have also been rated. But in many sectors, these standardised frameworks have yet to be established, and each project is *sui generis*.

With the growth of limited-recourse finance, entering more and more innovative areas, methodologies for the rapid screening of investment proposals will become increasingly useful. This paper has proposed one such methodology, whereby the implications of the capital structure on the probability of default can be rapidly assessed. Clearly, this would only be the first phase for broadly categorising projects into risk classes prior to a more detailed credit assessment.

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Annex

The present value of the time-stream of the profits before depreciation, interest and tax coming from an investment of unit size is given by:

$$[1] \quad B(i) = e^{n.(r-i)}$$

where the investment has a life of n years, r is the rate of rate of return of the investment, and i is the risk-free interest rate. In other words, the project's net benefits are *equivalent* to a payment of $e^{n.r}$ in year n , even though the actual profile of the cashflow may be quite different from this terminal year pay-off. This figure is discounted to the present by multiplying by $e^{-n.i}$.

Define $L(i,j)$ as the present value, discounted at rate i , of loan repayments, where the loan's implied yield is j . Also let the proportion of project costs financed with debt equal a . Then the value of $L(i,j)$ depends upon the outcome of the project, i.e.

$$[2] \quad \begin{aligned} L(i,j) &= B(i) && \text{if } a.e^{n.(j-i)} \leq B(i) \text{ as all debt is repaid; and,} \\ L(i,j) &= a.e^{n.(j-i)} && \text{if } a.e^{n.(j-i)} > B(i) \text{ as there is a default.} \end{aligned}$$

Substituting [1] in [2] gives a relationship for b , the actual return of the loan above the riskless rate i (i.e. the loan yield is $i+b$):

$$[3] \quad \begin{aligned} a.e^{n.b} &= e^{n.(j-i)} && \text{if } r \geq z \\ a.e^{n.b} &= e^{n.(r-i)} && \text{if } r < z \end{aligned}$$

where z is the rate of return of the investment at which the project defaults. This comes from solving equation [2] at the point when the project return exactly equals the required loan return, i.e.:

$$z = (1/n) \cdot \ln(a) + j$$

Note that the possibility of temporary liquidity problems are not considered. This means that the contracted coupon of the loan is irrelevant, and the default condition depends only on the implied yield of the loan, j .

Assuming the continuous rate of return to the project, r , is normally distributed with mean, m , and standard deviation, s , the expected present value of the project is:

$$\begin{aligned} E[e^{n.(r-i)}] &= e^u \\ \text{where } u &= n.(m - i) - 1/2.(n.s)^2 \end{aligned}$$

In a similar way, taking expectations of equation [3] gives the expected present value of the loan:

$$[4] \quad \begin{aligned} E[a.e^{n.b}] &= F.e^u + a.(1-q).e^{n.d} \\ \text{where } F &= N((z-m)/s - n.s), \\ q &= N((z-m)/s) \\ d &= j - i, \text{ the premium charged by the lender} \\ &\quad \text{over the riskless rate. (11)} \end{aligned}$$

11) While b is a random variable describing the actual project outcome (with mean, $m - i$, and standard deviation, s), d is a contracted pre-determined figure. Ex post, b may be greater or less than d depending upon the project's outcome.

and where $N(\cdot)$ is the cumulative standard normal distribution. Note that q equals the probability of default.

Setting the expected value of the loan in equation [4] equal to a gives the level of risk premium required by a risk-neutral investor. Dividing through by a we obtain:

$$[5] \quad 1 = (1/a) \cdot F \cdot e^u + (1-q) \cdot e^{n \cdot d_0}$$

Note that F depends upon z , which is in turn a function of the risk premium, d_0 . Thus, equation [5] is a complex expression of d_0 which is solved numerically.

Value-at-Risk and Capital Adequacy: The challenge for financial

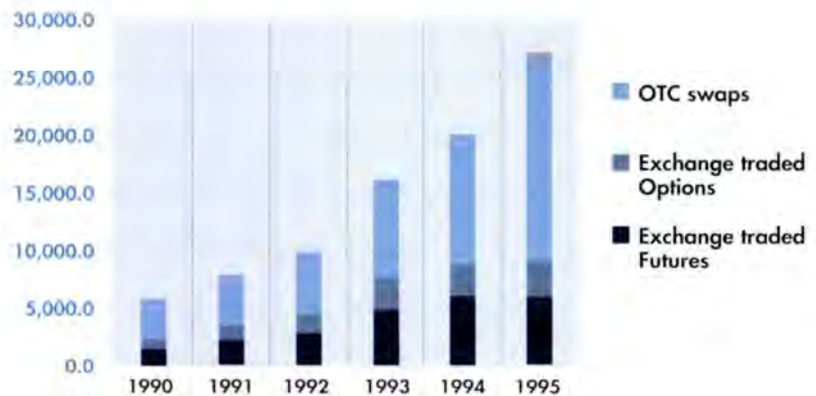


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1. Introduction

Supervision of financial institutions has changed dramatically in the last two decades as a reaction to the significant changes of major capital markets. Up to the 1980's financial supervision was effected on a national level with financial supervisors implementing capital adequacy rules for covering credit risk. The gradual liberalisation of financial markets and increased cross-border transactions, however, raised the need for common capital adequacy rules. A first major step in this direction came with the Bank of International Settlement's (BIS) Basle Accord capital adequacy rules to cover credit risk in 1988, which were implemented by national supervisors in most of the developed world. However, new types of securities and the dramatic increase in financial asset trading quickly outpaced these rules. Furthermore, traditional banking intermediation between lenders and borrowers continues to lose ground to securities markets intermediation. Thus, traditional regulation by product and institution type is no longer valid, because delimitations have become blurred. The fast expansion of derivatives and the emergence of hybrid capital instruments have compounded this difficulty. In the early 1980's financial derivatives barely existed, whereas today the total notional amount outstanding is close to USD 30 thousand billion, as shown in the graph below. Furthermore, Over-the-Counter (OTC) swaps (i.e., instruments traded outside official exchanges) have risen by more than 400% since 1990.

Figure 1 - Markets for derivatives



Source: BIS 66th Annual Report 1996.

In mid-1970's, daily foreign-exchange trading amounted to USD 10 - 20 billion, whereas today daily trading is above USD one thousand billion. Cross-border securities transactions have also soared since the 1970's. These trends and structural changes of capital markets present major challenges for financial supervisory and regulatory regimes and emphasise the need for common rules and cross-border supervision of financial institutions.

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The latest Capital Adequacy Directive (CAD II) proposals will allow financial institutions to use internal Value-at-Risk models to determine capital adequacy for market risks.

The liberalisation and deregulation of domestic financial markets and competition from non-banks have led banks to rely more on proprietary trading to offset the fall in margins on their traditional products. Thus, banks temporarily tie their own capital to large net positions. Former capital rules, such as the BIS 1988 Basle Accord and the 1989 EU Solvency Ratio Directive (89/647/EEC), were established to let banks hold a minimum capital against credit risk, i.e., the risk that a borrower will default in "traditional" banking and off-balance sheet activities. The EU's Capital Adequacy Directive (CAD) and the Basle Committee proposal from the beginning of the 1990's contain comprehensive capital adequacy rules to protect against market risk on the trading book. Market risk is the institutions' exposure to changes in prices of securities or derivatives in which it has a position. However, the rapid development of financial markets made these banking supervisory rules obsolete even before they were implemented. The recent amendments to the Basle Committee on Banking Supervision BIS (1996a) rules and the latest EU's CAD II proposal for measuring capital to be set aside to cover market risk might lighten this Sisyphean labour for financial supervisors, as they allow the use of internal Value-at-Risk (VAR) models (1) for determining capital to be set aside against market risk. Thus, the role of financial supervisors changes from assessing risk to regulating risk methodologies. Furthermore, the development of credit risk derivatives (2) might ultimately lead to both market and credit risk being handled within a VAR-approach. However, the use of internal VAR models might not be sufficient to control risk, as these models depend on the methodology and the historical data used as explained later in this paper.

Capital serves two functions for financial institutions: (1) it represents the institution's owners claim on the bank and (2) it serves as a buffer-stock against losses on the institution's portfolio. In addition to the growing interdependence of financial institutions and markets which emphasises the need for common rules, there are several other reasons why the European Union countries would want to implement a common set of rules for the measurement of risk and common capital requirements for the financial institutions of the European Union. First of all, by establishing a set of minimum capital level rules meaning a 'level playing field' for financial services, the CAD could help to reduce the competitive inequalities existing among the different EU countries. Thus, implementation of the CAD is a means of also achieving a "single market" for financial services, although this might not necessarily be the case, as explained later in this paper. Another reason is that banks have become more vulnerable to crisis and failure on account of increasing economic and financial instability, as has been illustrated by the Third World debt crisis, the Saving and Loans crisis in the United States and the collapse of the property sector in several European countries. By setting minimum rules for bank capital the CAD can be seen as the principal tool for controlling the growth both of lending activity at large and of specific segments of it as, e.g., control of the use of derivatives. Thus, the CAD acts as a complementary tool of monetary policy although this aspect of capital adequacy rules is not addressed in this paper.

The CAD complements the Second Banking Co-ordination Directive (2BCD) (3) for banks and provides an adjunct to the Investment Service Directive (ISD) (4) for investment firms. The 2BCD and the ISD have the objective of establishing a "passport" freedom for credit institutions and investment firms; i.e., when a bank or an investment firm is established in one member state it is free to operate in any of the other member states. This freedom has been in place for banks since 1993 and for investment firms since the beginning of 1996. In the mid of 1997 the first amendment to the CAD,

1) These models are explained in section 3 of this paper.

2) Credit risk derivatives are explained in section 5 of this paper.

3) European Commission 89/646/EEC.

4) European Commission 93/22/EEC.

the CAD II rules that allow financial institutions to only use internal Value-at-Risk (VAR) models to determine the capital to be set aside against market risk is expected to be agreed upon by the EU member states. Table A1 in the annex to this paper shows the purpose of the different EU directives. The rest of the paper contains a description of the current and expected future capital adequacy rules in the EU and an appraisal of whether the rules are in accordance with the intentions behind them. The plan of the paper is as follows: Section 2 describes the main principles in the CAD. Section 3 describes Value-at-Risk models. Section 4 evaluates whether the rules in the CAD are consistent with the aim of the Directive. An evaluation of the use of Internal Value-at-Risk models to determine capital adequacy is provided in Section 5. Some conclusions are offered in Section 6.

2. Capital Adequacy rules

The first part of this section outlines the main principles of the CAD. The second part compares the CAD with the present BIS rules and provides an assessment of whether the two sets of rules 'level the playing field' between financial institutions.

2.1 The EU Capital Adequacy Directive

The main parts of the CAD are the *trading book*, the *building block methodology*, the concept of *netting*, and the measurement of *market risk*. The CAD requires institutions to divide their business into short-term trading operations, the "*trading book*", and into long-term lending, deposit-taking and investment activities, the "*banking book*". The CAD only applies to the trading book, whereas all other activities are subject to the Solvency Ratio Directive (SRD) for banks. Thus, the CAD only applies to activities in marketable instruments. The trading book is *marked to market* daily and the CAD allows off-setting positions to be netted. The CAD demands capital to be allocated against position risk, settlement and counterparty risk and large exposure risk arising from trading book activities. There are also capital requirements for foreign exchange risk for all business activities. Market risk is separated into *specific risk* and *general risk*. Specific risk is the risk of a price change in the instrument concerned due to factors related to its issuer or, in the case of a derivative, the issuer of the underlying instrument. General risk is the risk of a price change due to a change in the level of interest rates or, in the case of an equity or equity linked derivative, to a general equity-market movement unrelated to the specific instrument.

The division of all business into "trading" and "banking" is difficult in practice.

The *building block approach* refers to the *additive* structure of the CAD, i.e., the capital to be set aside for each category of risk is added together to get the total capital requirement for the positions. Although, the division of all business into "trading" and "banking" is difficult in practice, the need to measure the market risk and to mark-to-market the trading book daily makes it likely that only traded financial instruments will be included in the trading book. Small institutions can be allowed to calculate capital requirements under the SRD, if the total trading book positions do not normally exceed ECU 15m, and never exceed ECU 20m, and the trading book business does not normally exceed 5% of total business and never exceeds 6%.

The CAD allows the capital requirements to be based on net positions in individual instruments. The basic rules for netting are:

$$\text{Net position} = \text{Excess of long (short) positions over short (long) positions} \\ \text{in the same instrument}$$

Thus, a long position in one asset matched by an exactly off-setting short position in the same asset does not require any capital to cover market risk.

2.2 The CAD versus the BIS rules

In 1993 the Basle Committee proposed changes to the 1988 Capital Accord. The proposed changes concern: 1) Liberalisation of the terms of bilateral netting of certain financial instruments (the *Netting Paper*), 2) Provision of explicit capital charges for market risk (the *Market Risk Paper*), and 3) Creation of a common framework for the measurement of interest rate risk (the *Interest Rate Risk Paper*). These BIS rules only exist as a proposal and are still subject to ongoing changes.

There are some differences between the two sets of rules. Firstly, the CAD is more comprehensive, as it includes provisions related to underwriting procedures, settlement risk, counterparty risk, large exposure risk, and requirement for "other" risks (as described in the first part of this section). Secondly, the CAD allows, in some instances, specific risk for equities to be covered by a 4% capital requirement, or 2% for liquid and well-diversified portfolios, whereas the BIS rules state that this should be respectively 8% and 4%. Thirdly, although the way the two sets of rules deal with foreign exchange risk is quite similar, the alternative ways of calculating foreign exchange risk in the CAD (as stated in table A3 in the annex) are not possible in the BIS rules which lay down a capital charge of 8% of an institution's net open position, with no exception. Lastly, the Basle proposals allow for full use of internal VAR models when the models are approved by the national authorities.

The present CAD only allows internal models to be used for: 1) Option pricing; i.e., calculation of delta weight for capital charge, 2) Historical simulation for foreign exchange and 3) Interest rate sensitivity for institutions which mark-to-market and manage interest rate risk on discounted cash flow basis. However, the European Union's Financial Services Commission has issued a statement that the use of internal risk management models is allowed according to the CAD under certain specific conditions explained in section 3 below. However, capital is still to be calculated by the building block methodology described in the first part of this section. As institutions are to use the higher of these two figures for capital to be set aside to cover risk, the use of internal VAR-models is not a real alternative for the moment. However, the latest CAD II proposal seems to bring the EU's capital adequacy rules in line with the latest amendment to the BIS rules. Thus, financial supervisors seem to move toward 'levelling the playing field' between institutions operating under each set of rules.

The current stricter BIS rules for setting aside capital to cover market risk, compared to the present CAD, reflect both a more prudent view on financial market regulation especially from US financial supervisors and that the CAD covers a more homogenous group of countries. However, the UK has announced that the stricter BIS rules will be applied for UK financial institutions. Furthermore, even the BIS rules might be too lax for financial institutions operating in emerging markets, or for the transition economies in Eastern Europe and, thus, it might be necessary to implement a third set of rules for financial institutions operating in these markets.

3. Value-at-Risk models

This section contains a description of so-called internal Value-at-Risk models to determine capital to be set aside for market risk and can be skipped by readers familiar with the subject. VAR-models are sta-

The use of Value-at-Risk (VAR) models is a major step away from the micro-management of market risk in the present CAD.

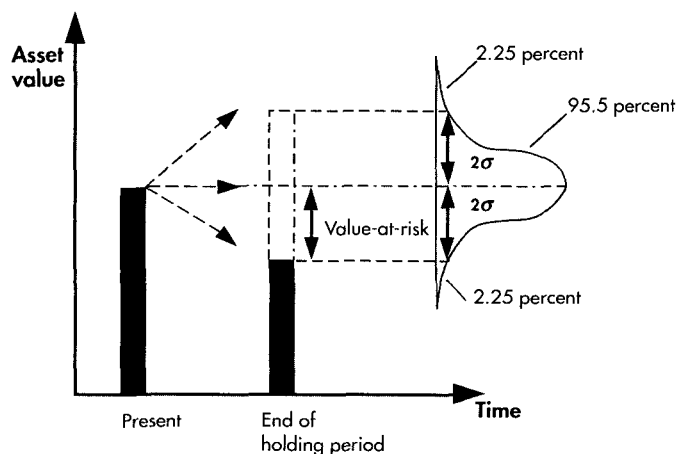
tistical models to measure market risk by determining how much the value of a portfolio could decline over a given period of time with a given probability as a result of changes in market prices when correlations within prices are taken into account as explained in box 1. For example, if the period is one day and the chosen probability is 1%, the VAR measure would be the model's estimate of the maximum loss that could occur with a one percent probability over the next trading day. The use of VAR-models is a major step away from the micro-management of market risk in the present CAD, which contains a large number of fixed risk weightings for each type of security, for different maturities, for different issuers, etc. Fixed risk weightings are too inflexible for today's financial markets and, as they might not reflect the true risk, they are no insurance against default risk and, furthermore, they might hamper optimal allocation of capital. The VAR concept, on the other hand, is a flexible risk management tool which might cover the risk of the whole balance sheet in the future. Many national financial regulators have declared that the use of VAR-models is fundamental to current best practices in risk management, although VAR-models as well have limitations and pitfalls, as shown in section 5.

Box 1 - Value-at-Risk

Value-at-risk is the estimated losses a portfolio may experience over a given holding period with a certain probability if changes in market prices follow the assumed statistical distribution. The most important elements of VAR-models are:

1. Time interval required to close the positions (the holding period).
2. The confidence level, e.g., two standard deviations.
3. The assumed statistical distribution; often the normal distribution.
4. The historical data used for determining correlations across assets.

When prices are assumed to follow the normal distribution, the graph below shows the value-at-risk measure for a confidence interval of double the standard deviation:



Adapted from: Bank of Japan (1995)

The CAD and BIS rules demand that institutions scale up the VAR-measure by a factor currently of 3. This arbitrary way of dealing with the short-comings of the present VAR-models is strongly criticised by financial institutions and is likely to be changed as financial supervisors and institutions become more experienced in the use of VAR-models. The CAD operates with a 10-day holding period and a 95% (99%) confidence level for the historical data covering the last 5 (3) years. A confidence level of 95% means that observations greater than the VAR-measure occur at a maximum of one day out of 20, whereas they occur at a maximum of one day out of 100 when a confidence level of 99% is used. However, these figures are only theoretical figures as the models rely on the assumed statistical distribution and, thus, in practice significant different outcomes might appear, as explained in section 5 of this paper. Box 2 shows a simple example of how the VAR-measure is calculated and the effect of allowing for correlations across asset classes stated in the latest capital adequacy proposals.

Box 2 - Simple example of Value-at-Risk measures

A nominal ECU 100m position in a 10-year 7% bond is held with a current yield of 7% corresponding to a market value equal to the nominal value. The modified duration is 6.8 years at the day in question. Historical data shows that with 90% confidence the yield return will not exceed $\pm 1.995\%$ over the next 24 hours. Thus, with 90% confidence the price return will not exceed $\pm 0.950\%$ ($6.8 \cdot 0.01995 = 0.07$) over the next 24 hours. Thus, there is a 5% chance that we would lose more than ECU 950.000 ($0.950\% \cdot 100m$) and a 5% chance of earning more than ECU 950.000 the next 24 hours.

However, as returns on different assets are not perfectly correlated, the return on a portfolio of assets is partly hedged. The standard deviation of a portfolio consisting of two assets when returns are assumed to be normally distributed is given by:

$$\sigma_{AB} = \sqrt{a^2\sigma_A^2 + b^2\sigma_B^2 + 2ab\rho_{AB}\sigma_A\sigma_B}$$

σ_A, σ_B = standard deviation of each asset

ρ_{AB} = correlation between asset A and B

a, b = amount invested in asset A and B

Consider a portfolio of ECU 100m consisting of 50% invested in the ECU bond above and 50% in a stock index measured in ECU. Historical data shows that with 90% confidence the stock index return will not move by more than 1.210% the next 24 hours. Thus, for a ECU 50m position this represent an exposure of 605.000. If the returns on the bond and the stock index were perfectly correlated, total market risk would be additive and, thus, equal to ECU 1.080.000 ($605.000 + 0.5 \cdot 950.000$). However, historical data shows that these two series have a correlation coefficient of 0.49 and, thus, the value-at-risk measure is:

$$VAR = \sqrt{475.000^2 + 605.000^2 + 2 \cdot 0.49 \cdot 475.000 \cdot 605.000} = 934.493$$

Thus, as the bond and the stock index returns are not perfectly correlated, the value-at-risk is lower than the simple sum of the risk of the two assets.

4. Are the CAD rules consistent with the Second Bank Directive?

One important goal of the CAD is to create a 'level playing field' for banks and investment firms in Europe. However, there are several reasons why this might not be the case as explained below. This section draws on the results in Hall (1989, 1995), Scott & Iwahara (1994), Wagster (1996) and Wagster, Kolari & Cooper (1996).

4.1 Regulatory arbitrage

The CAD sets minimum standards for regulation and, thus, sets a barrier for regulatory arbitrage and for propagation of Gresham's law that states, that 'bad' (soft) regulatory systems will drive out 'good' (strict) ones. However, member states are free to adopt stricter rules, and with the implementation of the CAD in the national regulations, it has already been seen that Member States choose different standards; i.e., the United Kingdom has applied the stricter BIS rules to national regulations by setting capital requirements for government bond positions, because it is considered essential to take the position risk into account. The liberalisation of capital markets means that it is very difficult to maintain different rules among the major countries in the international financial markets without causing financial institutions to move their business. Accordingly, it is considered necessary to harmonise beyond the borders of the EU to avoid investment firms moving their activities to countries with more beneficial rules than the CAD. The proposed CAD II seems to be in line with the latest BIS amendment. However, the increased use of internal VAR models may endanger the harmonisation process, as it is up to national supervisors to approve the models. National supervisor discretion determines the properties of the VAR-models and, thus, in the end how much capital institutions have to set aside. Wagster, Kolari & Cooper (1996) show that national discretion when implementing the 1988 Basle Accord on credit risk led to significantly varied market reactions by bank investors when different countries announced their capital rules. Wagster (1996) shows that the 1988 Basle Accord did not eliminate the pricing advantage of Japanese banks as intended. Thus, national discretion when implementing capital adequacy rules might not necessarily lead to the disappearance of regulatory arbitrage.

National discretion when implementing capital adequacy rules might not lead to the disappearance of regulatory arbitrage.

4.2 Problems for single instruments

The present CAD do not allow for netting of off-balance-sheets exposures with on-balance-sheet exposures and this would be a problem if off-balance-sheet instruments are used to hedge on-balance-sheet exposures. However, it should be stressed that the CAD treats most of the common off-balance-sheet instruments, such as futures, options and swaps, as on-balance-sheet positions in the underlying assets. Secondly, the CAD assumes that debt instruments perform better than equity instruments as, for example, the capital requirement against general risk for equities is always 8%, whereas for debt instruments the capital requirement depends on the maturity and is less than 8% for instruments with a maturity below 12 years. Thus, borrowers might increase their use of securitisation and Commercial Paper programmes to raise capital.

4.3 Differences between banks and securities firms

As mentioned, one of the purposes of the CAD is also to create a 'level playing field' between banks and securities firms. However, the significant differences between the composition of the balance

sheets between the two types of financial intermediaries call for different regulations. The bulk of bank assets are not marketable and liabilities are deposits, whereas the trading book in securities firms consists predominantly of marketable instruments. Furthermore, banks have an important role as they are needed to have a well-functioning payment system and they are main credit providers. If banks fail to lend it would lead to a drop in purchasing power in the local economy. Thus, the two kinds of institutions might call for different minimum capital standards. The purpose of minimum capital standards for banks should be to ensure their long-term viability, whereas for investment firms it should be to ensure that capital is liquid enough. The capital requirements applicable to bank loans are much higher than those for debt securities, which can be considered to have equivalent default risk and maturity. The reason is that bank loans are held on the banking book, whereas debt securities, which constitute the main part of securities firms' assets, are held on the trading book because they are considered to be more liquid than bank loans. Thus, the CAD gives an incentive for banks to shift their business from traditional banking to securitised lending. However, the move towards VAR-models and the introduction of credit risk derivatives might mitigate this incentive. (5)

5. Full use of internal Value-at-Risk models

Moving to internal VAR models, the amount of capital to be set aside is constantly updated according to developments on financial markets. The introduction of credit risk derivatives might also enable risk managers to get a mark-to-market value of credit risk.

The present CAD rules described in section 2 have to be updated each time a new financial instrument is introduced and financial supervisors have to act as 'risk micro-managers' when controlling whether institutions set aside sufficient capital. Furthermore, the rapid changes of financial markets mean that the capital required to be set aside might not reflect the true risk, as the rules are static and somewhat arbitrary. By moving to internal VAR models, the amount of capital to be set aside to cover risk is constantly updated according to the latest developments on the financial markets. Furthermore, as historical price movements of the underlying assets for derivatives are included in VAR-models, the models can deal with almost any new financial instrument. Although the current rules for using internal VAR-models only allow for correlations within each asset class, the latest amendment to the BIS rules and the CAD II proposal by the EU, allow for correlations within broader asset classes, i.e. stocks, bonds, foreign-exchange, etc. as natural hedges across these markets might exist.

Furthermore, the introduction of credit risk derivatives to transfer credit risk might enable risk managers to get a mark-to-market value of financial institutions credit risk. (6) Thus, credit derivatives are expected to have wide-ranging effects on credit markets in line with the effects of the introduction of swaps and options on bond, stock and foreign-exchange markets, since they provide a flexible and liquid market in credit risk and, thus, enable financial institutions to manage their credit exposures actively. The Bank of England (1996) distinguish between total return swaps, which transfer market risk as a whole including credit risk, and credit default products, which transfer default risk only. Financial institutions are expected to include the former in the trading book whereas the latter would probably be recorded in the banking book.

5) Another factor which might 'unlevel the playing field' is that the Investment Service Directive was implemented three years after the Second Banking Co-ordination Directive which came into force the 1. of January 1993. Thus, banks had a three year advance on investment firms to establish business in the Member States.

6) The term "credit derivatives" describes various swap and option contracts designed to assume or lay off credit risk on loans and other assets in return for either interest payments or payment of premium.

However, although the move to internal VAR models is a natural step towards mark-to-market measurement of capital adequacy, the burden for financial supervisors might increase as these models demand thorough and frequent evaluations. There are several reasons for this such as the use of historical data in the models, model parameters, assumptions on distributions, and methodology. Most models use the normal distribution as a statistical foundation. However, a large body of evidence shows that financial asset prices have 'fatter tails' than predicted by the normal distribution and, thus, extreme outcomes occur more often. Furthermore, the assumption of a constant variance is questionable as the volatility of daily financial prices is far from constant. The period of historical data used in VAR models is also important, as structural changes such as the 1987 stock crash, the ERM crises in 1992-93 and the Kobe earthquake in Japan have significant impact on the calculated variances and correlations. Recent studies show that, although VAR-models seem to cover the risk as intended, there are substantial differences among various models and, in some cases, the actual daily losses are several times larger than the corresponding VAR-measures.

For example, Beder (1995) shows that the capital to be set aside to cover risk is very dependent on the methodology and the historical data used in the models. Thus, widely divergent capital requirements arise depending on the specifications of the VAR-model. Beder analyses the VAR-measure for a portfolio of bonds, a portfolio of stocks and stock index options and a portfolio consisting of a combination of bonds, stocks and stock options. For all three portfolios significantly different VAR-measures are estimated, depending on the statistical assumptions in the VAR-models, the historical period of data used, etc. Beder shows that correlation assumptions are important and, thus, the move to allow for correlations within broad risk classes in the latest amendments to the BIS rules and the CAD are expected to have a significant influence on the VAR-measure.

Hendricks (1996) analyses three common types of VAR-models, the equally weighted moving average, the exponentially weighted moving average and historical simulation approaches. The first two kinds of models assume normality and serial independence and, thus, the VAR-calculations requires only an estimate of the standard deviation which is assumed to be constant by the assumption of serial independence. The equal weighted models give the same weight to all observations, whereas the exponential weighted models give more weight to recent observations. However, as financial asset prices are far from normally distributed and show a high degree of serial interdependence, these models cannot be expected to provide reliable estimates. The historical simulation method does not rely on assumptions of the statistical distribution of asset prices or serial independence. However, this non-parametric method needs long sample periods to estimate confidence intervals. The three methods are explained in box 3.

Box 3 - Three categories of VAR approaches

1. Equally weighted moving average approach.

For these models the portfolio standard deviations are calculated as:

$$(1) \quad \sigma_t = \sqrt{\frac{1}{(k-1)} \sum_{s=t-k}^{t-1} (x_s - \mu)^2}$$

where σ_t denotes the estimated standard deviation of the portfolio at the beginning of day t . The parameter k specifies the observation period, x_s the change in portfolio value at day s , and μ the mean change in the portfolio value. Thus, equation (1) gives equal weights to all observations.

2. Exponentially weighted moving average.

For these models the portfolio standard deviations are calculated as:

$$(2a) \quad \sigma_t = \sqrt{(1 - \lambda) \sum_{s=t-k}^{t-1} \lambda^{t-s-1} (x_s - \mu)^2}$$

λ is the "decay factor" which determines the rate at which the influence of past observations decay as they become more distant. The aim of these models is to capture short-term movements which is illustrated by rewriting equation (2a):

$$(2b) \quad \sigma_t = \sqrt{\lambda \sigma_{t-1}^2 + (1 - \lambda) \cdot (x_{t-1} - \mu)^2}$$

Thus, the exponentially weighted average on a given day is a combination of the weighted average on the previous day, which receives a weight of λ , and yesterday's squared deviation, which receives a weight of $(1-\lambda)$. Thus, lower λ means faster decay in the influence of past observations.

3. Historical simulation approach.

Instead of using past historical observations to calculate the portfolio's standard deviation, this approach uses the actual percentiles of the observation period as a VAR-measure. Thus, there is no formula for calculating the standard deviation. For example, for an observation period of 500 days the 99 percentage VAR-measure is the sixth largest loss observed during the last 500 days as the 1% that should exceed the risk measure when a 99% confidence level is used, equates the five largest losses. Thus, the historical simulation approach does not make any assumptions of normality or serial independence. However, for each new choice of confidence level and holding period the VAR-measure has to be recalculated; i.e., 99% and 95% confidence levels will not be constant multiples of each other and holding periods other than one day will not be fixed multiples of the one-day VAR-measure.

Correlations among financial asset prices become stronger when the volatility of financial markets is high and, thus, natural hedges across assets become weaker when they are most needed.

Hendrics shows that, although the twelve models investigated in almost all cases cover the risk intended, substantial differences exist among the models for the same portfolio. Furthermore, extreme outcomes occur more often than predicted by the normal distribution and the size of market movements is not constant over time as assumed in the normal distribution. However, any single model type cannot be recommended and Hendrics suggests combining the best features from the different types of models. Borio & McCauley (1996) show that correlations among financial asset prices become stronger when the volatility of financial markets is high and, thus, natural hedges across assets become weaker when they are most needed. This indicates that VAR-models relying on normal distribution and constant correlation may not provide robust estimates for the actual risk in times

of market uncertainty. Thus, stress testing and 'back testing' of VAR-models are very important for evaluating whether the VAR-measure is in line with the actual risk. In stress testing, extreme price changes are inputted in the models, whereas in 'back testing' actual daily profit and losses are compared with the model-generated risk measures to gauge the quality of the VAR-model. The latest BIS amendment (Basle Committee 1996b) provides a framework for 'back testing' of VAR-models and the Basle Committee considers this to be an important exercise to improve and refine the models. Many risk variables, such as political risk, liquidity risk and regulatory risk (the risk of financial regulators changing rules) are not addressed by VAR-models. Thus, VAR measures must be supplemented with prudent checks, procedures, controls, and limits.

6. Conclusion

A common set of capital adequacy rules for financial institutions operating in the EU is necessary to create a single market also for financial services. However, this paper shows that the present Capital Adequacy Directive for financial institutions operating in the European Union might not 'level the playing field' as intended. Furthermore, the existing rules are already obsolete, as the move towards full use of internal Value-at-Risk models is recommended in the latest amendment to the BIS rules and in the 'CAD II' proposal to be decided by the EU during mid 1997. The rapid development of financial markets and of risk measurement techniques make the straitjacket of the current rather stiff CAD rules a drag on the development of prudent risk measurement systems. Furthermore, the introduction of credit risk derivatives makes it possible to mark-to-market credit risk and, thus, the distinction between trading book and banking book activities may become superfluous and only a single tool for risk measurement, the VAR-model, might be necessary for determining capital to be set aside for fully covering credit and market risk. This development changes the role of financial supervisors from assessing risk to regulating risk methodologies.

This will by, no means, reduce the role of financial supervisors as the results in this paper show that thorough and ongoing control of institutions' VAR-models by financial supervisors is necessary to ensure that risk measurement systems are prudent. Thus, where financial supervisors under the present capital adequacy rules can rather easily judge whether financial institutions obey the rules, the move towards internal VAR-models may well increase the burden on financial supervisors, as each institution's VAR-model has to be approved and frequent controls of the models are necessary. Furthermore, it is likely that the present 'x3' factor is going to be reduced as more experience from VAR-models are gathered. An other aspect is the danger of 'model monopoly' as a few firms mastering the VAR-technology might dominate the market. Although several new as well as established risk management firms have introduced VAR-models the last couple of years and, thus, the fear of one large firm getting monopoly in the risk management business seems to be unfounded, the capacity of national supervisors might limit the actual number of models approved.

The move away from stringent common rules for capital adequacy to internal risk measurement systems, approved by national supervisors, might provide an 'unlevel playing field' by encouraging financial institutions to move to countries with the most relaxed attitude towards the properties of the models. Thus, the need for further co-operation and exchange of information between national financial supervisors is actually increased by the move towards full use of internal risk measurement systems.

The move towards internal VAR-models may well increase the burden on financial supervisors.

Annex

Table A1: Key EU Financial Market Directives

| Directive | Name | Purpose | Date |
|-----------------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Capital Adequacy | CAD | To harmonise minimum capital requirements for banks and investment firms . | 1.1.1996 |
| Investment Service | ISD | A 'CAD' for investment firms so 1) a single passport principle exists for inv.firms and 2) equal rules for banks and inv. firms exist. | 1.1.1996 |
| Solvency Ratio | SRD | To harmonise minimum capital requirements for banks . | In the CAD |
| Second Banking Coord. | 2BCD | 'Single passport' authorising banks operating in one EU country to operate in any other. | 15.3.1996 |
| Own Funds | OFD | Define types of capital that banks may hold to satisfy the Solvency Ratio Directive. | In the CAD |
| Large Exposure | LED | To harmonise limits for banks on the extent of lending to any one borrower. | In the CAD |
| Deposit guarantee | DGD | To set minimum standards for guarantees to bank deposits . | 1.1.1996 |
| Investor Protection | IPD | To set minimum standards of customer protection for transactions with securities firms . | Proposal |
| Capital Adequacy II | CAD II | Proposal for use of internal VAR-models with allowance for correlations within broad risk classes. | Proposal (1.1.1998) |

Table A2: Definition of qualifying items

| | |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Long and short positions in traded financial instruments and in debt instruments issued by investment firms or by recognised third-country investment firms. |
| 2 | Long and short positions in debt instruments provided that they meet the following conditions: <ul style="list-style-type: none"> i Listed on at least one regulated market in a Member State or on a stock exchange in a third-country provided that it is recognised by the authorities in the Member State. ii Sufficiently liquid and subject to a degree of default risk which is comparable to or lower than that of the assets in Article 6 (1) b in the SRD; i.e., assets with a risk weighting of 20% |
| 3 | Notwithstanding 1 and 2, the authorities have the discretion to recognise as qualifying items sufficient liquid instruments where the default risk have been evaluated by at least two credit-rating agencies. |

Table A3: Alternative procedures for calculating foreign-exchange risk capital requirements

1. **Closely correlated currencies:**

Currencies where the likelihood of a loss less than 4% of the value of the matched position in question has a probability of 99% (95%), when the likelihood of loss is calculated on the basis of daily exchange-rate data for the preceding 3 (4) years. For these currencies the capital requirement is calculated as:

For matched positions: 4% of the position.

For unmatched positions: 8% of the higher of the sum of net short or long positions.

2. **Currencies with intergovernmental agreement**

These currencies may be removed and a capital requirement on this part may be no lower than half the *permissible currency variation*

Currencies of Member States participating in the second stage of the European Monetary Union a capital requirement of 1.6% of the matched positions is allowed.

3. **Internal VAR-model**

Capital requirement produced by this method must be sufficient to:

1) Exceed losses that would have occurred in at least 95% (99%) of the rolling 10-working-day periods over the preceding 5 (3) years, and 2) on the basis of analysis of exchange-rate movements during all the rolling 10-working-day periods over the preceding 5 (3) years, to exceed the likely loss over the following 10-working-day holding period 95% (99%) or more of the time

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