

INTERNATIONAL MONETARY FUND

**Financial Risk in the Fund and the Level of Precautionary Balances—
Background Paper**

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In consultation with other departments

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February 4, 2004

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I. INTRODUCTION

1. This document provides background information to the paper on *Financial Risk in the Fund and the Level of Precautionary Balances* (EBS/04/11, 2/4/04). It contains chapters on assessing credit risk and concentration for financial institutions, credit risk models and their application to the Fund, and financial scenario analysis. Chapter II indicates that financial institutions are concerned with concentration when facing the task of managing credit risk. Chapter III shows that most models identify concentration as undesirable and assume diversification as a key risk-mitigating rule. Finally, Chapter IV presents scenarios that highlight the importance of precautionary balances for the Fund in providing a buffer in the case of arrears, notwithstanding the low probability of arrears.

II. ASSESSING CREDIT RISK AND CONCENTRATION FOR FINANCIAL INSTITUTIONS¹

A. Introduction and Summary

2. **All financial institutions manage financial risks, although organizations follow different approaches reflecting the nature of their financial operations.** This chapter reviews approaches to assessing credit risk and credit concentration across selected institutions: commercial banks, central banks (the Bank of England (BoE) and the Bank for International Settlements (BIS)), and Multilateral Development Banks (the Asian Development Bank and the International Bank for Reconstruction and Development).² The FITCH IBCA quantitative approach for rating multilateral development agencies is also discussed as a basis for considering how the Fund compares with other international financial institutions (IFIs).

3. **The chapter concludes that financial institutions are concerned with concentration when facing the task of managing market and credit risk.** Large commercial banks have developed sophisticated Value-at-Risk (VaR) models to assess market risk, but it is only recently that inroads have been made in extending the use of these models to the assessment of credit risk. However, whether focused on market risk or credit risk, these models are based on the assumption that portfolio concentration is not desirable. In the case of the Bank of England, BIS and IBRD, unlike the Fund, the nature of their financial operations more readily allows the application of commercial credit risk assessment techniques, and consequently the implementation of strict limitations on credit concentration in their loan portfolios. Also, in contrast to the Fund, the multilateral development banks are

¹The main contributors to this paper are Ydahlia Metzgen, Sherwyn Williams, Frank Lakwijk, Sheila Bassett, Sarosh Khan and Anna Ter Martirosyan.

²In 1994 (EBS/94/53) staff presented the Board with a study which included a sample of practices followed by official and private entities with regard to risk assessment and provisioning for sovereign loans. In the case of direct lending by governmental agencies to sovereign borrowers, it was found that no assessment of specific country risks was made due to the political nature of these loans. Credit risk covered in this section reviews all lending by selected institutions, of which sovereign lending would be a subset.

able to estimate loss functions based on some average rate of payments arrears or default for different countries, and in a few cases, have either put into place or considered individual country exposure limits. These institutions are then able to carry reserves to guard against such losses and can provision against them as the probability of loss increases. In the Fund, the Board has consistently viewed a country credit rating system for individual Fund members as undesirable.

B. Commercial Banks and Credit Risk Models

4. Commercial banks incur two main areas of risk: credit risk and market risk. Credit risk is the risk to investment returns resulting from a counter party (borrower) not abiding by the terms of a loan or other financial contract. Market risk is the risk to investment returns due to changes in market conditions, such as changes in interest and exchange rates.

Capital standards and risk assessment

5. **Commercial banks are currently subject to risk-based capital standards, which set minimum requirements for equity capital invested by banks' owners.** The risk-based capital standards require more capital to be present when the bank takes on more risk. Or, more practically, these standards limit the risk that the bank can take on given the amount of equity capital³ that it has available.

6. **Risk-based capital standards were introduced in the Basel Capital Accord in 1988 and became effective in 1992.**⁴ Initially they were agreed among the G-10 central banks to apply common minimum capital standards to their banking industries. These standards have been progressively introduced not only in member countries of the BIS, but also in virtually all other countries with active international banks. Under the Basel standards, a bank's capital is required to be at least 8 percent of its risk-weighted assets.⁵

7. **A further step in improving capital standards was taken in 1996 with the market risk amendment.**⁶ This amendment, implemented in 1998, regulates the computation of risk by banks due to changes in market conditions such as exchange and interest rates. A

³Capital is required for a number of reasons. It can absorb losses that the bank may suffer that would exceed the bank's provisions or reserves. Capital also reduces systemic risk by providing a buffer against bank runs and contagion. Finally, capital reduces the moral hazard in lending other people's (e.g., depositors') money.

⁴*International Convergence of Capital Measurement and Capital Standards*, Basel Committee Publications No. 4 (July 1988).

⁵To calculate a bank's capital:asset ratio, its assets are weighted according to broad categories of relative credit riskiness, with weights ranging in five steps from 0 percent (least risky) to 100 percent (most risky).

⁶*Amendment to the Capital Accord to Incorporate Market Risks*, Basel Committee Publications No. 24 (January 1996).

standardized approach using a simple categorical framework applies to most banks. However, large banks with significant trading activities in financial markets are allowed to use their own internal “Value-at-Risk” (VaR) models to assess market risk, once regulators approved the models. In the United States, the 15 or so largest banks are required to use VaR models, and perhaps a quarter of some 8,000 banks use them voluntarily.

8. **A VaR model provides an estimate of how much the value of a trading portfolio could fall due to changes in market prices.** It allows for the incorporation of differences in volatility of various markets, correlation in price movements between markets, and diversification effects. The Value at Risk of a portfolio is a nominal amount and expressed along the following lines: “the chance of losing more than X dollars in the next 24 hours is 1 in 20,” or “we can expect to lose more than Y dollars on two days over the next year.” The specification of the horizon and the confidence interval are important choices, and model implementation calls for the resolution of a host of technical issues.

9. **One use of VaR models for trading portfolios is to set position limits for traders and business lines.** A VaR model allows limits to be set in terms of the maximum allowed VaR. In this way, risk is measured in a meaningful way, different markets and business lines become easily comparable, and trading units are allowed to optimize their portfolio within the constraints of the limit. In addition, many firms allocate equity capital to business units based on risk.

10. **In recent years proposals have been developed to extend the use of VaR models to the assessment of capital requirements for credit risk.** The proposed Basel II accord aims to link capital requirements of banks to the credit worthiness of borrowers. It would give banks three options for assessing credit risk. First, the standardized approach, geared towards smaller banks, would use ratings provided by agencies such as Moody’s Investors Service and Standard and Poor’s to determine capital requirements. Companies rated BBB or BB would have a risk rating of 100 percent, requiring a capital charge of 8 cents per dollar loaned, while a company rated AA would have risk weighting of 20 percent, requiring a capital charge of just 1.6 cents on the dollar.

11. **The proposed accord would also provide two internal-ratings-based (IRB) approaches, which allow banks to apply their own estimates of creditworthiness to determine capital requirements.** The IRB approach would use four key variables to determine capital requirements: probability of default; loss given default (the percentage of an exposure that a bank will lose if a borrower defaults); exposure at default (the amount of a lending facility that is likely to be drawn if default occurs); and maturity. Under the foundation IRB method, banks would estimate the probability of default of their borrowers and then apply the figures provided by banking supervisors for loss given default, exposure at default and maturity to calculate capital requirements.

12. **Under the advanced IRB approach, banks would use their own estimates for all four variables.** However, in order to qualify for the advanced approach, banks would be required to compile several years of data relating to the performance of their borrowers in

order to demonstrate to supervisors the soundness and reliability of their rating systems. Out of a total 365 banks that participated in the third Basel quantitative impact survey that took place in 2002, only 74 banks were able to calculate capital requirements using the advanced approach.

13. **In the private sector, diversification is a key risk mitigating rule.** In fact, portfolio diversification generally yields a lower VaR. However, in some cases commercial banks may take decisions allowing a greater degree of concentration if the potential returns are considerable. This could occur with market instruments. In the case of credit risk, the upside is often limited or nonexistent, and for private financial institutions there would be little or no reward for taking on concentrations of default risk.

14. **The Core Principles for Effective Banking Supervision of 1999, which provide the international financial community with a benchmark to assess the effectiveness of banking supervisory regimes, include a principle on credit concentration.** The principle stipulates that 25 percent of a bank's capital is the limit for an individual credit exposure to a private non-bank borrower or a closely related group of borrowers. The Fund's financial structure does not lend itself readily to the direct application of this principle.

C. Risk Management at the Bank of England (BoE)⁷

15. **The BoE faces various types of risk—including credit, market and operational risks**—in its financial operations and as agent for HM Treasury in managing the UK's official foreign currency and gold reserves.

16. **Risks of the BoE are monitored and managed through its internal control framework.** This includes oversight of the management of the Bank's balance sheet by the Assets and Liabilities Committee (ALCO) and the Risk Management Division (RMD) which is responsible for monitoring risk in the Bank's market operations. In addition, there is a procedure under which the Executive reports to the Court of Directors once a year on risk management in each of their areas of responsibility, supported by the maintenance of a bank-wide risk and controls matrix. The reports cover how risks are managed and monitored and the likelihood of risks materializing. The framework for risk control in the management of the UK's international reserves by the BoE is summarized in an annual Remit set by HM Treasury (HMT), as discussed further below.

⁷The sources of the information in this section is the Bank of England's website (www.bankofengland.co.uk); *Bank of England, Annual Report, 2003*; and *Debt and Reserves Management Report 2002-03*, March 2002, HM Treasury.

Risks Faced by the BoE in Financial Operations⁸

17. **In its financial operations, the BoE is exposed to credit risk when it provides liquidity to financial institutions in open market operations;** in the sterling and euro wholesale payments systems and securities settlement systems; in the management of its own funds; and through the banking services it provides to its customers. As a central bank, some of these operations involve the BoE having to accept large exposures from counterparties because it must satisfy the liquidity needs of the financial system as a whole.

18. **To contain credit risk in these activities, the BoE requires that counterparties meet appropriate credit and functional criteria and that exposures are fully collateralized** (with margin) by high quality, marketable securities. The Credit Risk Advisory Committee (CRAC) reviews the counterparties with whom the Bank deals, as well as the issuers of securities which the BoE holds. CRAC reports to the Executive Director for Markets, who is ultimately responsible for decisions on limits. The credit ratings developed by the BoE are then used as the basis for credit and settlement limits for counterparties where the BoE is not obliged to accept exposures to these counterparties because of the liquidity needs of the financial system as a whole. In exceptional circumstances, the BoE may act as lender of last resort to large financial institutions in difficulty. Such actions are governed under the memorandum of understanding with the Treasury and FSA.⁹ Market risks, e.g., risks stemming from interest rates on assets and liabilities, exchange rate risks, and changes in the market conditions, are largely managed through measuring Value at Risk of mismatched positions, as discussed further below.

Management of International Reserves at the BoE

19. The BoE, as agent of HMT, is entrusted with managing and safeguarding the UK's international reserves,¹⁰ as outlined in the Remit set by HMT.¹¹ The management of these reserves entails monitoring and controlling risks, including market, credit and liquidity risks.

⁸This section deals with the credit risks facing the Bank of England in its financial operations. Responsibility for prudential supervision of the banking system was transferred to the Financial Services Authority (FSA) in 1997. Financial sector stability is managed under the umbrella of the financial stability Memorandum of Understanding agreed by the BoE, UK Treasury, and FSA; and the associated financial stability Standing Committee.

⁹The MOU establishes a Standing Committee consisting of the BoE, FSA and Treasury that meets on a monthly basis (or at other times if an urgent issue arises) to discuss issues relating to financial stability. The MOU requires that if the BoE or FSA identify a problem of a systemic nature, they would immediately inform and consult each other. In addition, they would immediately inform the Treasury to give the Chancellor of the Exchequer the option of refusing support action and thereafter keep it informed about the developing situation, as far as circumstances allowed.

¹⁰The United Kingdom's official holdings of international reserves comprise gold, foreign currency assets, IMF SDRs, and the UK's Reserve Tranche Position (RTP) at the IMF. With the exception of the RTP, these reserves
(continued)

20. **Market risk, as required by the Remit, is managed in three main ways by the BoE:** (i) using a Value at Risk (VaR) measure to aggregate risk consistently across the components of the portfolio;¹² (ii) using sensitivity measures for a more detailed analysis of risk; and (iii) using stress tests that quantify the potential loss from worst-case scenarios. These VaR estimates are derived from the past volatility of, and correlations between, returns on different assets in the portfolio. The BoE measures the EEA's VaR exposure against limits set by HMT in the Remit. For internal BoE management control purposes, the Risk Management Division (RMD) also measures Delta. Delta is the change in value of the portfolio for each one basis point shift in the relevant yield curve. It supplements the VaR measure, and helps to test the sensitivity of the portfolio to changes in interest rates. Furthermore the BoE conducts regular stress tests to explore the vulnerability of the EEA to potential severe market movements and to estimate the potential losses (or gains) in these extreme conditions.

21. **With regard to credit risk, the management of the reserves involves taking credit exposures to banks and to the issuers of sovereign, supranational and commercial paper.** The creditworthiness of these banks and issuers is subject to regular scrutiny by the BoE's internal Credit Risk Advisory Committee (CRAC). As part of this process, limits are agreed for the maximum exposure to each bank and issuer in terms of both amount and maturity. Such exposures are monitored in real time against the limits. In addition, there are limits to contain exposure to each country's banking system, and limits that apply to certain instrument types. Certain derivative instruments entered into by the EEA are conducted under master legal agreements that permit collateralization of outstanding exposures. The system is kept under review in light of market or institutional developments affecting the position of counterparties. The BoE provides HMT with a monthly report of limit excesses or management overrides and a full statement of credit limits after each six-monthly meeting. With regard to **liquidity risk**, in agreement with HMT, a core level of liquidity is specified in the BoE's asset allocation model, leading to minimum holding thresholds in particular asset classes such as U.S. Treasury bonds.

are held in a government account administered by HMT, the Exchange Equalization Account (EEA), and are therefore not held on the BOE's balance sheet.

¹¹The management of international reserves is conducted within the framework of a Remit set by HMT that summarizes the benchmarks against which the reserves are actively managed; the investment constraints within which the BoE operates; the framework for risk control; and the arrangements for the audit of the EEA.

¹²The VaR model predicts at a specified confidence level, the maximum likely loss for a portfolio over a certain time period. In agreement with HMT, the Bank applies a 99 percent confidence interval and a ten-day holding period, such that in 99 ten-day periods out of a hundred, losses should not exceed those suggested by the model. These VaR estimates are derived from the past volatility of, and correlations between, returns on different assets in the portfolio.

Accounting and Provisioning Practices of the BoE

22. **Under the Bank of England Act 1998, accounting practices of the BoE are in accordance with the Companies Act of 1985 and applicable accounting standards in the United Kingdom**, except insofar as the Bank does not consider it appropriate to do so with regard to its functions. The financial statements of the BoE are audited by an external auditor. The BoE provisions for bad and doubtful debts as regarded necessary with respect to both specific and general factors. The general element arises with respect to existing losses which although not separately identified are known from experience to be present in any portfolio of bank advances. Specific provisions relate to identified advances at risk and are raised when it is considered that recovery of the outstanding balance is in serious doubt. The provision is the amount necessary to reduce the carrying value of the advance to its expected net realizable value including available collateral. The general provision is reviewed on a regular basis to ensure that it remains appropriate in the context of the perceived risk inherent in the lending portfolio and the prevailing economic climate.

BoE Approach to Risk Management and the Relevance for the Fund

23. **The role of the Fund in providing resources to countries is in some ways similar to a central bank in that both institutions must at times take on large exposures.** However, the nature of the risks is different. In the case of the BoE, lending is often backed with collateral in the form of market-based instruments, and the BoE can exercise more discretion in its operations. In contrast, the Fund does not require collateral for its lending and it is difficult for the Fund to limit exposure.

D. Risk Assessment at the Bank for International Settlements (BIS)

Risk and Exposure

24. **In its role as a banking institution, the BIS competes directly with private financial institutions.** In addition to its central bank customers, the BIS also acts as a banker to, and manages funds for a number of financial institutions. As of March 31, 2003, about 130 central banks held part of their reserves at the BIS, with total currency deposits amounting to SDR 122.5 billion. To provide security to its customers, the BIS has built up a sizeable equity capital and ample reserves. Its investment strategy is geared towards combining diversification benefits with intensive credit and market risk analysis. To maintain liquidity, the BIS stands ready to repurchase its tradable instruments at low cost to its customers and thus respond quickly and flexibly to their needs. A separate Risk Control unit monitors credit, market and operational risks.

25. **The financial operations of the BIS are carried out within a general policy framework that imposes certain general as well as specific limits on credit, market and liquidity risks to which it is exposed through its market activities.** These limits have been set to strict standards in order to maintain the outstanding credit quality of the BIS as counterparty to central banks and commercial institutions. The BIS's assets for the most part

consist of investments with top-quality commercial banks of international standing and government and quasi-government securities, including reverse repurchase transactions. The BIS also grants short-term credits to central banks, usually on a collateralized basis. The share of sovereign and quasi-sovereign securities increased noticeably during the past financial year to reach almost one third of total assets at end-March 2003. The BIS has a maximum exposure limit to a single commercial bank of 50 percent of capital. While the statutes do not include exposure limits to individual countries, operational credit rules specify individual country limits on an ongoing basis.

BIS Provisions and Reserves

26. **Provisions are recognized when the BIS has present legal or constructive obligations as result of past events and it is probable that resources will be required to settle the obligation.** Prior to fiscal year ending March 2003, a provision for banking risks and other eventualities, was included under miscellaneous liabilities. As a result of a change in accounting policy, these provisions and others are now credited to reserve funds.

27. **The BIS's reserves consist of the following four reserve funds: legal, general, special dividend, and free.** The yearly allocations to the various reserves funds are governed by its statutes. As of March 2003, the BIS's reserve funds stood at 5.2 billion gold francs, while its investments in currencies stood at 89.4 billion gold francs.

28. **The BIS maintains a low level of reserves compared to the level of its investments.** This is because the quality of the BIS's investments are very high and sufficiently liquid to enable quick and flexible response to the needs of its members. In contrast, IMF loans are granted to sovereign governments and usually in the context of programs and conditionality that helps ensure repayment.

E. Risk Assessment at the International Bank for Reconstruction and Development (IBRD)

29. **The IBRD maintains provisions and reserves in the form of the Accumulated Provision for Loan Losses, the General Reserve, and the Special Reserve.** Country credit risk—the risk that loans to specific countries may go into extended arrears—is the most important risk faced by IBRD. The magnitude of provisions and reserves reflect possible cash flow losses. While the IBRD has never written off a loan and thus recognized a loss of principal, delays in receiving loan payments result in losses to the institution because IBRD does not charge interest on overdue interest payments. Credit risk is managed through individual country exposure limits, which are set according to creditworthiness and performance on macroeconomic and structural policies, and an absolute single borrower exposure limit. In addition, financial incentives such as partial interest charge waivers conditioned on timely payment reinforce borrowers' self interest in preventing arrears.

30. **Credit risk is measured in terms of both expected losses and unexpected nonaccruals.** Provisions cover expected losses and reserves cover interruptions in cash flows from unexpected nonaccruals.

- *Expected losses: Provisions.* The IBRD holds provisions against each borrower to cover expected losses.¹³ The amount of provisions required for any individual borrower is the sum product of its estimated probability of default, its loans outstanding and its severity of loss given default. The probability of default is estimated using a credit migration matrix that reflects IBRD's own rating history, including nonaccrual events.¹⁴ The severity of loss given default depends on the duration of nonaccrual, the level of interest rates during that period, and the possibility of loss of principal. Using this framework, IBRD categorizes countries into three groups according to per capita income and creditworthiness and applies severities of 30 percent, 50 percent, and 100 percent.
- *Unexpected nonaccruals: Reserves.* Unexpected nonaccruals are estimated using the *Risk Adjusted Allocation of Capital (RAAC)* framework, which combines borrowers' probabilities of default, projected exposure, and sensitivity to different states of the world (covariance risk) into a single measure of the credit quality of the loan book.¹⁵ The output of the RAAC framework is the maximum shock the institution could face at a given confidence level.¹⁶ The adequacy of reserves is then determined by evaluating whether the institution could continue to intermediate effectively and grow its loan book while maintaining its equity-to-loans ratio.

31. **Credit risk is also managed through individual country exposure limits, which are set according to creditworthiness and performance on macroeconomic and structural policies, and an absolute single borrower exposure limit.** The single borrower exposure limit is set at the lower of an equitable access limit and a concentration risk limit.

¹³It is the policy of the IBRD to place in nonaccrual status all loans made to or guaranteed by a member of IBRD if principal, interest or other charges with respect to any such loan are overdue by more than six months.

¹⁴The rating scale used by IBRD's Country Credit Risk Department has 10 credit grades, including nonaccrual status. Given their sensitive nature, the countries' ratings are not made public. The Executive Board is provided with an overview describing the share of the loan portfolio in the different risk bands.

¹⁵The RAAC framework was discussed in at great length in the Appendix of EBS/02/185. In addition to the RAAC framework, three other measures of portfolio quality are used to provide information on the quality of the credit portfolio. These are the risk structure of the loan portfolio, which divides the portfolio into three broad categories of riskiness according to the country risk ratings; the loan portfolio score, which is the exposure-weighted average risk rating for the portfolio as a whole; and the exposure-weighted average expected default frequency (probability of default).

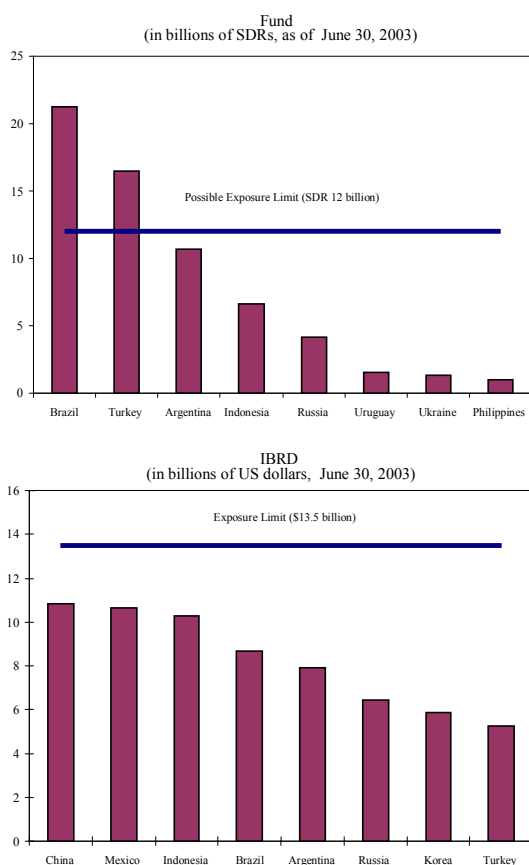
¹⁶A 95 percent confidence level in the RAAC is used by the IBRD. This level should be seen as implying an estimated 5 percent chance that the institution would need to make a call on its shareholders in order to finance, on a sustainable basis, continued loan growth at the target rate of 3 percent a year.

For FY 2004, the concentration risk limit is \$13.5 billion, unchanged from FY 2003. The equitable access limit is \$21.3 billion. The largest exposure to a single borrower was \$11 billion at June 30, 2003 (see Figure 1). In FY 2003, Directors approved a policy that would allow lending to borrowers that had reached the limit, provided that they have entered into an arrangement designed to insulate IBRD from possible cash flow losses resulting from exposure in excess of the concentration risk limit.

Maximum Country Exposure Limits: Application to the Fund

32. **To address the issue of increased risk from a large debtor, the Board of the Fund has considered setting a limit on maximum absolute exposure though most Directors saw little merit at that time in such an approach.**¹⁷ The World Bank employs such a limit and work is underway at the AsDB to implement a similar approach. Such country exposure

Figure 1. Top Eight Country Exposure at Fund and IBRD



Source: Finance Department, and World Bank Annual Report, 2003.

limits also feature directly in rating agencies' assessments of the creditworthiness of the international financial organizations that borrow on capital markets.

33. **A maximum country exposure limit could be based on the Fund's existing burden-sharing mechanism.** In this context, we assume that PB* equals the level of precautionary balances at time "t" and that the rate of accumulation is broadly appropriate. Thus, an exposure limit could be derived such that the Fund could not lend to a single borrower that is so large that in the case of arrears on charges the Fund could not fully compensate the income loss from unpaid charges through burden sharing.

34. **The implied maximum exposure to a single member for which the Fund through burden sharing could absorb potential income losses associated with the member not meeting its interest obligations would translate into a limit of about 23 percent of credit outstanding between 1997 and 2003, or a maximum nominal limit of SDR 12 billion.** This compares with a limit of \$13.5 billion

employed by the World Bank.

¹⁷See IMF Concludes Discussion on Access Policy in the Context of Capital Account Crises; and Review of Access Policies in the Credit Tranches and the Extended Fund Facility (PIN No. 03/37, 3/21/03).

35. **Setting a maximum exposure limit to safeguard Fund resources could signal a lack of confidence by the Fund in the member and its capacity to pay.** In addition, setting such a limit would raise issues of uniformity. That is, any limitation on access that is not based on quotas but on absolute amounts would discriminate against members with larger quotas. It is a matter for the staff and the Executive Board to find an appropriate balance between the principles of uniformity, and those of safeguarding the Fund's resources and protecting the financing mechanism of the Fund.

F. Risk Assessment at the Asian Development Bank (AsDB)

36. **The AsDB's precautionary balances consist of an ordinary reserve, a special reserve, surplus, and loan-loss provisions.** Currently, the AsDB follows a policy of allocating net income to achieve a reserve-to-loan ratio of no less than 25 percent. Loan-loss provisions are only made for private sector operations where amounts are set aside in connection with specific problem project loans and equity investments. Future loan losses, if these were to materialize, would first be charged against loan-loss provisions. Any remaining balance would then be charged against net income for the year in which the loss was incurred, and finally against the ordinary and special reserves. At end-2002, total loans outstanding were \$29.1 billion, the reserve-to-loan ratio was 32 percent, and loan-loss provisions were less than \$0.1 billion.

37. **AsDB's current lending policy, adopted in February 2003, limits outstanding commitments** i.e., the sum of outstanding disbursed loan and undisbursed loan balances, equity investments, and present value of guaranties to no more than the sum of total callable capital, paid-in capital, reserves (including surplus but excluding special reserve). At end-2002, AsDB's outstanding loan commitment in its ordinary operations totaled \$43 billion (78.1 percent of such lending ceiling), of which 98.2 percent were allocated to the public sector. The largest borrowers from AsDB in its ordinary operations, accounting for 93.7 percent of outstanding loans, were Indonesia (23.8 percent), The Peoples Republic of China (22.3 percent), India (18.6 percent), the Republic of Korea (9.1 percent), Pakistan (9 percent), the Philippines (8.7 percent) and Thailand (2.2 percent). AsDB has not suffered any losses of principal in its public sector ordinary operations, and occasional delays in repayments have not been material to AsDB's operations.

38. **The current policy regarding precautionary balances is about to be changed and AsDB is in the process of preparing a risk adjusted allocation of capital framework along the lines of that used by the IBRD.** Under this approach, the adequacy of equity capital and overall risk-bearing capacity will be assessed using inputs of borrowers' creditworthiness, the likely duration until arrears are cleared, and the default correlations assigned to the different borrowers.¹⁸

¹⁸Risk assessments will initially be based on public ratings provided by commercial credit rating agencies, where the expected default frequency associated with each rating grade will be adjusted by AsDB to reflect the
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39. **The financial operations of the AsDB are more similar to those of the IBRD than of the Fund.** As of end-April 2003, the reserve to credit outstanding ratio for the Fund was 6.5 percent, only one-fifth of the corresponding level maintained by the AsDB at end-2002. Also, the recent move towards the adoption of risk rating of borrowers by the AsDB has sharpened the distinction between the AsDB and the Fund, since the Fund's treatment of members under the Articles of Agreement requires uniformity.

G. A Credit Ratings Agency Approach to Credit Risk Management

The FITCH IBCA Approach¹⁹

40. **The international rating agency, FITCH IBCA (FI), has developed a quantitative framework for rating multilateral development agencies (MDBs),** including the World Bank, Asian Development Bank, and African Development Bank.²⁰ The rating of MDBs by credit rating agencies stems from the nature of the MDBs financing which depends in large part on resources borrowed on capital markets. While the Fund does not borrow from private markets, it may be interesting to see how a ratings agency might assess the Fund's credit risk and the level of precautionary balances.

41. FI assesses the adequacy of the MDBs capital coverage relative to its credit risk and it looks at other factors such as financial risks (e.g., interest rate and liquidity risks), capacity to build up reserves through profit generation; and relationships with shareholders.

42. **In assessing capital adequacy FI uses two types of analyses: 1) expected loss analysis; 2) risk concentration analysis.** The approach which yields the larger minimum capital requirement is used to assess capital adequacy. Loan loss analysis is derived by multiplying each loan by the default probability for an AAA rating corresponding to FI's sovereign rating and a severity rate of the loss (e.g., 75 percent).²¹ To take into account the preferred creditor status of MDBs, FI raises its ratings for sovereign loans by one notch. Shadow ratings are used in cases where FI does not have a sovereign rating.

institution's preferred creditor status. It is envisioned that the AsDB over time will establish an internal country credit risk assessment system.

¹⁹Source: *Risk Analysis of Multilateral Development Banks and Other Supranationals*, FITCH IBCA, March 1999.

²⁰Staff also looked at approaches by other ratings agencies, but the Fitch approach was used since it provided a detailed quantitative methodology which facilitated the application to the Fund.

²¹The AAA default probabilities for each credit rating are based on the FI default probability curve which determines the 10 year bond default probabilities for a range of given initial rating levels. These probabilities are then stress tested with the maximum stress applied to the case of AAA default. Thus a loan rated BBB has a base 10 year default probability of 4 percent which is then stressed to 14 percent when the portfolio is tested for an AAA rating.

43. **Risk concentration analysis assesses the potential loss arising from the default of the MDB's largest obligors.** For an AAA rating, FI has developed a matrix which indicates the number of obligors which need to be covered by capital within each sovereign rating category, e.g. to obtain an AAA rating, an MDB must cover its five largest obligors with a BBB rating or its nine largest obligors with a 'BB- or lower' rating.

44. **To assess the amount of available capital, FI uses a concept of paid in equity and "callable" capital.** Paid in capital would correspond to the paid subscriptions of the shareholders. "Callable" capital represents the amount of funds the shareholder is obliged to provide to cover the MDB's debt obligations, but not to finance new lending. In the World Bank, subscribers only pay a small portion of their subscription with the remainder being "callable." The World Bank then borrows from capital markets for a large part of its lending, but uses the "callable" capital as collateral. To allow for the potential default in a possible capital call, FI uses its default probabilities for an AAA rating for each shareholder (based on its sovereign rating) times the amount of its callable capital.

The Credit Ratings Approach and its Relevance to the Fund

45. **The use of default probabilities calculated by FI based on sovereign ratings does not have direct relevance for the Fund.** The expected loss for use of IMF resources is very small, especially given the Fund's 50 years of experience without default.

46. **The methodology breaks down further when trying to apply the FI definition of available capital to assess the Fund's capital adequacy, given the institution's unique funding arrangements.** Since the resources provided by the Fund's shareholders are the basis for its lending operations, there is no direct equivalent to "paid-in" capital or "callable" capital, as in the MDBs.

47. **Nevertheless, as a pedagogical device, what follows is an illustration of how the Fund might be viewed by potential investors, if the Fund borrowed in international capital markets.** The FI methodology was applied to the Fund's loan portfolio as of end-October 2003 to provide an indicative target of the minimum capital requirement under the two different approaches: expected loss analysis and risk concentration analysis. For the expected loss analysis each country's total outstanding credit with the Fund's General Resources Account (i.e., PRGF lending was excluded) was multiplied by the FI AAA stressed default probability corresponding to the member's credit rating. Consistent with the FI approach, the sovereign ratings for each country were adjusted up one notch to reflect the preferred creditor status of the Fund.²² This result was then multiplied by a severity loss of 75 percent (implying 25 percent recovery). This approach yielded a minimum capital requirement of SDR 36 billion or about 50 percent of total Fund credit outstanding (see Table 1).

²²In the absence of a FI sovereign rating, we assigned the country a speculative rating, and assumed a AAA default probability of 100 percent (this would be worse than that of a B- rating which carries a default probability of 75 percent for AAA rating).

Table 1. Expected Loss Analysis

Expected Loss (AAA Stressed)	Amounts		
	In billions of SDRs 1/	In billions of US\$ 2/	In percent of total. GRA credit
50% severity rate	24.0	33.6	34.5
75% severity rate	36.0	50.4	51.7
100% severity rate	48.0	67.2	69.0

1/ Based on Fund credit outstanding as of end-October, 2003.

2/ Assuming a SDR/US\$ exchange rate of 1.4.

48. **Using FI's concentration risk analysis, consistency with an AAA rating would suggest that the Fund would cover the loans of the 9 largest 'BB- or below' rated debtors.**²³ The illustration indicates that if the Fund were to borrow from capital markets, it would need the equivalent of available capital of at least SDR 60 billion to obtain an AAA rating (see Table 2) or about 85 percent of its total credit outstanding.

Table 2. Concentration Analysis

	Amounts	
	In billions of SDRs /1	In percent of total GRA credit
Brazil	23.4	33.5
Turkey	16.2	23.2
Argentina	10.6	15.2
Indonesia	6.7	9.6
Uruguay	1.6	2.4
Ukraine	1.2	1.8
Ecuador	0.3	0.4
Dominican Republic	0.1	0.1
Papua New Guinea	0.1	0.1
Total	60.1	86.4

1/ Based on GRA credit outstanding as of end-October, 2003.

²³Note that we excluded countries for which FI has no rating from this group. If we included those countries in the BB- group, it would only imply a difference of SDR 2 billion, i.e., SDR 60 billion vs. SDR 62 billion.

III. CREDIT RISK MODELS AND APPLICATION TO THE FUND

A. Introduction and Summary

49. **This chapter reviews several credit risk models and evaluates the possible application of a credit risk model to the Fund to determine a target level of precautionary balances (PB*) aimed at covering credit risk.**²⁴ Credit risk in the context of the Fund is the risk that a member will go into protracted arrears. Precautionary balances provide protection for the Fund's GRA balance sheet against this risk. Market risk, on the other hand, is not a risk factor in the GRA. Changes in exchange and interest rates do not affect the (present) value of the Fund's loans, which are denominated in SDRs and carry a variable interest rate.²⁵ Market risk analysis in the private sector is well advanced and formal bank capital requirements have been established for market risk at commercial banks.

B. Review of Credit Risk Models

50. **Credit risk analysis is constrained by limited or incomplete information on default probabilities and has so far not been incorporated in formal bank capital requirements.** A basic premise of credit risk modeling is that credit risk is managed in the context of a portfolio of holdings and that the portfolio is backed with sufficient capital. Portfolio management of credit risk requires knowing the default probabilities and default correlations, both of which are difficult to determine. Data are limited because credit is often not tradable, and model parameters can often not be estimated and must be preset. However, increasing securitization of credit allows market-based risk factors such as credit spreads to be used. Model validation, i.e., testing whether a model holds up well, is difficult in the case of credit risk. Back testing is not easily feasible as actual defaults are infrequent. Moreover, relevant historical data have not been systematically collected by most financial institutions.

51. **Credit risk models developed in the private sector and by the IBRD focus on the uncertainty surrounding a counter party's ability to service its debts and obligations.** Prior to default, it is not possible to discriminate unambiguously between entities that will default and those that will not, and only probabilistic assessments of the likelihood of default can be made. Default in the private sector varies widely and is rare: for example, the odds of a lowest rated ("CCC") firm defaulting are about 4 in 100 per annum, which is about 200 times the default odds for a highest rated ("AAA") firm.²⁶

²⁴See Crouhy, Galai, and Mark, "A Comparative Analysis of Current Credit Risk Models," *Journal of Banking and Finance*, Vol. 24, (2000), pp. 59-117.

²⁵The indirect effect of changes in international market conditions on members' ability to repay is considered under the Fund's credit risk.

²⁶KMV, "Modeling Default Risk," 2001.

CreditMetrics

52. **CreditMetrics from JPMorgan is a methodology to measure credit risk in a portfolio context.** The Value at Risk (VaR) for a whole corporation is computed across a wide range of instruments including bonds, loans, letters of credit, commitments, derivatives, and receivables. CreditMetrics is available on the web and includes a data set of default and migration probabilities, recovery rates, credit spreads, and correlations.²⁷

53. **The approach is based on credit migration analysis, i.e., the probability of moving from one credit quality category (such as “AAA”) to another, including default, within a given time horizon (often 1 year).** Historical credit quality data assembled by rating agencies or financial institutions themselves are used to derive a likelihood of changes in credit quality. Data may cover decades and a wide variety of firms. Each downgrade or upgrade is associated with a change in value of the instrument, which is estimated from historical credit spread data or recovery rates in default. Each value outcome is weighted by its likelihood to create a probability distribution of values for each asset. Concentration risks are quantified by incorporating correlations, which can however not be directly observed from historical data and instead are inferred from firms’ equity prices or assumed.

KMV

54. **KMV Corporation has developed a credit risk methodology and an extensive data base to assess default probabilities and the loss distribution related to default risk.**²⁸ It uses a microeconomic approach which relates the probability of default of any borrower to the market value of its assets. The default risk of the firm increases as the stock market capitalization of the firm approaches the book value of the firm’s liabilities. The uncertainty surrounding the value of the firm’s assets adds a stochastic element.

55. **KMV’s methodology differs somewhat from CreditMetrics as it relies upon the “Expected Default Frequency” for each issuer, rather than upon the average historical transition frequencies produced by the rating agencies for each credit class.** KMV notes that cross default clauses in debt contracts usually ensure that the default probabilities for each of the classes of debt for a firm are the same, although the loss in the event of default can vary widely by credit class. In KMV’s approach, default probabilities vary over time, while they do not in CreditMetrics.

²⁷See J.P. Morgan’s web site at www.jpmorgan.com. The model is co-sponsored by several other major banks.

²⁸The database includes over 250,000 company-years of data and over 4,700 incidents of default or bankruptcy (KMV Corporation, “Modeling Default Risk” (2001)). “KMV” stands for the first letter of the last names of the three founders of the company. KMV was recently acquired by Moody’s.

IBRD

56. **The IBRD evaluates its risk on the basis of a VaR model that is tailored to its portfolio and status.**²⁹ The Bank has rated borrowers since 1980 on a numerical scale, which currently represents 10 different degrees of creditworthiness (down to nonaccrual or default). The ratings reflect assessments by Bank staff of borrowers' external vulnerability to shocks affecting their current and capital accounts. Individual ratings are not made public and the Bank's Executive Board is periodically provided with the share of the loan portfolio in the different rating categories.

57. **The probability of country default is estimated on the basis of the Bank's experience with countries moving from one rating level to another.** A migration matrix is constructed that captures the deterioration (or improvement) in creditworthiness and risk of borrowers over time. Expected default frequencies over a period of several years are derived from the matrix, which takes into account that over time borrowers can slip into nonaccrual status. In addition, concentration risk is taken into account by assigning probabilities to events that would affect multiple countries and considering the impact these events would have on default probabilities.

CreditRisk+

58. **CreditRisk+ is a model produced by Credit Suisse Financial Products that allows for stochastic default rates.** It makes no assumptions about the causes of default: a borrower is either in default with probability P or not with probability $(1 - P)$. Default on individual loans is assumed to follow a Poisson process, which implies the following specific assumptions:³⁰

- The probability of default on a loan is the same in one month (year) as in any other month (year).
- The number of loans is large (the Poisson distribution is an approximation when the number is less than infinite).
- The probability of default on any loan is small.
- The number of defaults that occur in any one period is independent of the number of defaults in any other period.

59. **In order to derive the loss distribution for a well-diversified portfolio, the possible losses are divided into bands.** The possible loss in each band is approximated by a single number, the common exposure (e.g., 10 different bands could be considered, with

²⁹The model does not apply to IDA because IDA has a very different financial structure.

³⁰The Poisson distribution is fully specified by only one parameter, the mean, and is skewed with a fat right tail. A generalization would be to assume that the mean default rate is stochastic (with a specific distribution) and related to macroeconomic factors.

rising levels of exposure). A common Poisson distribution is assumed for the default probabilities of all loans within a band. The distribution of losses within each band and for the entire portfolio can then be computed.

60. **CreditRisk+ is relatively easy to implement.** Closed form expressions are derived for the probability of portfolio loan losses, which makes CreditRisk+ computationally attractive. Marginal risk contributions by loan can also be easily computed. CreditRisk+ ignores credit rating changes and therefore does not compute changes in the value of a loan prior to default.

CreditPortfolioView

61. **CreditPortfolioView is a model proposed by McKinsey which adjusts historical credit ratings data for the business cycle.** Default probabilities are time and country specific and modeled as a logit function dependent on a macroeconomic index. A limitation of the model is that sufficient data are needed, including reliable default data for each country, to calibrate the model.

C. Application of a Credit Risk Model at the Fund

62. **The starting point for most of the credit risk based empirical models is deriving the default probabilities and default correlations based on historical experience.** Credit quality is determined by a country's creditworthiness. Default probabilities and credit risk could be managed through individual country exposure limits. For the Fund, the commitment of its members to implement sound policies, the conditionality of Fund-supported programs, and relatedly the Fund's preferred creditor status would be associated with lower default probabilities than those underlying the ratings assigned by the international rating agencies to sovereigns. Hence, the Fund could construct its own credit ratings of member countries as does the World Bank though notably these credit ratings are not provided to the IBRD's Executive Board or made public (see Chapter II.E). However, the Fund Board has on numerous occasions expressed strong reservations as to the desirability of having the Fund move toward rating member countries.³¹

63. **Turning to specific evaluations of the applicability of available credit risk models to the Fund, the Fund's de facto preferred creditor status could not easily be captured in some models.** For example, one model (KMV) assumes that credit quality is determined by the firm and not the instrument. Applied to the Fund, this would mean that the country's creditworthiness, regardless of the identity of the lender, determines default probabilities. However, loans extended by the Fund to a country would be expected to have lower default probabilities than loans extended to that country by others. The World Bank has been constructing credit ratings for a while and is able to derive the likelihood of rating changes

³¹See *Biennial Review of Implementation of the Fund's Surveillance and of the 1977 Surveillance Decision* (SM/00/40, 2/18/00), page 16.

from its time series of credit ratings. This information is crucial for some credit risk models, such as CreditMetrics and the Bank's own model, and is not available at the Fund.³²

64. **The market value of most credit instruments is difficult to determine.** The idiosyncratic nature of most credit instruments, including the Fund's loans, implies that they are not easily tradable and that there are no current or historical market prices available for them. Credit risk models get around this lack of information by looking at credit ratings (CreditMetrics, CreditPortfolioView, IBRD) or related market and financial information (KMV), or making assumptions (CreditMetrics+). To apply a credit risk model at the Fund requires information on credit value that would need to be generated by using the credit ratings constructed by the Bank or constructing credit ratings from scratch (which would still not provide the required time series unless an additional effort were made to construct them).

65. **If a credit risk model had to be applied at the Fund at present, a model that abstracts from the causes of default and does not require credit ratings would be a candidate.** The CreditRisk+ model satisfies these requirements. It categorizes together loans of similar size and uses the average size of loans in each category in combination with an assumed probability distribution for the number of defaults. The model's output is an amount—the value at risk—estimated for a given year and at a selected confidence level. However, the methodology rests on the assumption that the number of loans in each category is very large and that there is therefore a high degree of diversification.

66. **In applying the model to the Fund, countries with credit outstanding that have borrowed within the access limits are grouped together.** Another group comprises exceptional access cases. In this way, credit concentration would be taken into account as the relatively few exceptional access cases account for the bulk of Fund credit. In each category, the calculation of the value at risk of loans according to the model would then require simulation of average exposure and positing a cumulative probability distribution.

67. **Bearing in mind that the number of loans at the Fund is not large as required by the model and the lack of information on default probabilities, the model could be applied at the Fund on the basis of the following assumptions.** Separate calculations for normal and high access cases are made.

68. **For average, i.e. nonexceptional, access cases, the calculation could proceed as follows:**

- The relevant average exposure would be calculated using the peak exposure for normal access cases that borrowed from the GRA since 1995. Peak exposure is a relevant concept in view of the risks to the Fund when the member has high

³²The Fund's internal vulnerability exercise and the models run by RES/PDR focus on crisis and not credit risk.

exposure.³³ This approach would involve 76 countries and lead to an estimation of average exposure of SDR 0.3 billion.³⁴

- Next, a cumulative probability distribution needs to be arrived at and a confidence level selected. Taking into account the Fund's experience with arrears and adjusting for the fact that many of those members no longer borrow from the GRA the distribution assumed is as follows: no more than perhaps, say, 10 members will be in protracted arrears per annum with a probability of 99 percent.³⁵ In other words, in 1 out of 100 years there would be more than 10 cases of protracted arrears in the GRA for normal access cases (nac).
- Using the average exposure estimate and the probability distribution, the value at risk for this group of members would be SDR 3 billion at a confidence level of 99 percent, i.e., in 1 out of 100 years protracted arrears at the end of the financial year would be greater than SDR 3 billion. PB_{nac}^* would then be set at SDR 3 billion to protect against this amount at risk.

69. Similarly, for exceptional access cases, the steps would be as follows:

- For those countries that have had access to Fund resources on an exceptional basis since 1995 (eac), average peak exposure is estimated at about SDR 11 billion.
- In arriving at a probability distribution, it could be assumed that no more than 1 default per annum occurs in these cases (i.e., only once every 100 hundred years would there be more than 1 protracted arrears case involving exceptional access).³⁶
- The value at risk for this category of countries is estimated at about SDR 11 billion at the same confidence level of 99 percent, i.e., in one out of 100 years would protracted arrears due to exceptional access exceed SDR 11 billion. That is, $PB_{eac}^* = 11$.

³³The simple average exposure (SDR 0.1 billion since 1995) would lead to a lower measure of VaR but may be less relevant because it would include exposure to countries that have low credit outstanding and have graduated from Fund support and no longer present much risk to the Fund.

³⁴The lowest peak exposure for normal access since 1995 was SDR 0.625 million (Madagascar) and the highest was SDR 2,763 million (India).

³⁵In the last 25 years, on average six Fund members have had protracted arrears at the end of the financial year, with a minimum of one member and a peak of 12 members.

³⁶This low default distribution is consistent with the experience that countries with high or exceptional access have enjoyed market access and in the past have repaid the Fund quickly. This is consistent with the requirements under the exceptional access framework that a country's external debt is sustainable. Assuming a higher default probability would result in higher expected loss and a higher level of PB^* for this group of countries.

70. **On the basis of the application of this model to the Fund's portfolio, PB*=14.** That is, the appropriate level of precautionary balances based on the assumptions employed would be SDR 14 billion.

71. **However, there are serious shortcomings of following such approaches which effectively rule out their use by the Fund.** While the calculations are straightforward, the key underlying assumptions when used for the Fund are problematic and tenuous at best:

- These models identify concentration as undesirable and assume diversification as a key risk-mitigating rule. As discussed in the main paper, concentration in the Fund's lending may not connote the same magnitude of risk as it does for other financial institutions. Diversification per se is not a key objective for Fund lending.
- It is difficult to estimate the credit risk faced by the Fund in its lending to individual members and such an assessment is integral to estimating value at risk in many credit risk models.
- The probability distribution applied for the Fund embodies more arbitrary assumptions than for other financial institutions given its preferred creditor status, limited underlying historical experience with protracted arrears and default, and the adoption of a generally successful strategy on arrears after many of the protracted arrears cases arose.
- The credit risk models most applicable to the Fund are based on distributions which assume a very large number of loans and thus a high degree of diversification. This is not and will never be a characteristic of the Fund's loan portfolio.

72. **The conceptual and practical drawbacks with a VaR type approach make it useful to explore other methods that shed light on the size of precautionary balances that the Fund should hold.** In particular, scenario analysis may be a useful device, as discussed below.

IV. FINANCIAL SCENARIO ANALYSIS

73. **An alternative to formal credit-based evaluation models is scenario analysis which focuses on the financial aspects of the Fund's balance sheet.** "What if" scenarios are relevant given that exceptional access by countries with large quotas has significantly increased the risk to the Fund associated with repayment difficulties by a single large debtor. The exercise, which follows, evaluates the potential impact on the burden sharing mechanism and the adequacy of Fund's precautionary balances of nonpayment by (i) a Fund member with average access; and (ii) a Fund member with average exceptional access.

74. **The Fund should be prepared for the possibility that adverse scenarios could materialize that resulted in disruption of payments to the Fund as follows:**

- In the baseline scenario, an average borrower—representing the average exposure of all Fund borrowers including large borrowers in the GRA, about SDR 1 billion—incurs arrears to the Fund; and
- In the alternative scenario, a large borrower—representing the average nonpeak exposure of the top 5 borrowers, about SDR 10 billion—incurs arrears to the Fund.

75. **To calibrate the financial impact on the Fund, the scenarios look at the stress on the burden-sharing mechanism and precautionary balances.** The arrears generated in the scenarios represent considerable risks to the Fund. However, the financial implications for the Fund differ:

- Under the baseline scenario, interest arrears due on credit outstanding would be accommodated by the current burden-sharing mechanism up to, currently, about SDR 170 million.³⁷
- Under the alternative, the burden-sharing mechanism could absorb only about one-third of the interest arrears. Absent a modification of the burden-sharing mechanism, the income short fall would be compensated through an increase in the rate of charge or through reductions in precautionary balances, which would be possible for a number of years.³⁸ Precautionary balances of the currently targeted level (SDR 10 billion) would just be sufficient to offset the impaired credit if there were no other arrears.

76. **These scenarios highlight the importance of precautionary balances in providing a buffer in the case of arrears, notwithstanding the low probability of arrears.** Even if the average credit risk of the Fund's portfolio is reasonably approximated under the baseline scenario, this would not be particularly useful in assessing the target level for precautionary balances. Instead, these scenarios point out the implications of the emergence of arrears by a large debtor: given the size of recent arrangements and high credit concentration, precautionary balances need also to cope with the consequences of more extreme but plausible adverse scenarios, and preserve the risklessness of FTP members' reserve positions.

³⁷The capacity of the burden-sharing mechanism is lower when credit outstanding is lower.

³⁸To spread the burden, the burden-sharing mechanism could be modified including: a lowering of the floor on remuneration to the 80 percent limit stipulated in the Articles (Article V, Section 9(a)); and activation of the burden-sharing mechanism immediately after a nonpayment (i.e., without the normal six months deferral); and exclusion of surcharges from coverage under burden sharing.