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RISK CONTROL

Client Report

Capital Adequacy Benchmarking for MDBs

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Contents

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Executive Summary

This document reports capital adequacy benchmarking for a set of nine prominent Multilateral Development Banks (MDBs). The project has been completed by Risk Control with sponsorship from the MDB Challenge Fund.

The MDB Challenge Fund's objectives are to assist MDBs in their efforts to implement the recommendations of the Independent Panel on MDB Capital Adequacy Frameworks (henceforth, 'the CAF Panel'). The Panel published an influential report in 2022 (see CAF Panel (2022)) proposing how MDBs could expand lending by managing their balance sheets differently.

Recommendation 5 of the CAF Panel was that MDB shareholders generate regular MDB benchmarking exercises to enhance the governance of these institutions. If shareholders better understand the MDBs they own, the banks are likely to use their capital more efficiently, and the shareholders themselves will be able to provide more targeted support.

Specifically, the Panel advocates: "a regular capital benchmarking report that presents MDB capital adequacy frameworks in a standardized format and with consistent definitions and metrics." Here, one may distinguish between (i) benchmarking capital adequacy and (ii) benchmarking capital adequacy frameworks.

Capital adequacy frameworks consist of the organisational arrangements through which banks manage their capital. These arrangements include such elements as the definition and level of country limits operated by the MDB, how they determine both the risk appetite and the primary risk metrics they use. The CAF Panel report already included the summary of descriptive information on such arrangements.

In addition, benchmarking may provide measures, computed on a consistent basis, of the balance sheet risk of multiple MDBs. The interest of these is to permit shareholders to understand how MDBs vary in the extent to which they need additional capital to achieve their objectives.

This project aims to provide benchmarking of capital adequacy rather than frameworks. For this purpose:

- We devise and calibrate a consistent, canonical, Economic Capital (EC)-based methodology for assessing MDB capital adequacy. The methodology implies an amount of required capital for a given target confidence level. Using this measure, one may compute a Capital Adequacy Ratio (CAR) equal to capital resources divided by capital required.
- We apply the methodology we develop to a set of MDBs using publicly available data and compare the results with other measures of MDB capital adequacy, including Basel and rating agency metrics.

Since our measures for individual MDBs are computed using a standard methodology, measures may be more informative for shareholders than risk metrics generated by the banks themselves. The latter are based on techniques that vary considerably across the banks. It is much easier, therefore, to 'read across' and compare calculations among banks.

One may argue that comparable data on the risk profile of different MDBs is already available as most major MDBs are rated by all three global rating agencies: Standard & Poor's, Moody's, and Fitch. However, the methodologies applied by the three agencies are inconsistent, and are not very closely aligned with how Basel regulators, commercial banks, or the MDBs themselves assess capital adequacy.

The benchmarking performed by Risk Control provides a 'snapshot' of the capital adequacy of MDBs at the end of 2022. In the future, shareholders may wish to perform more dynamic benchmarking to assess how much progress MDBs have made in implementing the CAF Panel recommendations. For example, for a risk transfer deals program, the shareholders may want to understand the capital savings generated and the additional lending headroom created. The models generated by the project could be used for this purpose, but the project itself does not attempt to deliver such assessments.

The aims of the current draft are as follows:

1. To explain what can be achieved by benchmarking.
2. To exposit at a high level the financial profile of the nine MDBs in our sample.
3. To set out what Basel and rating agency methods suggest for an initial narrower group of 4 MDBs.
4. To describe and justify a capital adequacy methodology that can be applied to all 9 institutions

5. To present the results of that analysis for the nine MDBs.

Table ES1: Implied CARs at 99.99% Confidence Level

	Basel CAR	S&P's RAC	Fitch's FRA	Risk Control 1-Year CAR
ADB	7.4	1.4	1.7	2.7
AfDB	4.3	1.2	1.5	2.8
CAF	6.3	0.8	1.4	2.6
CEB	5.4	1.2	1.1	2.0
EBRD	2.9	1.3	1.3	2.6
IBRD	4.4	1.1	1.5	2.2
IDB	5.4	1.0	1.5	2.0
IDB Invest	3.3	1.5	1.3	2.7
NDB	10.6	1.1	2.5	3.3

Note: Here, the Basel-implied CAR is based on the Internal Ratings Based (IRB) formula with a confidence level of 99.99%. Standard & Poor's RAC implied CAR is obtained by dividing the RAC ratio by 23%. This makes the denominator of the ratio equivalent to Economic Capital (EC) with a 99.99% confidence level. The Fitch-Usable Capital-to-Risk-Weighted-Assets-Ratio (FRA) implied CAR is obtained by dividing the FRA ratio by 35%, which yields a ratio in which the denominator is equivalent to EC for a AAA rated. The Risk Control's CAR is based on the economic capital required at 99.99% confidence level.

Table ES2: Pearson Correlation of MDB Capital Adequacy Metrics

	CAR 1-yr w/o pct	*CAR 3-yr w/o pct*	*Basel CAR w/o PCT*	*CAR 1-yr with pct*	*CAR 3-yr with pct*	*Basel CAR with PCT*	*S&P's RAC*	*Moody's Leverage Ratio*	*Fitch's Equity to RWA*
CAR 1-yr w/o pct	1.00	1.00	0.39	0.42	0.66	-0.33	0.63	0.56	-0.08
CAR 3-yr w/o pct	1.00	1.00	0.39	0.42	0.66	-0.33	0.60	0.58	-0.08
Basel CET1 w/o PCT	0.39	0.39	1.00	0.77	0.71	0.71	0.23	0.53	0.76
CAR 1-yr with pct	0.42	0.42	0.77	1.00	0.95	0.53	0.25	0.80	0.71
CAR 3-yr with pct	0.66	0.66	0.71	0.95	1.00	0.29	0.39	0.88	0.56
Basel CET1 with PCT	-0.33	-0.33	0.71	0.53	0.29	1.00	-0.26	0.23	0.86
S&P's RAC	0.63	0.60	0.23	0.25	0.39	-0.26	1.00	0.09	-0.08
Moody's Leverage Ratio	0.56	0.58	0.53	0.80	0.88	0.23	0.09	1.00	0.52
Fitch's Equity to RWA	-0.08	-0.08	0.76	0.71	0.56	0.86	-0.08	0.52	1.00

Note: The CAR is calculated using a constant idiosyncratic factor of 75%. The correlations for the 'Moody's Leverage Ratio' are multiplied by a factor negative one. The highlighted row demonstrates the correlation of relevant prudent CAR measures for the MDB with other capital adequacy metrics. Here, w/o denotes without. See note for Table ES1 for Basel CAR.

Our findings are as follows. For the group of nine MDBs, we find that CARs implied by the canonical EC methodology are substantial, being no less than 200% even when a high confidence level of 99.99% is employed. The high CAR statistics reflect the Preferred Creditor Treatment (PCT) that the MDBs enjoy in their sovereign lending and the conservative nature of their lending to non-sovereigns. In calibrating the Probabilities of Default (PDs) and the Loss Given Default (LGD) rates employed in the calculations, we draw on earlier studies Risk Control (2022), Risk Control (2024a), and Risk Control (2024b). Moreover, we examine the information provided by the MDBs in their public financial statements and risk reports.

We compare the CARs implied by the methodology with capital ratios obtained using Basel and rating agency methodologies (see Table ES1). Here, we find that, even when the calculations are performed using a 'triple-A' confidence level of 99.99%, the Basel-implied CAR ratios exceed 2.9 for all nine banks. The CAR ratios implied by the Standard & Poor's Risk Adjusted Capital (RAC) ratio and the Fitch Usable Capital to Risk Weighted Assets (FRA) ratio (in both cases at a 99.99% confidence level) are much lower, ranging from 0.8 to 1.5 for Standard & Poor's and 1.1 to 2.5 for Fitch.

We compute the correlations across nine banks of the different CAR ratios and the Moody's leverage ratio (see Table ES2). It is noticeable that the CARs calculated by Risk Control are relatively highly correlated with the Basel-implied CAR but quite lowly rated with the Standard & Poor's RAC-implied CAR. The Risk Control's CAR is also strongly correlated with the Moody's leverage ratio, which is surprising given the non-risk-sensitive nature of the latter. The Standard & Poor's RAC implied CAR has a very low correlation with the Moody's leverage ratio and is negatively correlated with the FRA ratio of Fitch.

1. Introduction

This report develops and implements capital adequacy benchmarks for Multilateral Development Banks (MDBs). Such benchmarking is recommended by the report of the Independent Panel commissioned in 2021 by the Italian Presidency of the G20 to review the Capital Adequacy Frameworks (CAFs) of MDBs. The Panel's report (see CAF Panel (2022)) makes five steps suggestions that MDB could take to boost their lending. Of these, the fifth advocates that MDBs and shareholders institute regular benchmarking of the risk profile of MDBs.

In the Panel's view, such benchmarking would improve MDB governance by giving shareholders consistent and systematic information MDB risk profiles. Some non-borrower shareholders in major regional MDBs and World Bank institutions have shareholdings in multiple institutions and are naturally interested in comparing the capital needs of different banks. The overlap of borrower shareholders across regional MDBs is less, but these shareholders would also like to understand the risk profiles of the MDBs to which they contribute capital and which serve their regions.

This document explains the capital adequacy methodology , developed by Risk Control, applicable to MDBs and presents capital benchmarking calculations for nine MDBs including Asian Development Bank (ADB), African Development Bank (AfDB), Development Bank of Latin America and the Caribbean (CAF), Council of Europe Development Bank (CEB), European Bank for Reconstruction and Development (EBRD), Inter-American Development Bank (IDB), IDB Invest, International Bank for Reconstruction and Development (IBRD) and New Development Bank (NDB).

The benchmarking methodology relies on consistently and transparently computed risk measures including measures of:

1. Economic Capital (EC)
2. Basel capital
3. Capital adequacy as viewed by rating agencies

The EC calculations are performed under different assumptions. These include (i) different confidence levels and risk horizons, (ii) risk parameters that allow for PCT or not, (iii) assumptions LGDs with and without volatility, and (iv) under different correlation assumptions. The EC calculations are broken down by sub-portfolio Sovereign Obligor (SO) and Non-Sovereign Obligor (NSO), high-income, medium-income and low-income countries and by risk category (credit, operational and market risk), and with computation of concentration risk effects.

The Basel capital calculations rely on the Internal Ratings Based Approach (IRBA) and, again, yield computations under different assumptions about (i) confidence levels, (ii) allowing for PCT and not, and (iii) with down-turn LGD assumptions.

As well as EC calculations, the benchmarking includes the primary capital adequacy metrics employed by the rating agencies. These include the Standard & Poor's Risk Adjusted Capital (RAC) ratio with adjustments for PCT and concentration risk, the Moody's Leverage Ratio, and the Fitch Usable Capital to Risk Weighted Assets ratio.

We implement the benchmarking methodology just described using public data for nine MDBs taken from their end-Financial Year 2022 financial statements.

One may compare the MDB benchmarking here developed to the Pillar 3 reporting that Basel regulators require of commercial banks. Basel rules oblige commercial banks to publish aggregate and semi-aggregate risk measures for their assets, liquidity measures and such information as the capital-ratio trigger levels at which their national regulators will restrict dividend payment.

The primary motivation for Pillar 3 as stated by regulators is to contribute to the 'market discipline' that banks face, i.e., to assist investors in bank liabilities to evaluate in understanding the banks' risk profiles. Regulators believe that investors will reflect their risk assessment in the terms on which they provide financing and, hence, banks will be motivates to limit the risk they take on.

The motivation for Pillar 3 is very different from that for MDB benchmarking (MDB shareholders certainly do not want the pricing terms of MDB bond issues to provide discipline if an MDB's risk profile worsens). But the principles established by the Basel Committee may serve as helpful guides in designing MDB benchmarking. Also, the idea of influencing external parties' views of banks by publishing information inducing them to take some action is a point in common. Providing a clear understanding of capital adequacy across MDBs may help influence ratings agencies to review their approaches to assessing MDBs and persuade bond market investors to supply financing to MDBs on favourable terms.

The remainder of this study is organised as follows: Section 2 sets out principles for MDB benchmarking, drawing on the discussion provided by the CAF Panel report as well as Basel guidelines and standards documents. Section 3 supplies risk profiles for a set of 20 MDBs, consisting of basic financial ratios. Section 4 presents the methodologies employed including EC measures, the Basel IRBA, and the approaches of the three rating agencies. Section 5 provides results for nine MDBs. Section 6 concludes.

2. Principles for MDB Benchmarking

2.1 Introduction

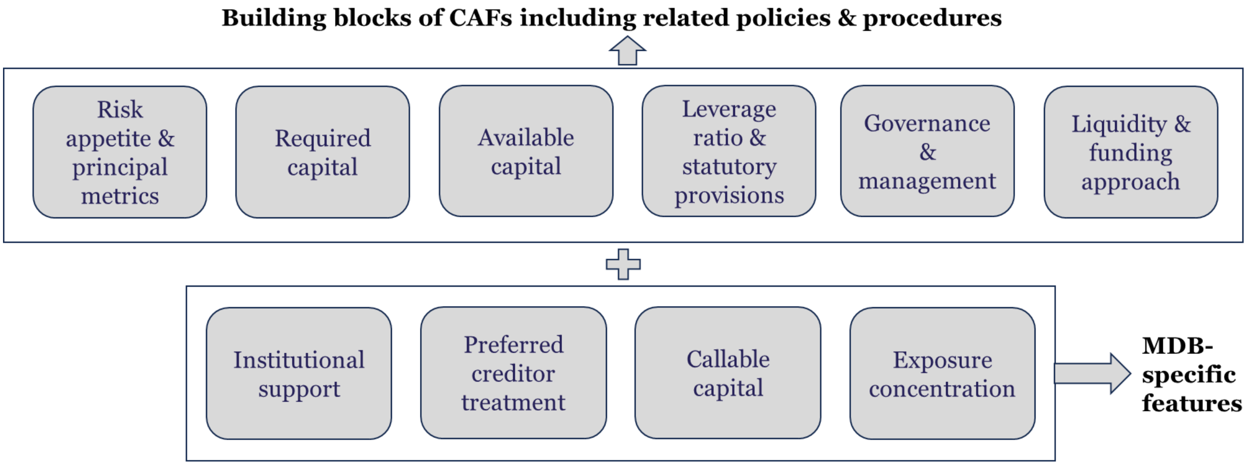
This section explains the motivation for the approach we take to MDB benchmarking. The CAF Panel recommendations are discussed in detail. Note that the Panel's conception of benchmarking is broader than what we aim to accomplish in this project. Our objective aligns closely with a specific part of the Panel's recommendation on benchmarking, namely that measures of capital adequacy be provided on a comparable basis for MDBs in general.

Our approach, based on canonical approaches to assessing Economic Capital (EC) meets many sensible principles that one might wish to require of a transparency exercise undertaken on behalf of a group of banks. We show this by setting out guidelines established by the Basel Committee in the form of principles for commercial banks' Pillar 3 disclosures. We briefly explain in this section how our approach relates to these principles but will return to this topic below after expositing methodologies and performing and reporting calculations for a group of MDBs.

2.2 CAF Panel Recommendations on MDB Benchmarking

The July 2022 report of the G20 Independent Panel on MDB Capital Adequacy Frameworks (CAF) proposes that MDBs and their shareholders generate benchmark comparisons of the capital needs and risks of MDBs. Specifically, the Panel's recommendation 5b proposes that MDB shareholders should: "Prepare regular capital benchmarking reports on each MDB's capital adequacy framework in a comparable format employing harmonized definitions and support regular MDB reviews of capital resources."

Figure 2.1: Key Components of MDB Capital Adequacy Frameworks



Note: The figure is reproduced from CAF Panel (2022).

The Panel, furthermore, states that: "Well-designed capital adequacy frameworks and related policies and procedures have a number of important components [...]. Their key elements and drivers should be accessible to shareholders and other stakeholders in a manner that is readily understandable and that allows comparison across institutions. In the Panel's view, this would be best addressed with a regular capital benchmarking report that presents MDB capital adequacy frameworks in a standardized format and with consistent definitions and metrics. This would address an important gap in MDB's governance toolkit on financial policy, and support shareholder decision-making at a time when there are considerable expectations for MDBs to scale up and deliver on the Sustainable Development Goals (SDGs) and climate goals. Given the rapid developments in the global economy such a report would best be prepared annually, though the exact frequency would need to be considered by shareholders. Shareholders may wish to consider combining regular capital adequacy reporting with the reporting mandates already in place on MDB balance sheet optimization, due to the close relation of these issues."

Furthermore, the Panel proposes: "Such a report could build on the benchmarking methodology and tables in the [Panel report itself] but should go a step further by harmonizing nomenclature and concepts and mapping methodologies across the MDBs to flag where they have commonalities and where they differ. *In particular, it should provide a comparable risk adjusted capital indicator across MDBs and describe its components and their methodologies*. [Here, the italic formatting is inserted by Risk Control.] The aim should be to i) better support capital and headroom comparisons for regular operations as well as countercyclical buffers and ii) give comfort to shareholders that these concepts are broadly aligned across institutions (see Recommendation 5c)."

The Panel report addresses these recommendations of action to shareholders rather than to the MDBs themselves (see Table 4.1 G20 CAF Panel (2022) page 53) although implementing the proposal would require participation and support from MDBs.

The objective of Risk Control's benchmarking project for the MDB Challenge Fund is to devise and implement a common methodology meeting the requirements of the italicised text in the above paragraph. Note that the project does not aim to contribute on two other elements of MDB capital adequacy benchmarking. Specifically, we do not document the internal arrangements, processes, and tools that form parts of MDB CAFs. This documentation would require significant cooperation by MDBs themselves.

Nor do we attempt to monitor the progress that MDBs make in adopting the recommendations of the CAF Panel Report. Ideally, this would yield comparable measures of the materiality of balance sheet optimisation steps, for example expressed as calculations of the additional lending headroom created. Again, monitoring MDBs' progress in implementing CAF Panel recommendations requires cooperation by MDBs and access to granular internal MDB data.

2.3 Basel Principles on Risk Disclosure

BCBS (2015) provides an authoritative expression of how banks should make the nature of the risks they face transparent to outsiders. This document explains the motivation of the Basel transparency requirements as follows: "Pillar 3 of the Basel framework aims to promote market discipline through regulatory disclosure requirements. These requirements enable market participants to access key information relating to a bank's regulatory capital and risk exposures to increase transparency and confidence about a bank's exposure to risk and the overall adequacy of its regulatory capital" see BCBS (2015) page 1.

The CAF Panel's notion that the provision of enhanced and consistent information on their capital adequacy by MDBs differs from what the Basel Committee has in mind. Shareholders rather than the wider market are the audience but 'shareholder discipline' is not wholly different from market discipline. If additional information gives shareholders greater confidence to commit additional equity or risk-bearing capacity in the form of guarantees, then MDBs would be the gainers.

BCBS (2015) (see pages 3-4) sets out five guiding principles for banks' Pillar 3 disclosures. These are as follows:

- **"Principle 1: Disclosures should be clear**
  Disclosures should be presented in a form that is understandable to key stakeholders (i.e., investors, analysts, financial customers and others) and communicated through an accessible medium. Important messages should be highlighted and easy to find. Complex issues should be explained in simple language with important terms defined. Related risk information should be presented together."
- **"Principle 2: Disclosures should be comprehensive**
  Disclosures should describe a bank's main activities and all significant risks, supported by relevant underlying data and information. Significant changes in risk exposures between reporting periods should be described, together with the appropriate response by management. Disclosures should

provide sufficient information in both qualitative and quantitative terms on a bank's processes and procedures for identifying, measuring and managing those risks. The level of detail of such disclosure should be proportionate to a bank's complexity. Approaches to disclosure should be sufficiently flexible to reflect how senior management and the board of directors internally assess and manage risks and strategy, helping users to better understand a bank's risk tolerance/appetite."

- **"Principle 3: Disclosures should be meaningful to users**
  Disclosures should highlight a bank's most significant current and emerging risks and how those risks are managed, including information that is likely to receive market attention. Where meaningful, linkages must be provided to line items on the balance sheet or the income statement. Disclosures that do not add value to users' understanding or do not communicate useful information should be avoided. Furthermore, information which is no longer meaningful or relevant to users should be removed."
- **"Principle 4: Disclosures should be consistent over time**
  Disclosures should be consistent over time to enable key stakeholders to identify trends in a bank's risk profile across all significant aspects of its business. Additions, deletions and other important changes in disclosures from previous reports, including those arising from a bank's specific, regulatory or market developments, should be highlighted and explained."
- **"Principle 5: Disclosures should be comparable across banks**
  The level of detail and the format of presentation of disclosures should enable key stakeholders to perform meaningful comparisons of business activities, prudential metrics, risks and risk management between banks and across jurisdictions."

Below, we shall explain our approach to benchmark MDB capital adequacy and relate this to the above five principles. One may note that calculations of Economic Capital (EC) using canonical methodologies meet many of the Basel Committee requirements. While EC has some technicalities in its computation, it is straightforward to explain its overall nature and the motivation for its use (Principle 3). It also represents an approach widely accepted across the banking sector and is commonly adopted in other non-bank financial organisations. Our approach involves a comprehensive application (Principle 2) of EC approaches to MDBs in a way that is comparable across banks (Principle 5) and can be repeated in future (Principle 4). In the exposition of results below, we aim to present EC calculations in a clear and easily comprehensible form(Principle 1), showing their sensitivity to different aspects of the assumptions adopted.

3. How MDB Balance Sheets Vary

3.1 Introduction
This section presents descriptive information about the balance sheets of a group of 20 MDBs. More detailed information about the rating profile of MDB loans and guarantee Development Related Assets (DRAs) is presented for a smaller group of 4 MDBs.

3.2 Key Financial Ratios
Table 3.1 presents, for 20 MDBs, a set of financial ratios important for understanding the balance sheets of these institutions. The data are taken from these institutions' publicly available financial or annual[1] reports.[2] In this, we adopt the following assumptions:

1. The net loans and guarantees are the sum of loans outstanding described in the assets side of the MDBs balance sheet. They do not include the allowance for credit losses.
2. Equity investments are added only when they appear in the balance sheet.
3. The reporting of treasury or liquid investments is inconsistent between the observed 20 MDBs. Thus, the value is reported equal to that the MDB refers to as aggregate treasury or liquid investment in their financial/annual report. If aggregate information on liquid investments is missing, then the liquid assets reported in the balance sheet are taken (usually assets reported above the total outstanding loans).
4. Debt issued is the borrowing reported by the MDB in the liability side of the balance sheet.
5. Total assets, callable capital, paid-in capital is directly taken from MDBs either financial or annual report.

[1] Some MDBs does not have separate financial statement documents, the financial statements are appended to the annual report of the MDB.
[2] The collected data are shown in Table A1.1.

6. Reserves is the difference between the total equity and paid-in capital.

Most MDBs may be said to have fully deployed their capital, but one, AIIB, is still ramping up its loan portfolio and has a high equity-to-loans-and-guarantees ratio.

Few institutions listed in the table hold significant fractions of their Development Related Assets (DRAs) in instruments other than loans and guarantees. Four exceptions are IFC, EBRD, CEB, and IDB Invest for which equity exposures constitute 26%, 14%, 12%, and 5% of DRAs.

The ratios of Treasury to total asset vary considerably across the institutions listed. In some cases, the reason is evident. EIB has access to European Central Bank (ECB) liquidity and does not find it necessary to hold a large Treasury portfolio. For lower-rated MDBs, it is costly to run large Treasury portfolios since their cost of borrowing is high.

Accounting approaches may affect ratios. For example, some MDBs record the value of swaps on both sides of their balance sheets, which leads to higher total assets. If the swap's asset side is not included in investments or the Treasury assets aggregate, then the ratio of Treasury assets to total assets will be low. This is true of ADB.

Table 3.1 also shows the ratio of callable equity to Total Equity. The latter includes both paid-in equity and accumulated reserves. The ratio varies greatly, equalling 14 for AfDB and 4.9 for IBRD, for example, but zero for IFC and IDB Invest.

Table 3.1: Key Financial Ratios

MDB	Equity to Loans Ratio	Equity to Assets Ratio	Callable to Equity Ratio	Treasury to Assets	Equity Inv. to Total DRA	Treasury to Debt
ADB	37%	19%	2.5	16%	1%	36%
AfDB	48%	26%	14.0	38%	5%	60%
AFREXIMBANK	23%	19%	0.6	15%	0%	122%
AIIB	116%	43%	3.8	21%	0%	40%
APICORP	66%	32%	3.0	25%	21%	53%
BOAD	45%	33%	0.7	8%	6%	18%
CAF	45%	27%	0.1	30%	1%	71%
CDB	64%	41%	1.6	32%	0%	63%
CEB	17%	11%	1.4	32%	12%	42%
EBRD	65%	27%	1.2	43%	14%	70%
EIB	18%	14%	2.9	14%	2%	18%
IBRD	25%	18%	4.9	24%	0%	34%
IDA	97%	82%	0.0	14%	0%	100%
IDB	34%	26%	4.4	22%	0%	31%
IDB Invest	50%	32%	0.0	28%	5%	45%
IFC	112%	32%	0.0	36%	26%	77%
IsDB	59%	37%	4.1	32%	3%	52%
NDB	77%	43%	3.8	43%	0%	104%
NIB	19%	10%	1.8	34%	0%	42%
TDB	31%	23%	1.2	21%	1%	29%
Total	40%	27%	2.2	21%	2%	36%

Note: All the values are estimated using Table A1.1. The term Equity employed in the headers refers to 'Total Equity', i.e., paid in equity plus reserves. The data are taken from the banks' financial statements and are not adjusted for differences in accounting treatments.

4. Basel and Rating Agency Views of MDB Capital Adequacy

4.1 Introduction
In this and subsequent sections, we report risk measures for a sample of nine MDBs. These are Asian Development Bank (ADB), African Development Bank (AfDB), Development Bank of Latin America and the Caribbean (CAF), Council of Europe Development Bank (CEB), European Bank for Reconstruction and Development (EBRD), Inter-American Development Bank (IDB), IDB Invest, International Bank for Reconstruction and Development (IBRD) and New Development Bank (NDB). We focus on these nine institutions rather than the wider group of twenty listed in Section 3 because their financial reports offer fuller information so one may analyse their capital adequacy using public data.

As a first step in understanding the capital adequacy of the MDBs, in this section, we present capital calculations using the Basel credit risk capital formula. Banks permitted by their supervisors to use the Internal Ratings Based Approach (IRBA) employ this formula for wholesale exposures.

The IRBA formula equals the Marginal Value at Risk (MVaR) implied by a simplified model of portfolio credit risk under the assumption that exposures are perfectly granular, defaults are driven by Gaussian latent variables with a single common factor, LGDs are deterministic,[3] and losses are only registered when a loan defaults.[4]

Under these assumptions (which regulators sometimes refer to as the 'Asymptotic Single Risk Factor' model), MVaRs are given by a simple analytical formula that depends only on PDs, LGDs and correlations. The Basel formula supposes that correlations are a function of loan PDs. Regulators calibrated this function using corporate data. It assumes that lower quality (higher PD) loans are less correlated with each other than are higher quality loans. Supposing this and the correlation levels assumed by Basel might be questioned in the context of sovereign loans and we shall examine different correlation assumptions in what follows below.

In this section, we also apply to the nine MDBs in our sample the approaches to measuring capital adequacy employed by the global ratings agencies, Standard & Poor's, Moody's and Fitch. These agencies, respectively, on a Risk Adjusted Capital (RAC) ratio, a leverage ratio and an Equity to Risk Weighted Assets (RWAs) ratio.

4.2 Basel CET1 Ratio
This section focusses on the Basel Core Equity Tier 1 (CET1) ratio using an Internal Ratings Based formula to calculate capital (see CRE31.5 in BCBS (2023c)). Note that we estimate the two CET1 ratios (i) only accounting for credit risk, and (ii) accounting for credit, market and operational risk.

The parameters employed in estimating Basel economic capital are:

1. Probability of Defaults (PDs) for SO: The Preferred Creditor Treatment (PCT) adjusted PDs for the SO are taken from a Risk Control study providing PCT-adjusted PDs (see Risk Control (2024b)). The non-PCT adjusted PDs for the SO are taken from the Standard & Poor's default study of the sovereign (see Table 33 of Standard & Poor's (2023b)). The PDs employed are one-year PDs.
2. PDs for NSO: The PDs for the corporates are based on the Standard & Poor's default study on global corporates (see Table 23 of Standard & Poor's (2023a)).
3. Loss Given Default (LGD): The different LGDs employed for the four cases are:
    a. SO (PCT-adjusted): It is taken as 20% to incorporate stressed LGD estimates of the MDB. It is double the LGD estimate used in the Risk Control's Capital Adequacy model (see Section 5.3.4).
    b. SO (non-PCT adjusted): It is taken as 50% consistent with the 50% issuer-weighted recover rate observed in the Moody's study on sovereign bond issues (see Moody's (2023e)). It is conservative estimate compared to the GEMs (2024) study on recovery rate.
    c. NSO: It is taken as 50%, like the SO exposures without PCT adjustment.
4. Maturity: All the exposures were assumed to be 1-year loans.

[3] Or equivalently in this perfectly granular case, the risk of individual LGDs is independent across loans and of other sources of risk.
[4] I.e., changes in the value of loans associated with rating transitions short of default do not contribute to total losses.

Basel III suggests that banks will assign a risk weight of 400% to speculative unlisted equity exposure[5] (see CRE20.57 in BCBS (2023b)). Then the capital requirement of equity investment would be calculated based on equation (4.1).

$$Capital\ Charge\ = \frac{400\% \times\ Equity\ Investment}{12.5} \tag{4.1}$$

Table 4.1 and Table 4.2 present Economic Capital (EC) implied by the Basel IRB approach. When the IRB formula is evaluated with a confidence level of 99.9% (i.e., unity minus 10 basis points), the EC may be regarded as corresponding to a 'A' rated stress level. In this study we are focussed on MDBs that mostly aim for a 'AAA' rating from the CRAs. Thus, we also evaluate the Basel EC with a 99.99% confidence level (i.e., 1 basis point). This may be regarded as equivalent to a 'AAA' stress level. The methodologies employed to obtain EC for market and operational risk are explained in Section 5.5 and Section 5.6, respectively.

Table 4.1: Basel Economic Capital with PCT Adjustment

	Basel 10bp		Basel 1bp		MR	OR	EI
MDB	SO	NSO	SO	NSO			Basel capital
ADB	2,506	492	4,249	692	1,322	571	460
AfDB	612	635	1,032	837	628	150	444
CAF	593	149	1,020	198	669	171	122
CEB	134	77	268	140	237	41	0
EBRD	199	2,638	344	3,695	1,005	381	1,673
IBRD	3,814	0	6,732	0	4,320	1,395	0
IDB	1,995	326	3,487	471	2,412	627	0
IDB Invest	0	406	0	614	139	62	85
NDB	197	133	352	196	424	51	0

Note: All amounts are in USD million. Here, MR denotes Market Risk, OR denotes Operational Risk and EI denotes Equity Investment.

Table 4.2: Equity Ratios with PCT Adjustment

			w/o MR and OR		with MR and OR		
MDB	Total Equity (TE)	TE to DRA Ratio	Total Basel RWAs	Basel CET1 ratio	Total Basel RWAs	Basel CET1 ratio	Basel Implied CAR
ADB	54,214	37%	43,221	125%	66,881	81%	7.4
AfDB	13,143	45%	21,146	62%	30,869	43%	4.3
CAF	13,719	44%	10,796	127%	21,300	64%	6.3
CEB	3,685	17%	2,630	140%	6,111	60%	5.4
EBRD	20,699	56%	56,379	37%	73,703	28%	2.9
IBRD	55,320	23%	47,676	116%	119,109	46%	4.4
IDB	37,873	34%	29,016	131%	67,012	57%	5.4
IDB Invest	2,964	48%	6,141	48%	8,647	34%	3.3
NDB	10,815	77%	4,126	262%	10,058	108%	10.6

Note: All amounts are in USD million. MR denotes Market Risk, OR denotes Operational Risk, EI denotes Equity Investment, and w/o denotes without. The Basel implied CAR ratio is based on 99.99% confidence level equivalent to AAA rating stress level.

[5] Basel defines speculative unlisted equity exposures as those in "unlisted companies that are invested for short-term resale purposes or are considered venture capital or similar investments which are subject to price volatility and are acquired in anticipation of significant future capital gains".

We observe from Table 4.2 that the Basel CET1 ratio (equity resources divided by total RWAs) at a 99.9% confidence level, ranges from 28% to 108% for difference MDBs. The Basel-implied CAR for a 99.99% confidence level is calculated by evaluating the IRB formula for 1 basis point. In this case, the Basel CAR ranges from 2.9 to 10.6. The Basel CAR ratios clearly vary very substantially across the group of MDBs we study.

We also estimate the Basel EC without adjusting for PCT for the SOs. The results appear in Table 4.3 and Table 4.4. The CET1 ratios are much lower in this case, ranging across the banks from 24% to 79%.

Table 4.3: Basel Economic Capital without PCT Adjustment

	Basel 10bp		Basel 1bp		MR	OR	EI
	SO	NSO	SO	NSO			Basel captial
ADB	10,393	492	15,572	692	1,322	571	460
AfDB	3,102	635	4,335	837	628	150	444
CAF	3,213	149	4,468	198	669	171	122
CEB	622	77	1,106	140	237	41	0
EBRD	981	2,638	1,414	3,695	1,005	381	1,673
IBRD	18,095	0	27,248	0	4,320	1,395	0
IDB	10,470	326	15,062	471	2,412	627	0
IDB Invest	0	406	0	614	139	62	85
NDB	960	133	1,417	196	424	51	0

Note: All amounts are in USD million. Here, MR denotes Market Risk, OR denotes Operational Risk and EI denotes Equity Investment.

Table 4.4: Equity Ratios without PCT Adjustment

			with MR and OR		w/o MR and OR	
MDB	Total Equity (TE)	TE to DRA Ratio	Total Basel RWAs	Basel CET1 ratio	Total Basel RWAs	Basel CET1 ratio
ADB	54,214	37%	165,473	33%	141,812	38%
AfDB	13,143	45%	61,987	21%	52,264	25%
CAF	13,719	44%	54,055	25%	43,552	32%
CEB	3,685	17%	12,211	30%	8,730	42%
EBRD	20,699	56%	83,474	25%	66,151	31%
IBRD	55,320	23%	297,621	19%	226,188	24%
IDB	37,873	34%	172,939	22%	134,943	28%
IDB Invest	2,964	48%	8,647	34%	6,141	48%
NDB	10,815	77%	19,591	55%	13,659	79%

Note: All amounts are in USD million. MR denotes Market Risk, OR denotes Operational Risk, EI denotes Equity Investment, and w/o denotes without. The Basel implied CAR ratio is based on 99.99% confidence level equivalent to AAA rating stress level.

4.3 Rating Agency's Capital Adequacy Metric

The three global rating agencies, Standard & Poor's, Moody's and Fitch, calculate financial indicators in their assessments of MDB capital adequacy. This section discusses these indicators for the nine MDBs for which we perform capital adequacy benchmarking.

Standard & Poor's bases its initial assessment of MDB capital adequacy on the agency's proprietary Risk Adjusted Capital (RAC) ratio. The assessment is then adjusted to reflect qualitative aspects of loan performance and the MDB's risk management (see Standard & Poor's (2023c)). Table 4.5 lists the RAC ratios examined by Standard & Poor's.

Moody's MDB assesses capital adequacy based on the weighted sum of three factors: (i) the Leverage Ratio, (ii) the Development Asset Credit Quality (DACQ) and (iii) Asset Performance (see Moody's (2024)). The Leverage Ratio accounts for 40% of the capital adequacy assessment. The ratio equals the sum of development-related assets and treasury assets (rated A3 and lower) divided by total equity. Table 4.5 lists the Leverage Ratios reported by Moody's in the MDBs' rating reports.

Fitch's capital adequacy assessment is assessed using three factors. In decreasing order of importance, these are: (i) the Usable Capital to Risk-Weighted Assets (RWA), (ii) the Equity to Assets ratio and (iii) internal capital generation (see Fitch (2023c)). Fitch's Usable Capital to RWA ratio equals the sum of total equity and 10% of callable capital subscribed by 'AAA' and 'AA-rated shareholders divided by the agency's proprietary definition of RWA. Table 4.5 lists the capital to RWA reported by the Fitch in MDB rating reports.

Table 4.5: Rating Agency's Capital Adequacy Metric

MDB	S&P's RAC	Moody's Leverage Ratio	Fitch's Capital to RWA
ADB	32%	281%	59.0%
AfDB	28%	229%	52.0%
CAF	18%	235%	48.1%
CEB	27%	573%	39.1%
EBRD	30%	203%	44.0%
IBRD	25%	420%	52.8%
IDB	22%	300%	52.0%
IDB Invest	34%	224%	44.2%
NDB	26%	133%	86.0%

Note: The source is from public available rating agency reports for fiscal year end 2022. The Fitch's capital to RWA for ADB and Moody's leverage ratio for NDB are Risk Control estimates. The Fitch's capital to RWA for CAF and IDB Invest are end Sep 2022.

4.4 Correlations

This section shows how related are Basel CET1 and rating agency's capital adequacy metrics for the nine MDBs in our sample. Table 4.6 shows correlation coefficients for the indicators. We include Moody's leverage ratio which we multiply by minus one since, while all the other indicators are increasing in capital adequacy, a higher leverage ratio is associated with lower capital adequacy.

Table 4.6 shows that the two Basel CET1 measures based on risk parameters with and without PCT are reasonably highly correlated at 74%. The measure without PCT also has a 22% correlation with the S&P RAC ratio. The Fitch useable equity to RWA ratio has a high correlation of 74% and 82% with the two Basel ratios. The S&P's RAC ratio has a lower correlation with the other indicators ranging from minus 24% to positive 22%.

Table 4.6: Correlation Matrix between Basel CET1 and Rating Agency Ratios

	Basel CET1 w/o pct	Basel CET1 with PCT	S&P's RAC	Moody's Leverage Ratio	Fitch's Equity to RWA
Basel CET1 w/o pct	1.00	0.74	0.22	0.39	0.74
Basel CET1 with PCT	0.74	1.00	-0.24	0.16	0.82
S&P's RAC	0.22	-0.24	1.00	0.09	-0.08
Moody's Leverage Ratio	0.39	0.16	0.09	1.00	0.52
Fitch's Equity to RWA	0.74	0.82	-0.08	0.52	1.00

Note: The correlations for the 'Moody's Leverage Ratio' are multiplied by a factor negative one. The CET1 ratio used here is inclusive of market and operational risk.

5. How to Assess MDB Economic Capital

5.1 Introduction

For MDBs, the greatest source of risk is the credit risk generated by their portfolios of Development Related Assets (DRAs). MDBs' Treasury portfolios may also contribute a small amount of credit risk. Some MDBs have significant exposure to equity investments. For our purposes, in line with Basel regulations, we will treat this as a sub-category of credit risk.

This section sets out a methodology for modelling credit risk capital, including DRA, Treasury portfolios and equity risk. The approach is based on canonical approaches to modelling credit risk first proposed in the 1990s and described in the industry publication J.P Morgan (1997). In this approach, defaults are caused by correlated latent variables.

In line with the classical Merton model of firm default, the latent variable may be interpreted as the logarithmic change in the asset value of the borrower's 'assets.' Even when no such asset value interpretation is appropriate (for example, when the insolvency default is one of a sovereign borrower), the approach may be regarded as a reduced form representation of default.

When an exposure defaults, a random Loss Given Default (LGD) is generated equal to a stochastic LGD rate applied to the Exposure at Default. Suitable Probabilities of Default (PDs) and the mean and volatility of LGD rates are estimated using historical data, and EADs are computed based on amortisation and drawdown assumptions. The correlations of the latent variables driving defaults may be calibrated in a variety of ways. Common industry practice is base correlation estimates on equity index log returns data. Alternative data sources are spread changes (either Credit Default Swap (CDS) or bond spreads), rating changes or time series of default rates.

In the approach just described, defaults occur when a latent variable exceeds a threshold value. The threshold value is inferred from the assumed probability of default. Similar assumptions are employed in the statistics literature for modelling discrete choice events. When the underlying random variable is Gaussian, statisticians refer to this approach as 'the Probit model'. Hence, one may refer to the credit risk modelling approach described as a version of the Probit model allowing for correlation.

5.2 Data Sources

We provide this benchmarking analysis for nine prominent MDBs, namely:

(i) Asian Development Bank (ADB)
(ii) African Development Bank (AfDB)
(iii) Development Bank of Latin America and the Caribbean (CAF)
(iv) Council of Europe Development Bank (CEB)
(v) European Bank for Reconstruction and Development (EBRD)
(vi) International Bank for Reconstruction and Development (IBRD)
(vii) Inter-American Development Bank (IDB)
(viii) Inter-American Investment Corporation (IDB Invest)
(ix) New Development Bank (NDB)

In the cases of ADB, AfDB, CAF, CEB, EBRD, IDB, IDB Invest and NDB, the benchmarking is performed using public data contained in the banks' annual reports for the year ending December 2022 (see ADB (2023), AfDB (2023), CAF (2023), CEB (2023), EBRD (2023), IDB (2023), IDBI (2023) and NDB (2023)). The benchmarking for IBRD is based on end June 2022 data since this coincides with that institution's financial statement reporting date (see IBRD (2022)). Most MDBs we examine have portfolios mainly comprising Sovereign Obligor (SO) loans with smaller exposures to Non-sovereign Obligors (NSOs) (see Table 5.1). In contrast, two NSO-focused MDBs, EBRD and IDB Invest, have outstanding loans to NSO counterparties that contribute 78.5% and 100%, respectively, of their total outstanding loans.

Table 5.1: Loan Summary of the Regional MDBs

MDB	NSO OL	SO OL	NSO OL % of Total OL	NSO UL	SO UL	Equity Investment	Total Equity
ADB	6,471	138,589	4.5%	2,428	48,272	1,438	54,214
AfDB	3,898	24,601	13.7%	2,538	12,748	1,388	13,143
CAF	1,168	29,791	3.8%	339	8,641	382	13,719
CEB	3,619	17,671	17.0%	1,655	8,082	0	3,685
EBRD	26,787	7,321	78.5%	6,827	9,262	5,229	20,699
IBRD	0	229,344	0.0%	0	74,523	0	55,320
IDB	4,177	108,520	3.7%	1,876	29,252	0	37,873
IDB Invest	6,221	0	100.0%	1,562	0	265	2,964
NDB	1,869	12,505	13.0%	928	6,212	0	10,815

Note: All the amount is in USD million. The Euro/USD exchange rate used is 1.0705 as on 30/12/2023. The UA/USD exchange rate used is 1.33 as for December 2022. OL denotes Outstanding Loans and UL denotes Undisbursed Loans.

CEB and NDB do not supply aggregate summary tables of loans broken down by NSO and SO obligors in their financial statements. For these two banks, we, therefore, rely on the Standard & Poor's Supranationals report (Standard & Poor's (2023c)) which gives the proportions of SO and NSO loans. We assume that the proportions of NSO loans for CEB and NDB to be 17% and 13%, respectively. We suppose that the same proportion of SO and NSO apply to both outstanding loans and undisbursed loans.

For the SO exposures, each MDBs provides a table that includes loan data aggregated by countries and is divided into outstanding and undisbursed loans. We use this to calculate the exposure amount by sovereign as the sum of the outstanding loans and 50% of undisbursed loans.

For NSO exposures, only IDB and IDB Invest provide a breakdown by country. Hence, for other MDBs we assume that total NSO exposure is distributed as follows:

- If the MDB is sovereign-focused, 50% of the NSO exposures is distributed by weight of the SO exposures to the top 5 borrowing countries of the MDB ordered by their GDP. Then the rest of the 50% is distributed by the weight of the SO exposures of the rest of the borrowing countries.
- For the other MDBs (here EBRD alone, since IDB Invest already provides distribution by country), the NSO exposures follows the same distribution aggregate loan distribution by country.

NSO exposures are assigned to sectors and countries. These affect the correlation between these exposures used in the model. EBRD and IDB Invest provide loan data aggregated by sectors. We convert their sector categories into Global Industry Classification Standard (GICS). For banks that do not report sectoral distributions, we make the following assumptions:

- Each country's NSO exposure is divided into two GICS sectors: (i) Financials and (ii) Utilities, with 60% and 40% of the NSO exposure allocated respectively. This distribution is based on the reported sectoral distribution of ADB's NSO exposures.

Table 5.2 Equity Investment Summary

MDB	Equity Investment	% of Total Equity	% of Total DRA
ADB	1,438	2.7	1.0
AfDB	1,388	10.6	4.8
CAF	382	2.8	1.2
CEB	0	0.0	0.0
EBRD	5,229	27.0	14.1
IBRD	0	0.0	0.0
IDB	0	0.0	0.0
IDB Invest	265	8.9	4.3
NDB	0	0.0	0.0

Note: All the amount is in USD million.

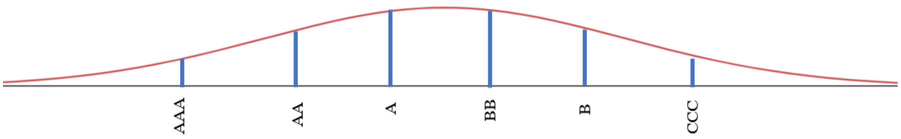
Of the nine MDBs listed in Table 5.2, five have equity exposures. The EBRD has the greatest volume of equity investments, accounting for 27.0% of its total equity. ADB, AfDB and CAF do not provide the equity investment aggregated by countries. We, therefore, assume that equity exposure is distributed as follows:

- 50% of the equity exposures is distributed to the top 5 borrowing countries of the MDB (ordered by their GDP) in proportion to the SO exposure weights. If one of the top five sovereigns does not have an MSCI equity index, we assign the NSO weight to the largest country that does have such an index.
- The remaining 50% is distributed to a single region corresponding to the MDB.

5.3 Credit Risk EC Methodology

The default probability of any defaultable security is assumed to be summed up by its rating. Ratings are assumed to be distributed as a time-homogeneous Markov chain. This implies that ratings are multinomially distributed from one period to the next.

Figure 5.1: Distribution of Latent Variable



To allow for correlations between ratings transitions, the model employs an ordered probit method in that, given an initial rating i (in a set of possible initial ratings $j = 1,2,..,J$) at date t, the rating of the exposure at date $t+1$ is determined by the realisation of a standard Gaussian latent variable A. If A lies in the interval $[Z_{i,j-1}, Z_{i,j}]$ where $Z_{i,j-1}$ and $Z_{i,j}$ are elements in a set of cut off points $Z_{i,2} < Z_{i,3} < \cdots < Z_{i,J}$, then the exposure is rated j at $t+1$. The approach is multi-period in that the model described here is applied repeatedly to generate time paths of ratings for each given exposure over the full simulation horizon.

The ordered probit approach is illustrated above in Figure 5.1 Suppose there are $J = 7$ rating classes. The initial rating of the obligor is $i = 'BB'$ and, depending on the realisation of the latent variable A (as plotted on Figure 5.1), the terminal rating may be $j = 'AAA', 'AA' \ldots \; or \; 'CCC'$. The areas between two consecutive thresholds Z and below the normal distribution correspond to the conditional probabilities of ending up in the various ratings.

Given an estimate of a rating transition matrix, $\left[\pi_{t,T}^{(i,j)}\right]$, the cut off points $Z_{i,j}$ may be deduced directly from the recursive equations:

$$\begin{aligned} \pi_{t,T}^{(i,J)} &= 1 - \Phi\left(Z_{i,J-1}\right) \\ \pi_{t,T}^{(i,j)} &= \Phi\left(Z_{i,j}\right) - \Phi\left(Z_{i,j-1}\right), j = 2, \ldots, J-1 \\ \pi_{t,T}^{(i,1)} &= \Phi\left(Z_{i,1}\right) \end{aligned} \tag{5.1}$$

Here, $\Phi(.)$stands for the cumulative distribution function for the standard Gaussian.

The approach of assuming that transitions between several discrete states are driven by a latent variable with a continuous distribution is widely applied in the discrete choice econometrics literature. When the latent variable is normally distributed, it corresponds to the ordered probit approach. The major benefit of employing this approach in credit risk modelling is that it permits one to allow rating transitions by different obligors to be correlated simply by assuming that the latent variables driving transitions for different credit exposures are correlated.

For the Sovereign Obligors (SO), the model assumes that the latent variable for the i^{th} exposure A_i can be broken down into an idiosyncratic component e_i and multiple systematic risk factors. All the factors are rescaled so that they have unit variance and a zero mean. In this study a two-factor model drives the latent variable A_i for asset, namely:

- i) Country factor, $F_{c,i}$
- ii) Sector (or Industry) factor, $F_{s,i}$

Equation 5.2 represents the A_i in terms of the common factors $F_{c,i}$and $F_{s,i}$

$$\begin{aligned} A_i &= \sqrt{1 - \eta_i{}^2}\left(\frac{\alpha}{W_i} f_{c,i} + \frac{\beta}{W_i} f_{s,i}\right) + \eta_i e_i \\ W_i &= \sqrt{\alpha^2 + \beta^2 + 2\alpha\beta \times Corr(f_{c,i}, f_{s,i})} \end{aligned} \tag{5.2}$$

where, η_i is the exposure's idiosyncratic factor, e_i is the idiosyncratic shock, α is the weight of the country factor, β is the weight of the sector factor and $\alpha + \beta = 1$.

The pair-wise correlation $\rho_{i,j}$ between two exposures $A_i$and $A_j$is shown in equation 5.3.

$$\rho_{i,j} = \frac{\sqrt{1 - \eta_i^2} \times \sqrt{1 - \eta_j^2}}{W_i W_j} \left[\alpha^2 \rho_c(i,j) + 2\alpha\beta\rho_{c,s}(i,j) + \beta^2 \rho_s(i,j)\right] \tag{5.3}$$

Here,

- $\rho_c(i,j)$ is the correlation between the country of risk for exposures i and j,
- $\rho_{c,s}(i,j)$ is the correlation between the country of exposure i and the sector of the exposures j.
- $\rho_s(i,j)$ is the correlation between the sector of the exposures i and j.

The estimation of the correlation structure between countries and sectors is discussed in sub section 5.4.3.

For the Non-Sovereign Obligors (NSO) we assumed diversified pool exposures, see Section 5.3.1 for further details. These exposures rather than being a single underlying exposure such as a loan or a bond, represents a diversified pool of such primitive, individual exposures. We implement diversified pool exposures to offset the lack of granular information of the NSO exposures and use aggregated NSO exposures by country.

The parameters which influence the EC calculated using the CPM are:

- (i) Confidence Level:
  It dictates the prudence in the Value-at-Risk (VaR) estimation from the CPM. We produce the results at 1 basis point confidence interval, which correspond to 'AAA' confidence level.
- (ii) Credit Ratings:
  We use the sovereign credit ratings as in Risk Control (2024b), in the order of preference Standard & Poor's, Moody's, Fitch and ratings inferred from OECD country risk

classification. If there is no rating from all the four sources, we assign the exposure as 'CCC'. For the NSO exposures the rating is assumed three notches below the sovereign rating of the NSO exposure.

(iii) Transition Matrix (TM):
This matrix provides the probabilities of transition from one rating to another. The last column is the array of probabilities of default (PDs). We employ three transition matrixes
(a) SO without PCT: It is based one is based on historical TM from Standard & Poor's (see Table 33 Standard & Poor's (2023))
(b) SO with PCT: We implement the methodology discussed in Risk Control (2024a) to obtain historical TM with PCT for rating between AAA to C (see Appendix for the TM employed).
(c) NSO exposures: It is based one is based on historical TM from Standard & Poor's (see Table 23 Standard & Poor's (2023))

(iv) Correlation Matrix:
The correlation between borrowing countries and sector which is estimated using the MSCI equity indices for the different countries and sectors.

(v) Idiosyncratic Risk Weights (η_i):
The weight which drives the value of latent variable A_i for an idiosyncratic shock is assumed to be zero as the idiosyncratic factors are included in the correlation matrix calculated for this study.

(vi) Loss Given Defaults (LGDs):
We employ a stochastic LGD with mean 10% and volatility as 16.8% for SO exposures with PCT adjustment. While, for SO exposures without PCT adjustment we employ LGD with mean 50% and volatility 28.0%. For the NSO exposures, the means of LGD varies across different regions and industries, where the recovery rates (equal to unity minus the LGD rate) are shown in Table 5.3. The volatilities equal to $\lambda \times \sqrt{\theta(1-\theta)}$, where θ is the mean of LGD. Cruces and Trebesch (2013) estimated mean and standard deviation of haircuts as 37.04 and 27.28 respectively. Using these results, we calculate the value of λ as $\frac{0.27}{\sqrt{0.37(1-0.37)}.} = 0.56$.

Table 5.3: Loss Given Default by Industry and Region

	Infrastructure	Financials	Other
East Asia and the Pacific	0.65	0.629	0.719
Europe and Central Asia	0.791	0.738	0.708
Latin America and the Caribbean	0.731	0.654	0.728
Middle East and North Africa	0.879	0.826	0.814
South Asia	0.689	0.786	0.639
Sub-Saharan Africa	0.943	0.821	0.808
N/A	0.705	0.567	0.669

Note: The source is from GEMs (2024). We presume N/A here are for those contracts for which no information about region was available.

(vii) Number of Simulations:
We have used 3 million replications in the Monte Carlo simulation, to achieve convergence in the economic capital estimate.

5.3.1 Diversified Pool Exposures

Suppose an obligor, i, defaults at time t if a latent random variable $Z_{i,t} < -c$ for some constant c.

Suppose the $Z_{i,t}$ for $t = 0,1,2 \dots$ and $i = 1,2,3 \dots n$ satisfy a factor structure in that:

$$Z_{i,t} = \sqrt{\rho} X_t + \sqrt{1-\rho}\varepsilon_{i,t} \tag{5.4}$$

Assume that:

$$X_t = \sqrt{\beta} X_{t-1} + \sqrt{1-\beta}\eta_t \tag{5.5}$$

Where $\varepsilon_{i,t}$ and η_t are standard normal and independent for pairs of obligors i and j and across time t. Note that the X_t has been constructed so that it has unconditional unit variance.

If X_t has unconditional unit variance then so to does $Z_{i,t}$. The unconditional probability of default then satisfies:

$$\Phi^{-1}(-c) = q \tag{5.6}$$

This model is the basis for a derivation that leads to a dynamic process for the loss fraction, θ_t, of a pool of exposures at time t. Further details may be found in Lamb and Perraudin (2008). In fact, the process derived is for a transformation of the loss fraction given by taking its standard normal inverse:

$$\Phi^{-1}(\theta) = \tilde{\theta} \tag{5.7}$$

The dynamics of the transformed loss rate is then given by:

$$\tilde{\theta}_t = \sqrt{\beta}\tilde{\theta}_{t-1} + \frac{1-\sqrt{\beta}}{\sqrt{1-\rho}}\Phi^{-1}(q) - \frac{\sqrt{\rho}\sqrt{1-\beta}}{\sqrt{1-\rho}}\eta_t \tag{5.8}$$

Hence, the transformed loss rate at t has a normal distribution:

$$\tilde{\theta}_t \equiv \Phi^{-1}(\theta_t) \sim N\left(\sqrt{\beta}\tilde{\theta}_{t-1} + \frac{1-\sqrt{\beta}}{\sqrt{1-\rho}}\Phi^{-1}(q), \frac{\rho(1-\beta)}{1-\rho}\right) \tag{5.9}$$

5.3.2 NSO Credit Ratings

In this section, we discuss the NSO credit ratings assumed for the eight MDBs (excluding IBRD which has only sovereign obligors) with NSO exposures considered in the study. We find that the MDB report the distribution of loan portfolio based on the bank's internal credit rating group. We leverage this to assign an appropriate notching to the sovereign rating of the NSO exposures to match the distribution or weighted average rating of the NSO portfolio with the bank's own estimate.

We match the observed rating distribution of NSO observations for the following banks: (i) ADB, (ii) AfDB, (iii)EBRD, and (iv) NDB, as these banks provide rating distribution which is an equivalent rating by external Credit Rating Agencies CRAs.

1. ADB
   ADB (2023) reports the distribution of the NSO loan portfolio by different risk groups based on the bank's internal rating and also provides equivalent ratings by CRAs. We downgrade the sovereign rating by 1 notch to obtain the rating of the NSO obligors. Table 5.4 demonstrates that the Risk Control estimate is conservative to reflect the presence of non-performing loans in the ADB portfolio.

   Table 5.4: ADB NSO Loan Distribution by Rating Group

	Percentage of OL	
	ADB	Risk Control
Investment grade	37	33
BB+ to BB-	32	27
B+ to B-	26	20
CCC+ to CC or NPL	5	19

   Note: Here, OL denotes outstanding loans and NPL denotes non-performing loans.

2. AfDB
   AfDB (2023) reports the distribution of the NSO loan portfolio by different risk groups based on the bank's internal rating and also provides equivalent ratings by CRAs. We downgrade the sovereign rating by one notch to obtain the rating of the NSO obligors. The Risk Control estimates have a low proportion of loans in investment grade (see Table 5.5) due to the assumption of geographic distribution of NSO exposures (explained in Section 5.2).

2. EBRD:
EBRD (2023) reports the distribution of the loan portfolio by different risk groups based on the bank's internal rating and also provides equivalent ratings by CRAs. We downgrade the sovereign rating by one notch to obtain the rating of the NSO obligors. We do not assume any NSOs in the non-performing loan category when estimating the economic capital estimate. Thus, we take a conservative assumption compared to the observed distribution. Table 5.6 demonstrates that risk control estimates almost double the proportion of loans in the CCC+ to CC rating group.

Table 5.5: AfDB NSO Loan Distribution by Rating Group

	Percentage of OL	
	AfDB	Risk Control
Investment grade	18	3
BB+ to BB-	16	22
B+ to B-	34	41
CCC+ to C	32	34

Note: Here OL denotes outstanding loan.

Table 5.6: EBRD Loan Distribution by Rating Group

	Percentage of OL + UL	
	EBRD	Risk Control
Investment grade	13	17
BB+ to BB-	25	28
B+ to B-	40	20
CCC+ to CC	16	35
Non-performing loans	6	0

Note: Here OL denotes outstanding loan and UL denotes undrawn loans.

4. NDB
NDB (2023) reports the distribution of the loan portfolio by the bank's internal rating. We apply the same rating criteria for NSO obligors as we do for SO obligors. Table 5.7 demonstrates that Risk Control's estimation is close to the distribution reported by the bank.

Table 5.7: NDB NSO Loan Distribution by Rating Group

	Percentage of OL + UL	
	NDB	Risk Control
AAA to A-	32	32
BBB+ to BBB-	32	29
BB+ to CCC	36	39

Note: Here, OL denotes outstanding loans and UL denotes undrawn loans.

IDB, IDB Invest, and CEB provide rating distribution based on the bank's internal rating classification. The internal rating classification is mapped to the external rating, such the resulting likelihood of the loss based on the external CRA is similar to the observed likelihood of the loss for a given internally rated exposure.

5. IDB
IDB (2023) reports the distribution of the NSO loan portfolio by different coarse rating grades based on the bank's internal rating. The internal rating is mapped to Standard & Poor's rating so that the likelihood of loss based on the Standard & Poor's rating is similar to IDB's internal likelihood of loss. We estimate the weighted average rating (using the NSO PDs, as seen in Section 5.3.2) of the IDB's NSO portfolio to be B- based on the IDB (2023) report. We apply no notch to the sovereign rating of the NSO exposures and get a weighted average rating of B- (using the NSO PDs, as seen in Section 5.3.2).

6. IDB Invest
   IDB Invest (2023) reports the distribution of the loan portfolio by the bank's internal credit risk classification range. We apply the same rating criteria for NSO obligors as we do for SO obligors. We compute the NSO weighted average rating (WAR) using Risk Control's PDs. The WAR inferred from the portfolio reported by the bank is BB-. In contrast, Risk Control's estimation is B. IDB Invest has a higher inferred WAR than Risk Control's estimation since the bank maps internal ratings to long-term PDs published annually by an international rating agency (IDB Invest (2023)). Hence, we cap the rating of the NSO obligors at the sovereign's rating which is a conservation assumption based on the bank's own loan performance.

7. CEB
   CEB (2023) reports the distribution of the loan portfolio by the bank's internal credit risk classification range. We apply the same rating criteria for NSO obligors as we do for SO obligors. We compute the NSO weighted average rating (WAR) using Risk Control's NSO PDs. The WAR inferred from the portfolio reported by the bank is BBB, whereas the Risk Control's estimation is BB. This discrepancy might be due to the bank using long-term PDs.

8. CAF
   CAF does not report the rating distribution of the loan portfolio, which could be used to compare with the external rating of the CRAs. Thus, we make a prudent assumption of 1 notch downgrade to the sovereign ratings to arrive at the NSO ratings.

5.3.3 *Probabilities of Default*
The transition matrix for the SO and NSO exposures resembles the historical rating transition observed in the Standard & Poor's (2023b) and Standard & Poor's (2023a) default study respectively. In the other study by Risk Control (2024b) the Preferred Creditor Treatment (PCT) adjusted PDs by ratings are estimated. This set of PDs is used for the default column of the Standard & Poor's TM for SO with PCT adjustment.

Table 5.8 presents (i) Risk Control (2024b) PD, (ii) the Standard & Poor's historical sovereign PD and (iii) the Standard & Poor's historical global corporate PD. In the Credit Portfolio Model (CPM), Risk Control's PD and Standard & Poor's global corporate PD are used for SOs and NSOs respectively. The effect of PCT is substantial for 'B' and 'CCC' rating grades. This estimate is consistent with another study performed by the Risk Control for the G20 CAF (Capital Adequacy Framework) panel, which found the ratio of without PCT PDs to with PCT PDs to be more than 3 for single 'B' rating grade.

5.3.4 *Loss Given Default Rates*
For stochastic LGD, we suppose that recoveries (equal to unity minus the LGD rate) are beta-distributed on the unit interval with the means equal to θ and volatilities equal to $\lambda \times \sqrt{\theta(1-\theta)}$. Cruces and Trebesch (2013) estimated mean and standard deviation of haircuts as 37.04 and 27.28 respectively. Using these results, we calculate the value of λ as $\frac{0.27}{\sqrt{0.37(1-0.37)}.} = 0.56$. Additionally, for SO exposures, we assume that (1-θ) (mean LGD) is equal to 10% with PCT adjustments and 50% without PCT adjustments. Therefore, volatilities are 0.168 and 0.28 with PCT and without PCT adjustments respectively. The means of LGD for the NSO exposures vary across different regions and industries, which are shown in Table 5.3.

5.3.5 *Correlation Structure*
Correlation assumptions are crucial inputs to credit portfolio analysis. One common practice is to base correlations on equity return data.

For the equity index-based approach, we use a mixture of country, region and GICS sector equity indices provided by MSCI. We use monthly time series index data from 2004-01-30 to 2022-12-30. We calculate the monthly log returns by $r_t = \log(x_t) - \log(x_{t-1})$ where x_t is the index value on month t, then calculate the pairwise correlations between each index.

A list of all countries with sufficient country index data is shown in Table 5.9 and a list of all GICS sectors is shown in Table 5.10.

Table 5.8: Probability of Default

Ratings	SO with PCT	SO without PCT	NSO
AAA	0.01	0.01	0.01
AA+	0.02	0.05	0.02
AA	0.03	0.08	0.02
AA-	0.04	0.12	0.03
A+	0.05	0.15	0.04
A	0.07	0.19	0.05
A-	0.09	0.22	0.07
BBB+	0.10	0.26	0.09
BBB	0.14	0.29	0.14
BBB-	0.18	0.33	0.22
BB+	0.21	0.50	0.29
BB	0.25	0.68	0.45
BB-	0.33	0.85	0.91
B+	0.43	1.70	1.91
B	0.61	2.54	2.85
B-	0.86	7.01	5.53
CCC+	0.93	17.01	25.70
CCC	1.69	45.26	
CCC-	13.82	84.78	
CC	18.41	100.00	
C	6.82	-	-

Note: All the Probability of Default (PD) values are in per cent. Here rating 'C' could be understood as obligors who have defaulted to private creditors but not have gone into non-accrual status with MDB.

Table 5.9: Countries with Sufficient Country Index Data

Region	Country
Europe and Middle East	Austria, Belgium, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Jordan, Lebanon, Netherlands, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom
Africa	Egypt, Kenya, Mauritius, Morocco, Nigeria, South Africa
Asia	Australia, China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, New Zealand, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand
North America	Canada, USA
Latin America and Caribbean	Argentina, Brazil, Chile, Colombia, Mexico, Peru

In the case that no country index exists, or the index data does not cover the whole sample period, we map the country to a region index. We use four region indexes: EM Europe and Middle East, EFM Africa, EFM Asia and EM Latin America. Here, EFM stands for Emerging Frontier Markets and EM stands for Emerging Markets. A list of all countries with insufficient country index data is shown in Table 5.11.

Table 5.10: GICS Sectors

Sector
Energy
Materials
Industrials
Consumer Discretionary
Consumer Staples
Health Care
Financials
Information Technology
Communication Services
Utilities

Table 5.11: Countries with Insufficient Country Index Data

Region	Country
Europe and Middle East (EM)	Albania, Bahrain, Belarus, Bosnia and Herzegovina, Bulgaria, Iceland, Iran, Iraq, Jersey, Kosovo, Kuwait, Lithuania, Luxembourg, Macedonia, Moldova, Montenegro, Oman, Qatar, Romania, Russia, Saudi Arabia, Serbia, Syria, Ukraine, United Arab Emirates, Yemen
Africa (EFM)	Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Republic of the Congo, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Sudan, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe
Asia (EFM)	Afghanistan, Armenia, Azerbaijan, Bangladesh, Bhutan, Brunei, Cambodia, Cook Islands, Fiji, Georgia, Kazakhstan, Kiribati, Kyrgyzstan, Laos, Maldives, Marshall Islands, Micronesia, Mongolia, Myanmar, Nepal, Palau, Papua New Guinea, Samoa, Solomon Islands, Tajikistan, Timor-Leste, Tonga, Turkmenistan, Tuvalu, Uzbekistan, Vanuatu, Vietnam
Latin America (EM)	Antigua and Barbuda, Bahamas, Barbados, Belize, Bermuda, Bolivia, Cayman Islands, Costa Rica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Nicaragua, Panama, Paraguay, Saint Lucia, Suriname, Trinidad and Tobago, Uruguay, Venezuela

We now explain the calculation of the country/sector correlation matrix, including countries with and without sufficient country index data. Each factor (a country or sector) is mapped to a corresponding index. There are two cases: (1) countries with sufficient index data and sectors are mapped to their specific index and (2) countries with insufficient index data are mapped to their region index. We then assign idiosyncratic risk weights. In case (1), the idiosyncratic risk weights are zero. In case (2), the idiosyncratic risk weights are region-specific and are calibrated based on historical data.[6] The idiosyncratic risk weights for each region are shown in Table 5.12.

Table 5.12: Regional Idiosyncratic Risk Weights

Region	Eta	Count
Africa	81%	8
Asia	69%	15
Europe and Middle East	81%	19
Latin America and Caribbean	69%	8

Correlations between factors are then calculated according to equation 5.4.

[6] To calculate the idiosyncratic risk weights for each region, we regress the individual country index returns on their corresponding region index return and obtain the regression coefficient β_i for each country i. We use the country indices with over 70% data availability throughout the entire period. The idiosyncratic weights for each country are then calculated as $\eta_i = \sqrt{1 - {\beta_i}^2}$. Finally, we average over each region to calculate the regional idiosyncratic weights.

$$\rho(f_1, f_2) = \begin{cases} \sqrt{1-\eta_1^2}\,\sqrt{1-\eta_2^2}\,\rho(i_1, i_2) & if\ f_1 \neq f_2 \\ 1 & if\ f_1 = f_2 \end{cases} \quad (5.4)$$

Here, f_1, f_2 are two factors (countries or sectors), i_1, i_2 are the corresponding indexes (countries, regions, or sectors) and η_1, η_2 are the idiosyncratic risk weights.

Table 5.13 provides average pairwise correlation factors for the four MDBs using two different idiosyncratic factors (i) regional idiosyncratic factor and (ii) constant idiosyncratic factor of 75%. The average pairwise correlation of AfDB is significantly lower than ADB and IDB when regional idiosyncratic factors are used. When using a constant idiosyncratic factor, the average pairwise correlation for AfDB resembles that observed in ADB.

Table 5.13: Average Pairwise Correlation

MDB	SO exposure	NSO exposure
ADB	43%	27%
AfDB	41%	27%
CAF	49%	27%
CEB	52%	28%
EBRD	38%	26%
IBRD	37%	-
IDB	47%	27%
IDB Invest	-	27%
NDB	56%	29%

5.4 *Equity Investments*

In this study, we assume that equity investments by MDBs have log normal returns. The log normal return is modelled like the latent variables driving credit quality for rated exposures, in that it is made up of country factors plus an idiosyncratic shock.

The country factor for equity investments is assumed to equal the MSCI country equity index. If there is no MSCI equity index for the country or if it is assigned as regional by the bank, we assign it to the regional MSCI index corresponding to the region of the MDB's headquarters. For example, the regional equity investments are assigned to 'Europe and Middle East' for EBRD.

We adopt the following input parameter assumptions for equity investments:

- The mean excess annual return is assumed to be zero. This parameter captures the total excess expected return on the equity. Excess is over the risk-free amount.
- Annual dividend rate is assumed as zero. This parameter captures the dividend payout rate on equity, i.e., the fraction of value paid out to equity-holders each period.
- Annual volatility of returns is assumed based on the MSCI country factor of the equity investment.

In the financial statements of the MDBs, we find that only EBRD considers equity investments as a source of market risk and tries to estimate the potential impact of profit or loss of holding the equity.

5.5 *Market Risk*

Market risk is defined as the risk of losses in both on- and off-balance sheet risk exposures due to movement in the market prices. For MDBs the primary factors which affect the exposures in their balance sheet are movement in the (i) interest rate and (ii) foreign exchange rate. Thus, the four banks have consensus on the two principal risks which contribute to market risk are:

1. Interest Rate Risk
2. Foreign Exchange Risk

The economic capital required for the interest rate risk is calculated by using the following data:

- MDB sensitivity: The fair value losses of the MDB portfolio due to an upward parallel shift by 1 basis point (bp) in the interest rates at the end of the fiscal year. IBRD and AfDB provides sensitivity results of the portfolio in gross value. ADB provides stress sensitivity results of the portfolio in gross value.
- US treasury yield: The monthly market yield of the US Treasury Securities at 3-year constant maturity for the last 10 years from December 2012 to December 2022 (see Federal Reserve Economic Data (2024)).

We estimate the 1-year change in the US treasury yield at the following confidence levels assuming the change in interest rate has a gaussian distribution with mean zero:

1. At 5 per cent
2. At 10 bps (equivalent to 'A' stress level)
3. At 1 bp (equivalent to a 'AAA' stress level)

The Value at Risk (VaR) due to interest risk at a given confidence level is the product of the 1-year interest rate change (at a given confidence level) with the MDB loss due to a change in interest rate by 1 bp.

The fluctuations due to foreign exchange risk is minimised by the four banks considered in this study by matching the currencies of the assets and liabilities to the extent possible. Due to this, there is a negligible contribution to the economic capital required for exchange rate risk.

In the financial statement of IBRD (2022), the bank reports that it has matched currencies of borrowing and outstanding loans (including derivatives) with 83% in USD and 17% in Euro. AfDB provides sensitivity results for currency risk, which shows a minimal effect of 4 basis points for a 10% depreciation of each African currency against the Special Drawing Rights (SDR).

We estimate the market risk economic capital for other MDBs based on the three banks: ADB, AfDB, and IBRD. First, we calculate the ratio of market risk at 1 basis point to credit risk at a 1-year horizon, with PCT adjustments. We then take the average of these ratios and apply it to the remaining MDBs.

5.6 Operational Risk

Operational risk is defined as the risk of loss due to inadequate or failed internal processes, people or external events. This definition is consistent with definitions found across the financial statements of the four regional MDBs (i) ADB, (ii) AfDB, (iii) IBRD and (iv) IDB, and the Basel III framework for the commercial banks. It is interesting to note that Basel's operational risk only includes legal risk and excludes strategic and reputational risk. The IDB considers operational risk to be events that can cause financial losses and financial reporting misstatements and impact the reputation of the MDB.

AfDB (2023) calculates the Operational Risk Capital (ORC) equal to 15 per cent of the 3-year average operation income of the bank, resembles recommended in Basel II. In this study, we benchmark the ORC according to the Basel III recommendations.

In the Basel III, ORC is calculated using the following three components (see BCBS (2023a)):

1) Business Indicator (BI): It is estimated using the bank's financial statement and is the proxy for operational risk. It is the sum of three components (i) Interest, Leases and Dividend Component (ILDC), (ii) Services Component (SC), and (iii) Financial Component (see equation 5.1).
2) Business Indicator Component (BIC): It is the product of BI with the Basel III's marginal coefficients (α). The value of α increases with the BI. For BI under €1 billion α is 12 per cent, for BI in between €1 billion and €30 billion α is 15 per cent, and for BI, over €30 billion α is 18 per cent.
3) Internal Loss Multiplier (ILM): It is a scaling factor estimated using the bank's average historical losses and the BIC.

Equation (5.5) describes the ORC estimated based on the Basel III framework.

$$ILDC_t = \min\left(\frac{\sum_{i=0}^{2} abs(interst\ income_{t-i} - interest\ expense_{t-i})}{3},\ 2.25\% \times \frac{\sum_{i=0}^{2} interest\ earning\ assets_{t-i}}{3}\right) + \frac{\sum_{i=0}^{2} dividend\ income_{t-i}}{3} \qquad (5.5)$$

$$SC_t = max\left(\frac{\sum_{i=0}^{2} other\ operating\ income_{t-i}}{3}, \frac{\sum_{i=0}^{2} other\ operating\ expense_{t-i}}{3}\right) + \max\left(\frac{\sum_{i=0}^{2} fee\ income_{t-i}}{3}, \frac{\sum_{i=0}^{2} fee\ expense_{t-i}}{3}\right)$$

$$FC_t = \frac{\sum_{i=0}^{2} abs(Net\ P\&L\ trading\ book)_{t-i}}{3} + \frac{\sum_{i=0}^{2} abs(Net\ P\&L\ banking\ book)_{t-i}}{3}$$

$$ORC = BIC \times ILM$$

The data input required to estimate the ORC is shown in Table 5.14. All the data is for a three-year time-period. For the MDBs, we have assumed zero trading book profit and loss. The interest-earning assets are assumed to be the difference between total assets and due from banks (cash). When the financial statement provided by the MDB does not differentiate between interest and non-interest revenue, all the revenue is assumed equal to interest income. Borrowing expense is considered as interest expense in the calculation of *ILDC*. If an MDB's income statement provides information on the net fee income and dividend income we include in the input to Table 5.14, otherwise it is assumed zero. The net Profit & Loss (P&L) of the banking book is assumed equal to the total comprehensive income reported by the MDBs. Finally, the scaling factor ILM is assumed to be unity due to the absence of the bank's historical loss data due to operational issues.

Table 5.14: Data Item Required for ORC

Item
Interest revenue
Borrowing expense
Total assets
Due from banks
Dividend income
Non-interest revenue
Non-interest expenses
Fee income
Fee Expense
Total comprehensive income
Net P&L trading book

Note: The expense is entered as a negative amount in the data input.

5.7 Conclusion

This section has explained the Economic Capital methodology we have devised for measuring capital adequacy. This includes risk categories such as credit risk, market risk (which here comprises interest rate risk alone) and operational risk. Omitted are foreign exchange risk, treasury credit risk (due to lack of granular data on treasury assets by MDBs) and pension fund risk.

6. MDB Capital Adequacy Benchmarking

6.1 Introduction

This section presents results for nine MDBs: ADB, AfDB, CAF, CEB, EBRD, IBRD, IDB, IDB Invest, and NDB, using the Economic Capital (EC) methodology described in Section 5.

6.2 Credit Risk EC Results

The Economic Capital (EC) required for the credit risk faced by the four regional banks is presented in Table 6.1.

Table 6.1: Economic Capital

	Without PCT		With PCT	
	1-yr	3-yr	1-yr	3-yr
ADB	58,033	66,013	17,864	22,629
AfDB	12,836	13,775	3,951	4,932
CAF	15,136	15,525	4,416	5,647
CEB	7,057	8,309	1,565	2,123
EBRD	9,499	10,400	6,634	7,668
IBRD	88,706	97,296	19,493	25,419
IDB	54,655	56,960	15,920	19,538
IDB Invest	914	1,023	914	1,023
NDB	7,992	8,748	2,796	3,595

Note: All units are in USD million. The Euro/USD exchange rate used is 1.0705 as on 30/12/2023. The UA/USD exchange rate used is 1.33 as for December 2022.

Figure 6.1: Credit Risk Classified by Income Group

a) Credit Risk

b) DRA Allocation

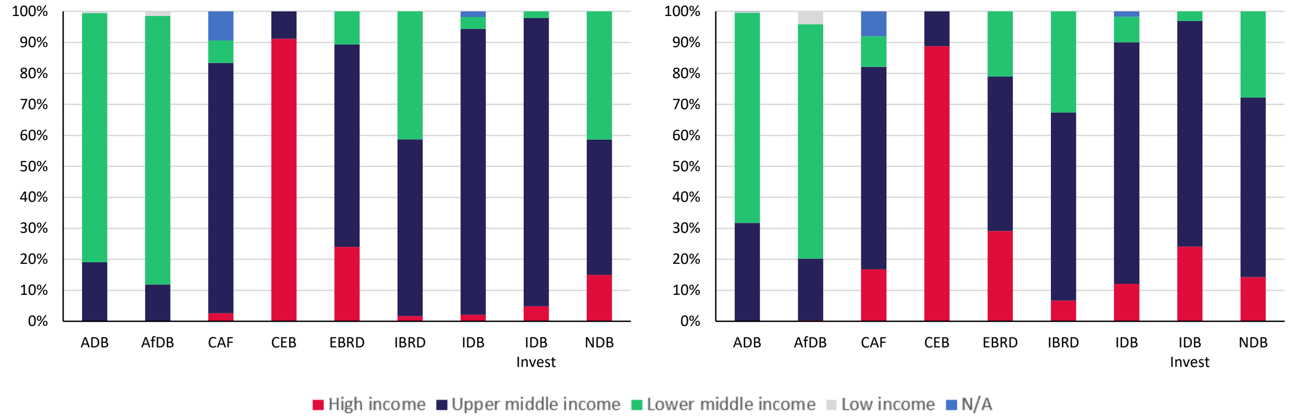


Figure 6.1 is divided into two parts. Panel a) shows the breakdown of credit risk exposures, measured by Marginal VaR, categorized by income group for each MDB, while Panel b) shows the breakdown of original loan portfolio exposures across these income groups. ADB and AfDB have significant exposure to lower-middle-income countries. CEB has its credit risk primarily exposed to high-income countries. Comparing the two panels demonstrates that countries with lower income contribute a higher proportion of total EC than the proportion of DRAs.

Figure 6.2: Credit Risk Classified by DRA Asset Type

a) Credit Risk

b) DRA Allocation

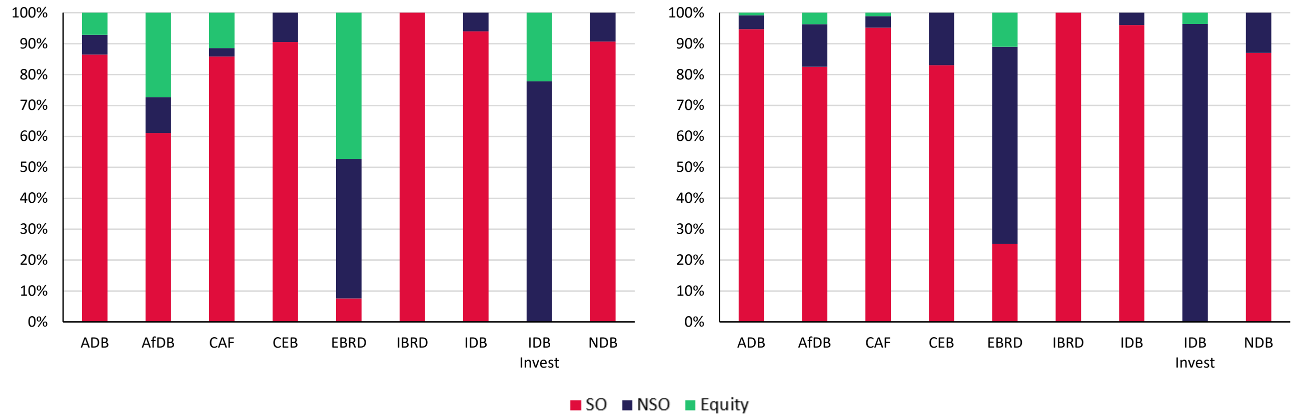


Figure 6.2 contrasts between the type of MDB DRAs by asset classes. Most MDBs covered in this study are sovereign focused (implying having SO account for 50% or more of total DRAs). We could observe that when we have presence of NSO or equity asset types it takes a larger share of the total required EC compared to their proportion of outstanding loans in total DRAs. The panel demonstrates the effect of PCT which enables the SOs to have lower contribution to EC compared to asset types which does not benefit from PCT.

6.3 Market Risk EC Results

We compute EC for Market Risk by multiplying interest sensitivities published by several MDBs by a series of stresses. The yearly interest rate change of the 3-year US Treasury Security at 95%, 99.9%, and 99.99% confidence level are 1.21%, 2.03% and 2.40%, respectively.

Based on these calculations, the EC required for the market risk ranges from 2% to 8% of the total equity (see Table 6.2). IBRD has the highest required EC for market risk of $4.3 billion (at 1 bp). For ADB, the 1-yr VaR at 95% confidence level is 1.2%. This may be compared with the value that ADB itself reports of 1.56% of the equity. AfDB's EC is around the median value for the MDBs at 4.8% of total equity.

Table 6.2: Market Risk Capital for the Regional MDBs

	Sensitivity for +1bp	Yearly 3-Yr Treasury Volatility	VaR in gross value at			Total Equity	VaR as % of Total Equity at		
			500 bp	10bp	1bp		500 bp	10bp	1bp
ADB	5.5	0.62%	666	1,118	1,322	54,214	1.2%	2.1%	2.4%
AfDB	2.6		316	531	628	13,143	2.4%	4.0%	4.8%
IBRD	18.0		2,176	3,654	4,320	55,320	3.9%	6.6%	7.8%

Note: All amounts are in USD million. The volatility is estimated using monthly yield data of 3-yr USD Treasury security. The yearly interest rate change at 95%, 99.9% and 99.99% confidence level are 1.21%, 2.03% and 2.40%.

Table 6.3 implements the approach described in Section 5.5. When a bank does not report an interest rate sensitivity, Market Risk EC is assumed to equal that bank's Credit Risk EC times the average of the ratio of Market to Credit Risk EC of the three banks that do report sensitivity data (i.e., ADB, AfDB and IBRD). The average ratio in question is 15% of the Credit Risk EC.

Table 6.3: Market Risk Capital for all MDBs

	Credit Risk	Market Risk
ADB	17,864	1,322
AfDB	3,951	628
CAF	4,416	669
CEB	1,565	237
EBRD	6,634	1,005
IBRD	20,076	4,320
IDB	15,920	2,412
IDB Invest	914	139
NDB	2,796	424

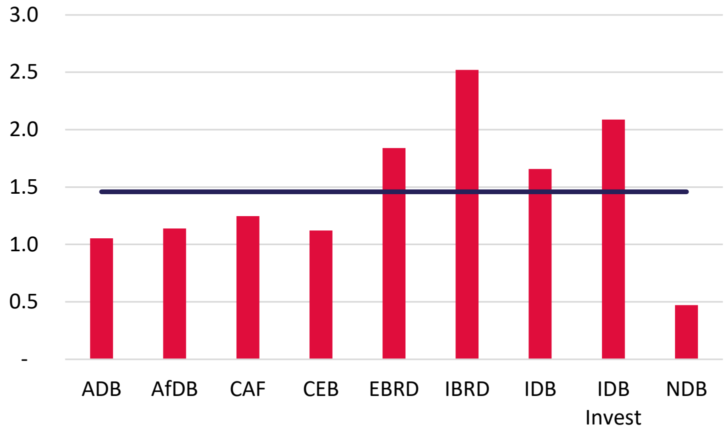
Note: All amounts are in USD million. The credit risk is 1-year with PCT adjustment. Market risk is estimated as 15% of credit risk (as described in Section 5.6).

6.4 Operational Risk EC Results

Table 6.4 shows that IBRD has the highest Operational Risk Economic Capital (OREC) at $1.4 billion among the major MDBs. The figures for ADB and IDB are similar at $0.6 billion ORC, almost half of the IBRD. Using the Basel III guidelines, AfDB's ORC is estimated to be $148 million. This may be compared to the level that AfDB reports which was stated to be $79 million in the Bank's latest financial statement.

The ORCs for the nine MDBs range from 1 to 3 percent of the bank's total equity, with an average of 1.5%.

Figure 6.3: Operational Risk Capital as Percentage of Total Equity



Note: The vertical axis is expressed in percentage.

Table 6.4: OREC for the Regional MDBs

MDB	ILDC	SC	FC	BI	ORC	% of TE
ADB	1,862	792	1,366	4,020	571	1.1
AfDB	560	292	361	1,213	150	1.1
CAF	996	187	171	1,355	171	1.2
CEB	156	59	129	344	41	1.1
EBRD	1,121	124	1,507	2,752	381	1.8
IBRD	2,319	2,080	5,113	9,512	1,395	2.5
IDB	1,731	1,137	1,528	4,396	627	1.7
IDB Invest	176	169	171	515	62	2.1
NDB	231	81	112	424	51	0.5

Note: All units are in USD million. ILDC denotes the Interest, Leases and Dividend Component, SC denotes the Services Component, FC denotes the Financial Component, BI denotes the Business Indicator, and ORC denotes Operational Risk Capital. The Internal Loss Multiplier is assumed to be unity.

6.5 Summary Findings

This section presents the results of the EC calculations for the nine MDBs in the sample. The CAR is calculated as ratio of total equity to EC, where the EC includes Credit Risk EC (inclusive of equity instruments), Market Risk EC and Operational Risk EC. Table 6.5 shows the CAR ratio (inclusive of PCT) using 1-year and 3-year Credit Risk EC for the nine MDBs. The 1-year CAR ranges from 2.0 to 3.3, with an average of 2.5.

Similarly, Table 6.6 displays CAR ratios with 1-year and 3-year Credit Risk EC without adjusting for PCT. The CAR ratios are significantly lower for the sovereign-focussed MDBs. The CAR ratio with 1-year Credit Risk EC without PCT varies from 0.5 to 2.7, with an average of 1.1.

The Credit Risk EC component of the CAR is calculated using a canonical Credit Portfolio Model (CPM). This is calibrated to estimate Value-at-Risk results at a 1 basis point confidence level, i.e., at a level equivalent to a 'AAA' stress event.

We generate equivalent Basel-implied and rating agency-implied CAR ratios. The Basel-implied CAR is computed using the Internal Ratings Based (IRB) formula with a confidence level of 99.99%. The Standard & Poor's RAC-implied CAR is obtained by dividing the RAC ratio by 23%. This transforms the denominator of the ratio into EC at a 99.99% confidence level. The Fitch-Usable Capital-to-Risk-Weighted-Assets-Ratio (FRA) implied CAR is obtained by dividing the FRA ratio by 35%, which yields a ratio in which the denominator is equivalent to EC for a AAA rated entity.

Table 6.5: Capital Adequacy Ratio for the MDBs Inclusive of PCT

	EC				CAR		Equity to	
	CR		MR	OR			Loans	Total
	1-yr	3-yr			1-yr	3-yr	Ratio	Equity
ADB	17,864	22,629	1,322	571	2.7	2.2	37	54,214
AfDB	3,951	4,932	628	150	2.8	2.3	48	13,143
CAF	4,416	5,647	669	171	2.6	2.1	45	13,719
CEB	1,565	2,123	237	41	2.0	1.5	17	3,685
EBRD	6,634	7,668	1,005	381	2.6	2.3	65	20,699
IBRD	19,493	25,419	4,320	1,395	2.2	1.8	25	55,320
IDB	15,920	19,538	2,412	627	2.0	1.7	34	37,873
IDB Invest	914	1,023	139	62	2.7	2.4	50	2,964
NDB	2,796	3,595	424	51	3.3	2.7	77	10,815

Note: Here the EC is based on 99.99% confidence level. All the amounts are in USD million.

Table 6.6: Capital Adequacy Ratio for the MDBs Exclusive of PCT

	EC				CAR		Equity to	
	CR		MR	OR			Loans	Total
	1-yr	3-yr			1-yr	3-yr	Ratio	Equity
ADB	58,033	66,013	1,322	571	0.9	0.8	37	54,214
AfDB	12,836	13,775	628	150	1.0	0.9	48	13,143
CAF	15,136	15,525	669	171	0.9	0.8	45	13,719
CEB	7,057	8,309	237	41	0.5	0.4	17	3,685
EBRD	9,499	10,400	1,005	381	1.9	1.8	65	20,699
IBRD	88,706	97,296	4,320	1,395	0.6	0.5	25	55,320
IDB	54,655	56,960	2,412	627	0.7	0.6	34	37,873
IDB Invest	914	1,023	139	62	2.7	2.4	50	2,964
NDB	7,992	8,748	424	51	1.3	1.2	77	10,815

Note: Here the EC is based on 99.99% confidence level. All the amounts are in USD million.

Table 6.7 compares the CARs implied by the canonical CPM with Basel- and rating-agency-implied capital ratios. The Basel-implied CAR ratios (computed for a 99.99% confidence level) are significantly higher than the CPM-based CAR ratios. The latter are in turn higher than those implied by the Standard & Poor's Risk Adjusted Capital (RAC) ratio and the Fitch Usable Capital to Risk Weighted Assets (FRA) ratio.

Table 6.8 presents correlations for the nine banks of the different CARs and the Moody's Leverage Ratio (multiplied by minus 1). As expected, the correlation between the CPM-based using 1 and 3-year Credit Risk EC is 95%. The CPM-based CARs are relatively highly correlated with the Basel-implied CAR but lowly correlated with the Standard & Poor's RAC-implied CAR. The CPM-based CAR is also strongly correlated with the Moody's leverage ratio, which is surprising given the non-risk-sensitive nature of the latter. The Standard & Poor's RAC implied CAR has very low correlation with the Moody's leverage ratio and is negatively correlated with the FRA ratio of Fitch.

Table 6.7: Implied CARs at 99.99% Confidence Level

	Basel CAR	S&P's RAC	Fitch's FRA	Risk Control 1-Year CAR
ADB	7.4	1.4	1.7	2.7
AfDB	4.3	1.2	1.5	2.8
CAF	6.3	0.8	1.4	2.6
CEB	5.4	1.2	1.1	2.0
EBRD	2.9	1.3	1.3	2.6
IBRD	4.4	1.1	1.5	2.2
IDB	5.4	1.0	1.5	2.0
IDB Invest	3.3	1.5	1.3	2.7
NDB	10.6	1.1	2.5	3.3

Note: Here, the Basel-implied CAR is based on the Internal Ratings Based (IRB) formula with a confidence level of 99.99%. Standard & Poor's RAC implied CAR is obtained by dividing the RAC ratio by 23%. This makes the denominator of the ratio equivalent to Economic Capital (EC) with a 99.99% confidence level. The Fitch-Usable Capital-to-Risk-Weighted-Assets-Ratio (FRA) implied CAR is obtained by dividing the FRA ratio by 35%, which yields a ratio in which the denominator is equivalent to EC for a AAA rated. The Risk Control's CAR is based on the economic capital required at 99.99% confidence level.

Table 6.8: Pearson Correlation of MDB Capital Adequacy Metrics

	CAR 1-yr w/o pct	*CAR 3-yr w/o pct*	*Basel CAR w/o PCT*	*CAR 1-yr with pct*	*CAR 3-yr with pct*	*Basel CAR with PCT*	*S&P's RAC*	*Moody's Leverage Ratio*	*Fitch's Equity to RWA*
CAR 1-yr w/o pct	1.00	1.00	0.39	0.42	0.66	-0.33	0.63	0.56	-0.08
CAR 3-yr w/o pct	1.00	1.00	0.39	0.42	0.66	-0.33	0.60	0.58	-0.08
Basel CET1 w/o PCT	0.39	0.39	1.00	0.77	0.71	0.71	0.23	0.53	0.76
CAR 1-yr with pct	0.42	0.42	0.77	1.00	0.95	0.53	0.25	0.80	0.71
CAR 3-yr with pct	0.66	0.66	0.71	0.95	1.00	0.29	0.39	0.88	0.56
Basel CET1 with PCT	-0.33	-0.33	0.71	0.53	0.29	1.00	-0.26	0.23	0.86
S&P's RAC	0.63	0.60	0.23	0.25	0.39	-0.26	1.00	0.09	-0.08
Moody's Leverage Ratio	0.56	0.58	0.53	0.80	0.88	0.23	0.09	1.00	0.52
Fitch's Equity to RWA	-0.08	-0.08	0.76	0.71	0.56	0.86	-0.08	0.52	1.00

Note: The CAR is calculated using a constant idiosyncratic factor of 75%. The correlations for the 'Moody's Leverage Ratio' are multiplied by minus one. The highlighted row demonstrates the correlation of relevant prudent CAR measures for the MDB with other capital adequacy metrics. Here, w/o denotes without. See note for Table 6.7 for Basel CAR.

7. Conclusion

This study presents comparable measures of capital adequacy for several MDBs. In this, we aim to shed light on the financial state of the institutions included. We are also interested in how the different measures perform and whether they measure required capital consistently.

We focus on nine MDBs. We provide some balance sheet ratios for some other multilateral lenders but their limited transparency regarding risk makes analysing their capital adequacy on the basis of public information difficult.

Our findings are as follows. For the nine MDBs, the CARs implied by the canonical EC methodology are high, being never less than 2 even when a conservative confidence level of 99.99% is employed. The high CARs reflect the Preferred Creditor Treatment (PCT) the MDBs enjoy in their sovereign lending and the conservative nature of their lending to non-sovereigns.

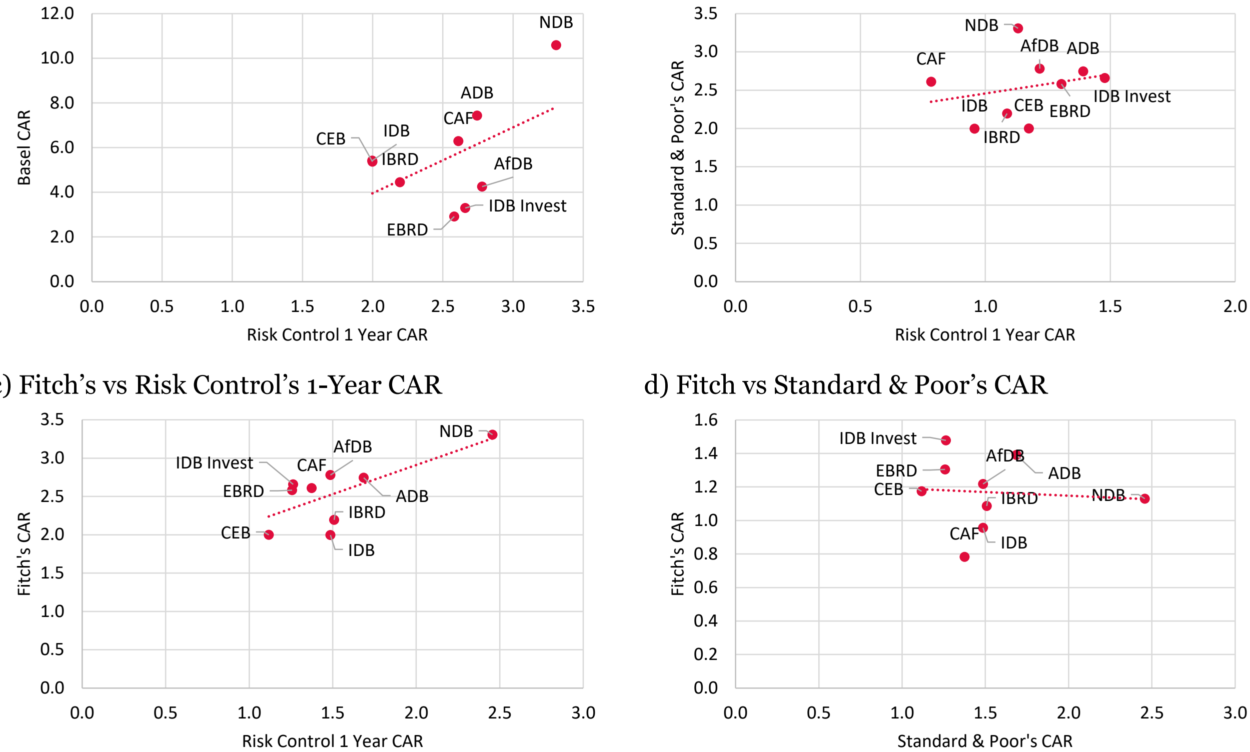
In calibrating the Probabilities of Default (PDs) and the Loss Given Default (LGD) rates employed in the calculations, we draw on earlier studies Risk Control (2022) and (2024) and employ information provided by the MDBs in their public financial statements and risk reports.

We compare the CARs implied by the methodology with capital ratios obtained using Basel and rating agency methodologies (see Table 6.7 and Figure 7.1). Even when Basel and rating agency-implied CARs are computed for a triple-A or 99.99% confidence level, the Basel-implied CAR ratios exceed 2.9 for all nine banks.

On the other hand, the CAR ratios implied by the Standard & Poor's Risk Adjusted Capital (RAC) ratio and the Fitch Usable Capital to Risk Weighted Assets (FRA) ratio (in both cases at a 99.99% confidence level) are much lower, varying from 0.8 to 1.5 for Standard & Poor's and from 1.1 to 2.5 for Fitch.

Figure 7.1: Scatter Plots of Implied CARs at 99.99% Confidence Level

a) Basel vs Risk Control 1-Year CAR
b) Standard & Poor's vs Risk Control 1-Year CAR



Note: Here the dashed line represents the best fit line for the scatter plots.

We compute the correlations across the 9 banks of the different CAR ratios and the Moody's leverage ratio (see Table 6.8). It is noticeable that the Risk Control CARs are relatively highly correlated with the Basel-implied

CAR but quite lowly correlated with the Standard & Poor's RAC-implied CAR. The CPM based CAR is also strongly correlated with the Moody's leverage ratio, which is surprising given the non-risk-sensitive nature of the latter. The Standard & Poor's RAC implied CAR has very low correlation with the Moody's leverage ratio and is negatively correlated with the FRA ratio of Fitch.

References

MDB Annual Reports

Asian Development Bank (2023) "Financial Report 2022," March, available at: https://www.adb.org/sites/default/files/institutional-document/872636/adb-financial-report-2022.pdf.

African Development Bank (2023) "Financial Report 2022," May, available at: https://www.afdb.org/en/documents/financial-report-2022.

AFREXIMBANK (2023) "Annual Report 2022," available at: https://media.afreximbank.com/afrexim/Afreximbank-2022-AR.pdf.

AIIB (2023) "Auditor's Report and Financial Statements for Year Ended Dec.31, 2022," available at: https://www.aiib.org/en/about-aiib/financial-statements/.content/index/pdf/AIIB-2022-yearend-Financial-Statements-signed.pdf.

APICORP (2023) "Annual Report 2022," available at: https://reporting.apicorp.org/2022/.

BOAD (2023) "Statutory Auditor's report on the Audit of the Financial Statements," available at: https://www.boad.org/wp-content/uploads/2023/04/Statutory-Auditor-Report-on-financial-statements-year-ended-december-31-2022.pdf.

CAF (2023) " Financial Statements," available at: https://www.caf.com/media/4384356/cafannualingle-s31-12-2022coninformedelosauditoresindependientes.pdf.

CDB (2023) "Annual Report 2022," available at: https://www.caribank.org/publications-and-resources/resource-library/annual-reports/cdbs-annual-report-2022.

CEB (2023) "Financial Report 2022," available at: https://coebank.org/media/documents/2022_CEB_Financial_report.pdf.

EBRD (2023) "Financial Report 2022," May, available at: https://www.ebrd.com/financial-report-2022.

EIB (2023) "Financial Report 2022," May, available at: https://www.eib.org/en/publications/20220270-financial-report-2022.

International Bank for Reconstruction and Development (2022) "Management's Discussion & Analysis and Financial Statements June 30.2022," available at: https://thedocs.worldbank.org/en/doc/16796f0d7a20087d312ec8634ace777c-0040012022/original/IBRD-Financial-Statements-June-2022.pdf.

International Bank for Reconstruction and Development (2023) "Management's Discussion & Analysis and Financial Statements June 30.2023," available at: https://thedocs.worldbank.org/en/doc/66512fcff3c06766d0bd85f5042d4101-0040012023/original/IBRD-Financial-Statements-June-2023.pdf.

IDA (2023) "Management's Discussion & Analysis and Financial Statements June 30.2023," available at: https://thedocs.worldbank.org/en/doc/b38629a142167d3f5b6dcf39646379c5-0040012023/original/IDA-Financial-Statements-June-2023.pdf.

Inter-American Development Bank (2023) "Annual Report 2022 Financial Statements," available at: https://publications.iadb.org/en/inter-american-development-bank-annual-report-2022-financial-statements.

IDB Invest (2023) "2022 Information Statement," available at: https://idbinvest.org/sites/default/files/2023-04/FY22%20IDB%20Invest_Info%20Statement_Final_Ext%20Pub_ENG_2023.02.23_branded.pdf.

IFC (2023) "Management's Discussion and Analysis and Consolidated Financial Statements June 30,2023," available at: https://www.ifc.org/content/dam/ifc/doc/2023/FY23-IFC-Annual-MDA-and-FS.pdf.

IsDB (2023) "Ordinary Capital Resources Financial Statements and Independent Auditor's Report," available at: https://www.isdb.org/publications/isdb-ocr-financial-statements-2022.

NDB (2022) "Annual Report 2021," available at: https://www.ndb.int/annual-report-2021/pdf/NDB_AR_2021_complete.pdf.

NIB (2023) "2022 Annual Report," available at: https://www.nib.int/files/417e821473134738d7e3cf646fd24cc7eed54498/nib-annual-report-2022.pdf.

TDB (2023) "Annual Report & Financial Statements 2022," available at: https://www.tdbgroup.org/wp-content/uploads/2023/08/TDB-Annual-Report-2022-ENG.pdf.

Other references

Basel Committee on Banking Supervision (2023a) "Calculation of RWA for operational risk," OPE25, March, available at: https://www.bis.org/basel_framework/chapter/OPE/25.htm?inforce=20230101&published=20230330.

Basel Committee on Banking supervision (2023b) "Calculation of RWA for credit risk," CRE20, January, available at: https://www.bis.org/basel_framework/chapter/CRE/20.htm?inforce=20230101&published=20221208#fn_CRE_20_54_20.

Basel Committee on Banking supervision (2023c) "Calculation of RWA for credit risk," CRE31, January, available at: https://www.bis.org/basel_framework/chapter/CRE/31.htm?inforce=20230101&published=20200327

Basel Committee on Banking Supervision (2015) "Standards - Revised Pillar 3 disclosure requirements," d309, January, available at: https://www.bis.org/bcbs/publ/d309.pdf.

CAF Panel (2022) "Boosting MDBs investing capacity, An Independent Review of Multilateral Development Banks' Capital Adequacy Frameworks," available at: https://www.dt.mef.gov.it/export/sites/sitodt/modules/documenti_it/rapporti_finanziari_internazionali/rapporti_finanziari_internazionali/CAF-Review-Report.pdf.

Cruces, Juan J., and Christoph Trebesch (2013) "Sovereign defaults: The price of haircuts.", 5 (3), 85-117, available at: https://www.econstor.eu/bitstream/10419/52478/1/669443050.pdf

Fitch (2023a) "Fitch Affirms African Development Bank at 'AAA'; Outlook Stable," July, available at: https://www.fitchratings.com/research/sovereigns/fitch-affirms-african-development-bank-at-aaa-outlook-stable-10-07-2023.

Fitch (2023b) "Fitch Affirms IBRD at 'AAA'; Outlook Stable," January, available at: https://www.fitchratings.com/research/sovereigns/fitch-affirms-ibrd-at-aaa-outlook-stable-20-01-2023.

Fitch (2023c) "Supranationals Rating Criteria," April, available at: https://www.fitchratings.com/research/sovereigns/supranationals-rating-criteria-11-04-2023.

Fitch (2023d) “Supranationals Rating Criteria: Discussion Paper,” December, available at: https://www.fitchratings.com/research/sovereigns/supranationals-rating-criteria-discussion-paper-12-12-2023.

Fitch (2022) “Fitch Affirms Inter-American Development Bank at 'AAA'; Outlook Stable,” November, available at: https://www.fitchratings.com/research/sovereigns/fitch-affirms-inter-american-development-bank-at-aaa-outlook-stable-16-11-2022.

Federal Reserve Economic Data (2024) “Market Yield on US Treasury Securities at 3-year constant maturity (GS3),” available at: https://fred.stlouisfed.org/series/GS3.

GEMs (2024) “Recovery Statistics,” available at: https://www.gemsriskdatabase.org/#Recovery%20Statistics%20Publication

Lamb, Robert, and William Perraudin (2008) “Dynamic default rates,” manuscript, *University of Minnesota,* available at: https://www.riskcontrollimited.com/wp-content/uploads/2015/02/Dynamic_Default_Rates.pdf.

Moody’s (2024) “Multilateral Development Banks and other supranational entities methodology,” February, available at: https://rb.gy/1f55lu.

Moody’s (2023a) “Asian Development Bank – Aaa stable,” July, available at: https://www.adb.org/sites/default/files/institutional-document/33067/moodys-report-20230728.pdf.

Moody’s (2023b) “IBRD (World Bank) – Aaa stable,” March, available at: https://thedocs.worldbank.org/en/doc/15143476b7c65175c6ad7a5b3e412650-0340022023/original/Moody-s-IBRD-03Mar2023.pdf.

Moody’s (2023c) “Moody’s affirms AfDB’s Aaa rating, maintains stable outlook,” October, available at: https://www.moodys.com/research/Moodys-affirms-AfDBs-Aaa-rating-maintains-stable-outlook-Rating-Action--PR_480177.

Moody’s (2023d) “Moody’s affirms the Inter-American Development Bank’s Aaa rating,” March, available at: https://www.moodys.com/research/Moodys-affirms-the-Inter-American-Development-Banks-Aaa-rating-maintains-stable-Rating-Action--PR_474022.

Moody’s (2023e) “Sovereign default and recovery rates, 1983-2022,” April, available at: https://www.moodys.com/research/Sovereigns-Global-Sovereign-default-and-recovery-rates-1983-2022-Sector-In-Depth--PBC_1358913.

Risk Control (2024a) “Fair Pricing of MDB Sovereign Loans,” September, 24-122a.

Risk Control (2024b) “Quantifying Preferred Creditor Treatment by Rating Grade,” September, 24-119a.

Standard & Poor’s (2023a) “Default, Transition, and Recovery: 2022 Annual Global Corporate Default And Rating Transition Study,” April, available at : https://www.spglobal.com/ratings/en/research/articles/230425-default-transition-and-recovery-2022-annual-global-corporate-default-and-rating-transition-study-12702145.

Standard & Poor’s (2023b) “Default, Transition, and Recovery: 2022 Annual Global Sovereign Default And Rating Transition Study,” April, available at: https://www.spglobal.com/ratings/en/research/articles/230428-default-transition-and-recovery-2022-annual-global-sovereign-default-and-rating-transition-study-12695994#:~:text=All%20of%20S%26P%20Global%20Ratings,of%20default%2C%20and%20vice%20versa.

Standard & Poor’s (2023c) “Supranationals,” October, available at: https://www.spglobal.com/ratings/en/research/pdf-articles/231012-supranationals-special-edition-2023-101587529.

Appendix A1: MDB Data from Financial Statements

Table A1.1: Key Financial Information

MDB	Net loans & guarantees	Equity investments	Treasury investments	Total assets	Debt issued	Callable capital	Paid in capital	Reserves	Total equity	Total liabilities	Last FY end date	Average Rating
ADB	145,060	1,438	47,550	290,658	131,571	134,494	7,081	47,133	54,214	236,444	31/12/2022	AAA
AfDB	27,523	1,388	19,343	50,832	32,256	184,586	8,262	4,882	13,143	37,688	31/12/2022	AAA
AFREXIMBANK	22,966	0	4,100	27,863	3,368	3,171	850	4,357	5,207	22,656	31/12/2022	BBB+
AIIB	17,642	0	9,746	47,409	24,476	77572	19393	1,073	20,466	26,944	31/12/2022	AAA
APICORP	4,229	68	2,210	8,742	4,209	8,500	1,500	1,309	2,809	5,933	31/12/2022	AA
BOAD	3,982	239	464	5,487	2,550	1,348	426	1,377	1,803	3,684	31/12/2022	BBB
CAF	30,622	382	15,127	50,377	21,252	1,626	9,778	3,941	13,719	36,657	31/12/2022	AA-
CDB	1,324	0	660	2,066	1,051	1,375	388	458	846	1,220	31/12/2022	AA+
CEB	21,289	2,993	10,854	33,751	25,932	5,207	656	3,029	3,685	30,066	31/12/2022	AAA
EBRD	31,887	5,379	32,683	76,675	46,479	25,202	6,655	14,044	20,699	55,975	31/12/2022	AAA
EIB	468,217	11,757	82,964	582,981	462,132	242,581	23,755	60,210	83,965	499,016	31/12/2022	AAA
IBRD	243,896	0	79,824	332,641	237,265	296021	21,819	38,563	60,382	272,259	30/06/2023	AAA
IDA	191,684	0	32,679	227,482	32,567	0	271,258	-85,476	185,782	41,700	30/06/2023	AAA
IDB	112,697	0	32,545	148,026	103,693	164,901	11,854	26,019	37,873	110,153	31/12/2022	AAA
IDB invest	5,921	287	2,586	9,401	5,784	0	2,424	541	2,964	6,437	31/12/2022	AA+
IFC	31,414	10,778	40,120	110,547	52,443	0	22,596	12,442	35,038	75,509	30/06/2023	AAA
IsDB	22,645	637	11,369	36,008	21,775	54,899	8,533	4,871	13,405	22,604	31/12/2022	AAA
NDB	13,965	0	10,583	24,888	10,140	41,199	10,299	434	10,733	14,155	31/12/2021	AA+
NIB	23,273	0	14,176	42,049	33,823	8,053	906	3,484	4,390	37,659	31/12/2022	AAA
TDB	6,301	71	1,738	8,392	6,046	2,323	580	1,387	1,968	6,424	31/12/2022	BBB-
Total	1,426,538	35,419	451,320	2,116,275	1,258,812	1,253,058	429,013	144,079	573,091	1,543,184		

Note: All units are in USD million. The Euro/USD exchange rate used is 1.0705 as on 30/12/2023. The UA/USD exchange rate used is 1.33 as for December 2022. The XOF/USD exchange rate used is .0016 as on 30/12/2022. The exchange rate used for ID/USD is 1.33 as on 23/12/2022. Reserves is calculated as the difference between 'Total equity' and 'Paid In Capital''. 'Total liabilities' are calculated as the difference between 'Total assets' and 'Total equity'. The 'Debt issued' considers only the debt issued as a certificate. The treasury investments are as reported in the Financial Statements of respective MDBs. The source of the data is from the Annual Report/Financial Report of respective MDB

Appendix A2: Historical TM with PCT

Table A2.1 demonstrates the TM employed in this study for the SO with Preferred Creditor Treatment (PCT) adjustments. Here the rating state 'C' represents those sovereigns which default to private creditors but do not go into non-accrual status with MDBs. The values in the row 'C' are based on historical observation of sovereign which go into default to private creditors and what is the status one year after the default (see Risk Control (2024a) for further details).

Table A2.1: One Year Historical TM with PCT

	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-	CC	C	D
AAA	97.10	2.81	0.08	0.00	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01
AA+	6.65	86.22	6.86	0.21	0.00	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03	0.02
AA	0.19	6.85	85.71	6.93	0.23	0.00	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05	0.03
AA-	0.00	0.23	7.78	84.31	7.21	0.34	0.00	0.00	-	-	-	-	-	-	-	-	-	-	-	-	0.08	0.04
A+	0.00	0.01	0.47	13.37	76.00	9.68	0.31	0.01	0.00	-	-	-	-	-	-	-	-	-	-	-	0.10	0.05
A	-	0.00	0.01	0.85	13.18	78.86	6.66	0.24	0.01	0.00	-	-	-	-	-	-	-	-	-	-	0.12	0.07
A-	-	-	0.00	0.02	0.75	11.85	79.30	7.35	0.48	0.01	0.00	-	-	-	-	-	-	-	-	-	0.14	0.09
BBB+	-	-	-	0.00	0.02	0.76	13.14	72.38	12.68	0.75	0.01	0.00	-	-	-	-	-	-	-	-	0.16	0.10
BBB	-	-	-	-	0.00	0.03	1.14	16.74	70.17	11.20	0.42	0.01	0.00	-	-	-	-	-	-	-	0.16	0.14
BBB-	-	-	-	-	-	0.00	0.04	1.32	14.83	75.94	7.16	0.38	0.01	0.00	-	-	-	-	-	-	0.15	0.18
BB+	-	-	-	-	-	-	0.00	0.06	1.54	19.91	67.55	9.83	0.59	0.02	0.00	-	-	-	-	-	0.30	0.21
BB	-	-	-	-	-	-	-	0.00	0.06	1.61	14.88	70.79	11.25	0.71	0.03	0.00	-	-	-	-	0.43	0.25
BB-	-	-	-	-	-	-	-	-	0.00	0.04	0.85	10.61	74.58	12.05	1.00	0.03	0.00	-	-	-	0.52	0.33
B+	-	-	-	-	-	-	-	-	-	0.00	0.02	0.59	10.67	70.47	15.66	0.88	0.02	0.00	-	-	1.27	0.43
B	-	-	-	-	-	-	-	-	-	-	0.00	0.02	0.79	13.97	71.78	10.48	0.41	0.01	0.00	-	1.93	0.61
B-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.03	1.14	15.17	69.56	6.68	0.38	0.03	0.00	6.15	0.86
CCC+	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.08	2.31	25.88	46.49	6.79	1.08	0.37	16.08	0.93
CCC	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.06	1.41	6.55	29.63	10.11	6.98	43.57	1.69
CCC-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	5.07	10.15	70.96	13.82
CC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	81.59	18.41
C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.55	27.27	22.73	2.27	2.27	4.55	29.55	6.82
D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.04	2.04	-	30.61	-	-	-	65.31

Note: All units are in percentage.

Appendix A3: Spearman Correlation Coefficients

Table A3.1 provides the spearman correlation coefficients for the various capital adequacy measures for MDB. The EC CAR calculation is with PCT adjustments and constant regional idiosyncratic factor of 0.75.

Table A3.1: Spearman Correlation of MDB Capital Adequacy Metrics

	CAR 1-yr w/o pct	*CAR 3-yr w/o pct*	*Basel CAR w/o PCT*	*CAR 1-yr with pct*	*CAR 3-yr with pct*	*Basel CAR with PCT*	*S&P's RAC*	*Moody's Leverage Ratio*	*Fitch's Equity to RWA*
CAR 1-yr w/o pct	1.00	0.98	0.72	0.63	0.90	-0.32	0.62	0.92	0.03
CAR 3-yr w/o pct	0.98	1.00	0.68	0.60	0.88	-0.33	0.50	0.93	-0.04
Basel CAR w/o PCT	0.72	0.68	1.00	0.65	0.72	0.23	0.52	0.72	0.11
CAR 1-yr with pct	0.63	0.60	0.65	1.00	0.87	0.25	0.38	0.70	0.51
CAR 3-yr with pct	0.90	0.88	0.72	0.87	1.00	-0.07	0.48	0.92	0.33
Basel CAR with PCT	-0.32	-0.33	0.23	0.25	-0.07	1.00	-0.43	-0.10	0.64
S&P's RAC	0.62	0.50	0.52	0.38	0.48	-0.43	1.00	0.33	-0.17
Moody's Leverage Ratio	0.92	0.93	0.72	0.70	0.92	-0.10	0.33	1.00	0.16
Fitch's Equity to RWA	0.03	-0.04	0.11	0.51	0.33	0.64	-0.17	0.16	1.00

Note: The CAR is calculated using the constant idiosyncratic factors. The correlations for the 'Moody's Leverage Ratio' are multiplied by a factor negative one. Highlighted row demonstrates the correlation relevant prudent CAR measure for the MDB with other capital adequacy metrics. Here w/o denotes without. See note for Table 6.7 for Basel CAR.