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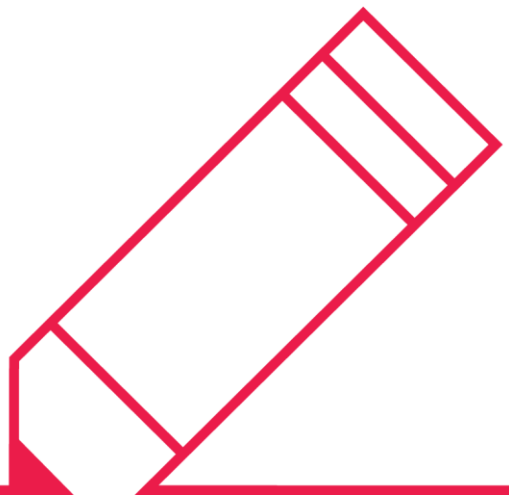
RISK CONTROL

Research Report

Room2Run: the AfDB's Approach to Sharing Risk with the Private Sector



Contents

Abstract

This paper describes the recent Room2Run Synthetic Securitisation of private sector infrastructure loans performed by the African Development Bank (AfDB) and discusses its significance for global development finance. We argue that the transaction, while modest in size, opens the way for Multilateral Development Banks (MDBs) and specialist private sector funds to channel investment from private sector buy-side investors to Emerging Market (EM) infrastructure projects. The transaction is all the more significant because the development objectives set out in the United Nations 2015 Sustainable Development Goals appear unachievable without radical and innovative approaches to expanding MDB balance sheets.

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1. Introduction

Synthetic securitisation allows banks to transfer to capital market investors the credit risk associated with their loans. In this way, securitisation has been widely used by commercial banks to economise on regulatory and economic capital. European Banking Authority (2015) summarises the growing European market in bilateral Synthetic Securitisation Transactions (SSTs). Although initially used to remedy shortages in regulatory capital, the SST market has grown substantially in recent years as issuers have employed securitization to optimize economic capital and to offset P&L and accounting-driven volatility under reporting standards such as IFRS-9.

When an SST is implemented, the loans involved remain on the balance sheet of the originating bank which continues to act as servicer and lender of record. In return for a premium, investors pledge collateral to the originator, which is available to cover losses on loans included in the securitisation pool. Typically, investors agree to cover losses up to a certain total amount and within a given range. The range is defined by 'attachment' and 'detachment' points. Each such range constitutes a 'tranche'. Tranches vary in seniority depending on how high is the attachment point. Transactions are constructed to satisfy the risk appetite of different investors by assigning to them senior, mezzanine or junior tranches.

In October 2018, the African Development Bank (AfDB) entered into an SST with a group of external investors. The transaction is ground-breaking in that it represents the first time that a synthetic securitisation transaction has been used to transfer risk from the balance sheet of a Multilateral Development Bank (MDB) to private sector investors.[1] The AfDB's SST transaction, known as "Room2Run," involves legacy non-sovereign, infrastructure and financial institutions-related loans. The AfDB's counter-parties are the International Infrastructure Finance Company Fund II (IIFC), a private credit investment vehicle managed by Mariner Investment Group, Africa50, a multi-lateral regional investment fund, and the European Commission. In the deal, the AfDB retains the most senior and the most junior tranches, IIFC and Africa50 invest in a junior mezzanine tranche, while the European Commission holds a senior mezzanine tranche.

This paper examines the significance of the Room2Run transaction and analyses the potential for MDBs to engage in more risk transfer via SSTs.

We argue that the Room2Run deal is highly significant, first, because it demonstrates how MDBs could respond to the considerable challenge they face to expand lending. In 2015, the United Nations published its 2030 plan for Sustainable Development Goals (SDGs). For these goals to be achieved, investment flows to Emerging Market (EM) countries will have to grow considerably. A natural component of the solution is an expansion in MDB lending. Such growth is, indeed, envisaged in the MDBs' recent 'Billions to Trillions' agenda (see MDBs (2015)). However, in the absence of capital increases, it is hard to see how MDBs could boost lending enough to make more than a marginal contribution to the UN's SDGs.

One might ask why can MDBs not boost their lending in any case? As unregulated financial institutions, MDBs are apparently free to decide the scale of their own lending. But MDBs operate by leveraging a rather narrow equity capital base through borrowing at low cost in international capital markets. Hence, the bond market's perception of MDB credit quality, and specifically that of the ratings agencies, constrains how much an MDB may lend for a given level of capital.

Aware of the constraint that MDBs face to maintain their ratings, the G20 encouraged MDBs to optimise their balance sheets, see G20 (2014). The G20 lists seven steps that MDBs could take in this regard including such examples as exposure exchanges between MDBs and consolidation of the balance sheets of concessional lending windows. A noteworthy element in the list of MDB actions suggested by the G20 is to explore synthetic securitization. AfDB's recent SST transaction is the first response by MDBs to this call from the G20.

The second reason why the Room2Run transaction is highly significant is that it establishes a new channel for investment in EM assets by developed country investment funds and the underlying limited partners that comprise these vehicles. We argue that an originating MDB and institutional investors with expertise in due

[1] Section 3.5 provides information on comparison transactions.

diligence and risk transfer technologies such as securitisation can offer a highly effective channel to invest savings into less correlated investment risk.

Such a channel is welcome because private sector financing flows to EM economies have largely stalled in recent years despite the fact that, with historically low interest rates, buy-side institutions have been in desperate search of yield. For most institutional investors, investing in EM countries is daunting. The selection and monitoring of assets in these markets are challenging since they entail as is navigating an investment environment that depends heavily on government decisions.

MDBs may be seen as highly effective mechanisms for evaluating, monitoring and servicing EM loans. This is the view expressed by Buiter and Fries (2002) and Perraudin and Yang (2018). Both studies endeavour to characterise the special role that MDBs play in capital markets. MDBs develop close relations with national governments and other public sector bodies. This engagement brings them so-called Preferred Creditor Treatment in their sovereign lending in that their claims are treated as senior even when this is not reflected in legal agreements.[2] In non-sovereign lending as well, MDBs enjoy unusually low default and Loss Given Default (LGD) rates thanks to their mostly conservative underwriting standards and links with national governments.

Partnership between an MDB and specialised buy-side funds (exemplified in the recent AfDB deal by Mariner and Africa50) providing specialist due diligence and risk transfer expertise, can produce a highly effective channel for investment flows from Developed Country (DC) savings institutions to EMs. The use of securitisation permits the investment risk to be parcelled out to different participants in the deal so as to match their respective levels of risk appetite.

We argue that there is considerable potential for more transactions resembling the Room2Run deal. We examine, using public data, the scope for MDBs other than AfDB to implement similar transfers of risk to private sector investors. For those with relatively risky corporate exposures, the scope seems to be considerable. A crucial factor is how such deals are evaluated by ratings agencies. Of these, Standard & Poor's (S&P) is particularly important because it evaluates MDB capital adequacy using a detailed quantitative methodology.[3]

To explain, S&P's approach to assessing MDBs (termed the Risk Adjusted Capital Framework or RACF) involves calculating Risk Weighted Assets (RWAs) for an MDB, subject to several adjustments.[4] A key challenge for the AfDB in implementing the transaction chronicled in this paper was clarifying with S&P what risk weights it would assign to the tranches in the deal that AfDB would retain. The agency ultimately agreed what one might term a 'mini-RACF' approach in which the Risk Weights employed in the RACF are themselves applied in deducing the RWAs for the senior tranche in the deal that an MDB would typically retain.

S&P recently published a note explaining the approach it took in assessing the recent AfDB deal. Minor and broadly reasonable extensions and clarifications of this mini-RACF approach would further boost the scope for use of Synthetic Securisation Transactions (SSTs) like the AfDB deal by other MDBs.

An important open issue remains what scope is there for MDBs to securitise *sovereign* loans? The G20 steered clear of an explicit suggestion for this in G20 (2014) and it has remained a controversial issue with some suggesting that such transactions could affect the PCT that MDBs enjoy. Perraudin and Yang (2018) argue that, if MDBs retain sufficient 'skin in the game' in their sovereign loans, there is little reason to believe that MDB PCT would be affected by a programme of sovereign loan securitisation.

The remainder of this paper is organised as follows. Section 2 explains motivations for the transaction. Section 3 describes the mechanics of the transaction. Section 4 discusses the main challenges participants in

[2] This refers to the market practice, Preferred Creditor Treatment (PCT), whereby financially distressed sovereigns treat MDB claims as senior even without a formal legal basis.
[3] In a recent Request for Comment (4 January 2019), related to updating its rating methodology for MDBs, Moody's has also proposed to include securitisation formally as a positive factor in its evaluation of an institution's credit quality.
[4] The adjustments are for diversification, Single Name Concentration (SNC) and, for sovereign MDB loans, Preferred Creditor Treatment (PCT).

the transaction faced with the primary issue being the clarification of rating agency treatment. Section 5 explains future implications of the transaction. Section 6 concludes.

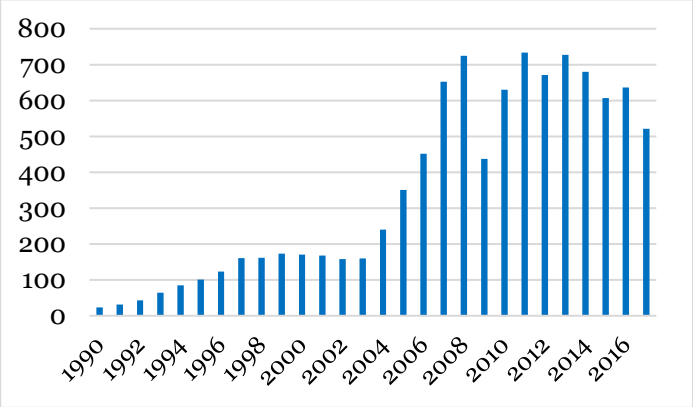
2. Motivations for the transaction

2.1 The 2030 Development Agenda and MDB Balance Sheet Optimization

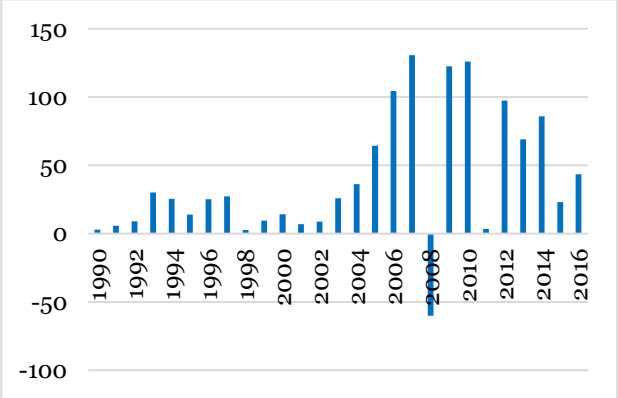
The United Nations (2015) sets out a development agenda for 2030 consisting of 17 Sustainable Development Goals (SDGs) covering social and economic development issues. The 2030 agenda contains extremely ambitious objectives[5] and it has been apparent to the MDB community that contributing substantively to the achievement of the SDGs (and also to the objectives of the Paris Climate Agreement) will require a major boost to MDB lending.

Figure 1: Financial Flows to Emerging Market Countries

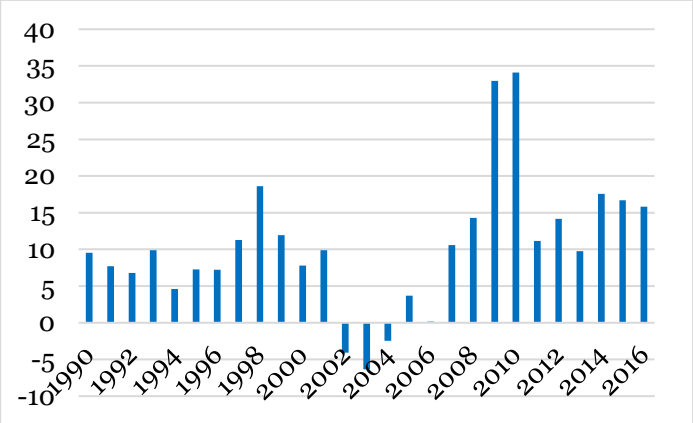
Panel a) Net foreign direct investment inflows



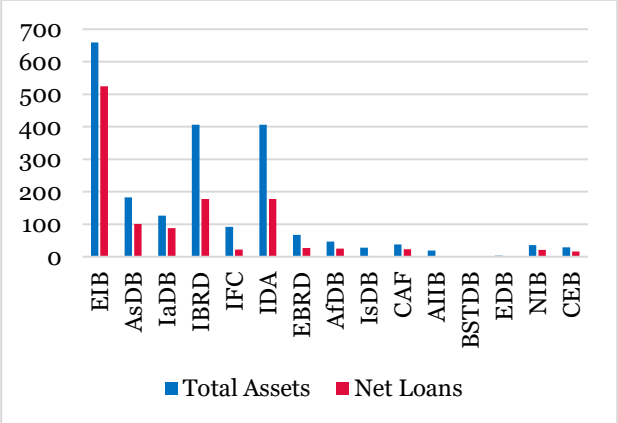
Panel b) Net portfolio investment, equity inflows



Panel c) Net MLI financial flows



Panel d) Total claims for MDBs



Note: The source for Panels a), b) and c) is the World Bank database. For Panel d), the data source is S&P (2018a) and corresponds to the entire balance sheet for an MDB. Figures are in current USD billions.

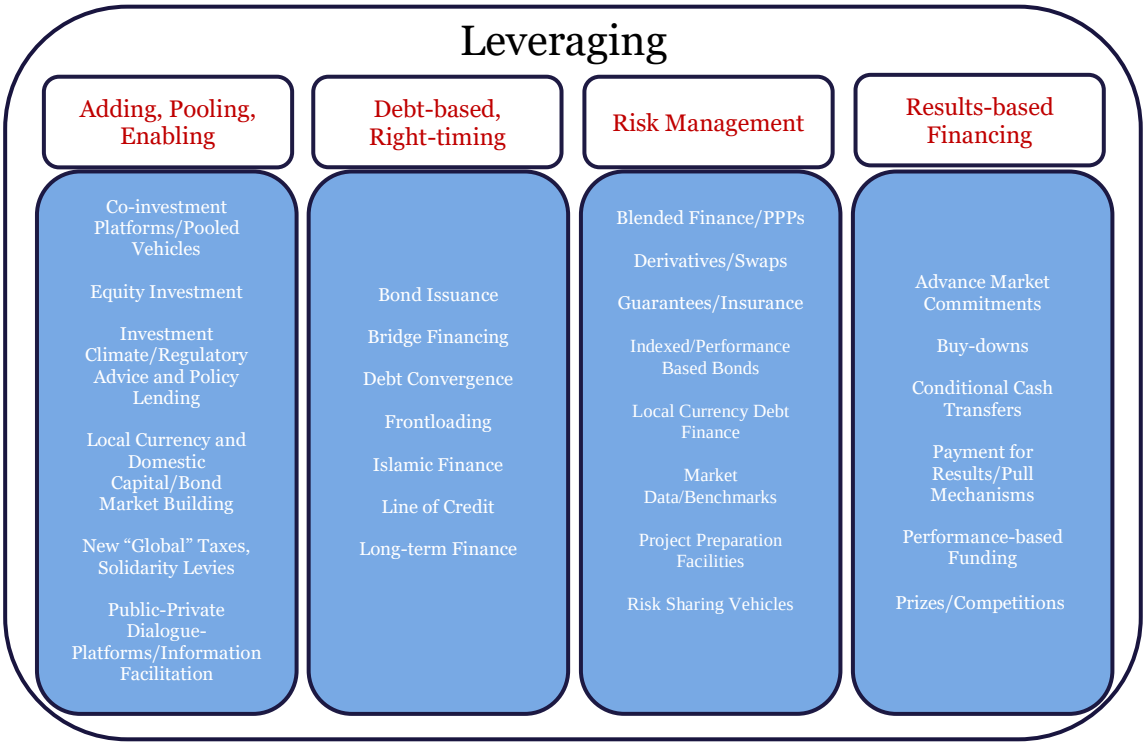
To understand the scale of the challenge, consider the data in Figure 1. Panels a) and b) show Foreign Direct Investment (FDI) and equity portfolio investment, respectively, while Panel c) shows net financing flows from Multilateral Lending Institutions. The data show that financial flows to EM countries rose markedly

[5] In its own words: "This Agenda is a plan of action for people, planet and prosperity. It also seeks to strengthen universal peace in larger freedom. We recognize that eradicating poverty in all its forms and dimensions, including extreme poverty, is the greatest global challenge and an indispensable requirement for sustainable development." See United Nations (2015).

from 2004 to 2008. In 2008-2009, both FDI and portfolio investment fell after the Lehman Brothers collapse with portfolio investment showing particular weakness. Portfolio investment also fell in 2011 after the European sovereign debt crisis. Broadly speaking, private sector flows have remained at relatively high levels established by 2007 but have not progressed beyond that point. Net flows from MLIs exhibit a counter-cyclical pattern, partially offsetting the 2008-9 shocks in 2009 and 2010. The scale of net MLI lending is no more than a fraction of portfolio flows (except in 2009 and 2010) and is very small compared to FDI flows. In recent years, MLI flows have not exceeded levels observed in the late 1990s. Panel d) in Figure 1 shows the assets and loan books of several prominent MDBs. The largest MDB by assets and loans, the EIB, is relatively less involved in lending to lower income countries. Several other large institutions (for example the EBRD) are also largely focussed on lending to middle income countries.

In April 2015, a group of major MDBs published their response to the 2030 agenda in a document entitled "From Billions to Trillions: Transforming Development Finance Post-2015 Financing for Development: Multilateral Development Finance." This document provides a comprehensive list of steps and approaches that MDBs could follow to boost the scale and the impact of their development financing. A flavour may be obtained from Figure 2 which reproduces a graphical summary contained in MDB (2015).

Figure 2: The MDBs Billions to Trillions Agenda



Listing different forms of development finance, however, does not acknowledge the primary constraint that MDBs face in responding to the 2030 Agenda. As unregulated financial institutions, MDBs are ostensibly free to decide their own borrowing and lending objectives. However, their business model entails leveraging equity they receive from sovereign shareholders by borrowing in the international bond market. If MDBs are to lend on favourable terms, they must themselves be able to borrow cheaply and, hence, must retain high credit standing.

The gate-keepers to the bond market are ratings agencies that are responsible for evaluating the credit quality of issuers' bonds. The role that the rating agencies have come to play in constraining the lending ambitions of MDBs has been widely discussed. Of the three major agencies, until now Moody's and Fitch have employed largely qualitative assessments whereas Standard & Poor's uses an elaborate quantitative framework known as the Risk Adjusted Capital Framework (RACF). This framework mimics the Basel framework for regulatory capital in that it reduces the assessment of a bank's capital adequacy to a calculation based on a weighted average of the bank's assets (the weights being selected to reflect the relative

risk of different asset categories). The formulaic nature of the S&P approach (even though the agency includes additional judgmental elements in its rating assessment) leads MDBs to treat the RACF as a direct constraint on expansion in their balance sheets.

Keen to see MDBs expand their lending and aware of the rating constraints, G20 governments began "in 2013 [...] calling on MDBs to work through their Boards to optimize balance sheets, in order to increase lending without substantially increasing risks or damaging credit ratings" (see G20 (2015)). This ultimately led to the G20 issuing an explicit Action Plan to optimise MDB balance sheets at its 2015 Toronto meeting (see G20 (2015)). Furthermore, in 2016, the G20 presented an Action Plan on the 2030 Agenda for sustainable development which promoted the mobilization and responsible use of all sources of financing including private financing to achieve all the SDGs. The G20 continues to encourage the optimization of MDBs balance sheets.

The G20's ideas on balance sheet optimization include multiple elements all aimed at permitting an expansion in the lending of MDBs without impairing their ratings. The elements include: (i) increase in capital efficiency, (ii) sovereign exposure exchanges among MDBs to take advantage of diversification opportunities, (iii) consolidation of concessional lending window balance sheets, (iv) transfer of non-sovereign risk to the private sector, (v) net income measures to improve the bank's capital position.

The fourth item in this list (which is the most relevant for this study) states: "MDBs should evaluate a full range of instruments that share risk in their non-sovereign operations with private investors, including syndications, structured finance, mezzanine financing, credit guarantee programs, hedging structures and equity exposure. This can allow the Banks to free up risk capital or crowd in additional resources for global development efforts. Instruments to transfer risk in sovereign operations – such as through guarantees or concessional finance from donors – should also be considered."

Within the MDB community, a strong advocate for the billions-to-trillions agenda was the World Bank's president J.Y. Kim. In 2017, Kim has said that "We knew that to meet what are now called the global goals, the world had to move the discussion from 'Billions' in official development assistance to 'Trillions' in investments of all kinds: public and private, national and global, in both capital and capacity." At the 2017 second round table, Kim said that "The scale of investment needed to meet the Sustainable Development Goals, address the infrastructure financing gap, and meet ever-rising aspirations means that we cannot continue business as usual. We need to maximize financing for development by leveraging the private sector and optimizing the use of scarce public resources".

2.2 Constraints on MDB Lending

As mentioned above, high credit standing reflected in rating agency evaluations allows MDBs to borrow funds from capital markets at cheaper rates than sovereign borrowers but the requirement of maintaining a high rating constrains their lending options. Humphrey (2015) expresses the trade-off as follows: "MDBs face restrictions on their ability to expand financing activities. The reasons behind these restrictions are many, including economic and political difficulties to additional shareholder capital contributions at the World Bank and major regional MDBs, as well as shareholder-imposed statutory and policy limits on leverage and portfolio growth. But one particular constraint that increasingly occupies the minds of treasury and risk officials at MDBs is the way in which MDBs are evaluated by the major credit rating agencies (CRAs)."

In their response to the G20 Action Plan for MDB balance sheet optimisation, the MDBs themselves described the trade-off in the following terms: "paramount, in both the G20 Action Plan and the MDB response, is balancing the objective to maintain the MDB's triple-A credit ratings with the ambition to increase lending towards achievement of the Sustainable Development Goals (and at the same time, maintain ability to provide this financing during cyclical downturns)," (see MDB (2017)).

We dwell on this point for a moment because the notion that MDBs are constrained in their lending has been denied by some. Specifically, S&P itself has published studies claiming that MDBs' have considerable 'headroom' in their lending in that MDB loans could expand by more than $1 trillion without any downgrades in their ratings (see S&P (2017a)). Several other studies have performed comparable calculations since then. Settimo (2017), Humphrey (2018) and Munir and Gallagher (2018) estimate that

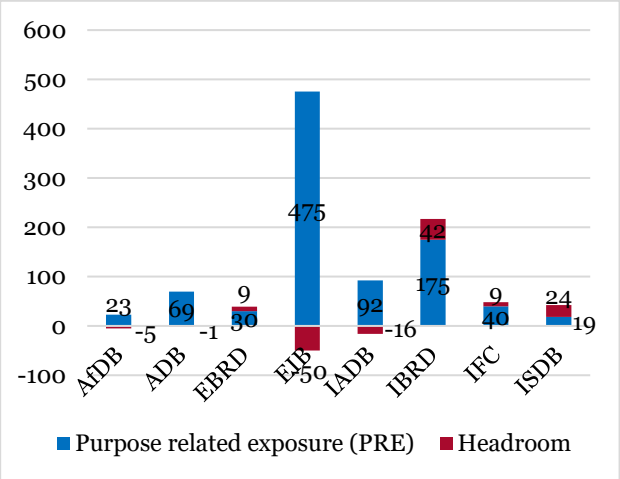
AAA-rated MDBs could collectively boost their lending by $785 billion, $334 billion, $598 billion, respectively without experiencing rating downgrades.

These calculations offer an alluring picture of expanding MDB balance sheets with no apparent cost in lower credit quality. However, they rely on the assumption that callable capital is equivalent to paid in capital. MDBs are actually loath to manage their balance sheets in ways that explicitly rely on callable capital since they and their shareholders would be very highly averse to a forced capital call. Figure 3 shows lending headroom for prominent AAA-rated MDBs leaving out of account callable capital (see Panel a)) or treating callable capital as equivalent to paid in capital (see Panel b)).

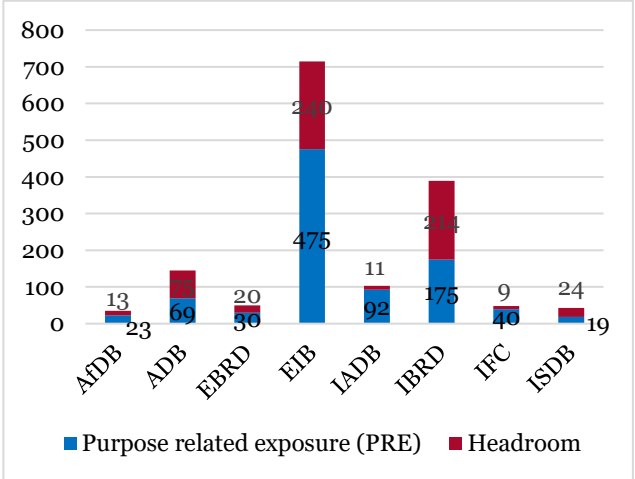
It is clear from the Figure 3 that lending headroom is actually negative for some MDBs when callable capital is left out of account. When callable capital is treated the same as paid-in capital, there is significant headroom for some institutions (in this our estimates resemble those of Humphrey and Munir and Gallagher) with the bulk being for the two largest MDB institutions, EIB and IBRD. Gearing up lending by relying on callable capital appears questionable. The kind of crisis that would lead to a capital call is so extreme that multiple MDBs and sovereign governments themselves would likely be affected.

Figure 3: MDB Lending Headroom

Panel a) Optimizing RWA without callable capital



Panel b) Optimizing RWA with callable capital



Note: The figure shows for a set of AAA-rated MDBs the banks' actual Purpose Related Exposure (broadly loans and guarantees) and the additional PRE that they could issue without losing their AAA status. The left-hand panel shows results leaving out callable capital. For three MDBs, the headroom, ignoring callable capital, is actually negative suggesting that callable capital is key in sustaining the bank's AAA rating. The right-hand panel shows headroom for the banks under the assumption that callable capital by AAA shareholders is equivalent to paid-in capital. One may observe that most MDBs have significant headroom by this measure. The largest headroom volumes are for EIB and IBRD, each of which has headroom equal to substantially more than the total for all the other MDBs.

2.3 Mobilising private sector risk capacity

Another theme in G20 communiques has been encouragement for MDBs to work with private sector investors in generating development finance. In its 2017 Hamburg Action Plan, the G20 welcomed work by MDBs on "crowding-in private finance" and endorsed the "MDBs' Joint Principles and Ambitions on Crowding-In Private Finance ("Hamburg Principles and Ambitions")". The G20 launched a G20 Africa Partnership as part of the achieving the SDG in Africa in order to foster sustainable and private investment, including in infrastructure, especially through the initiative 'Compact with Africa'.

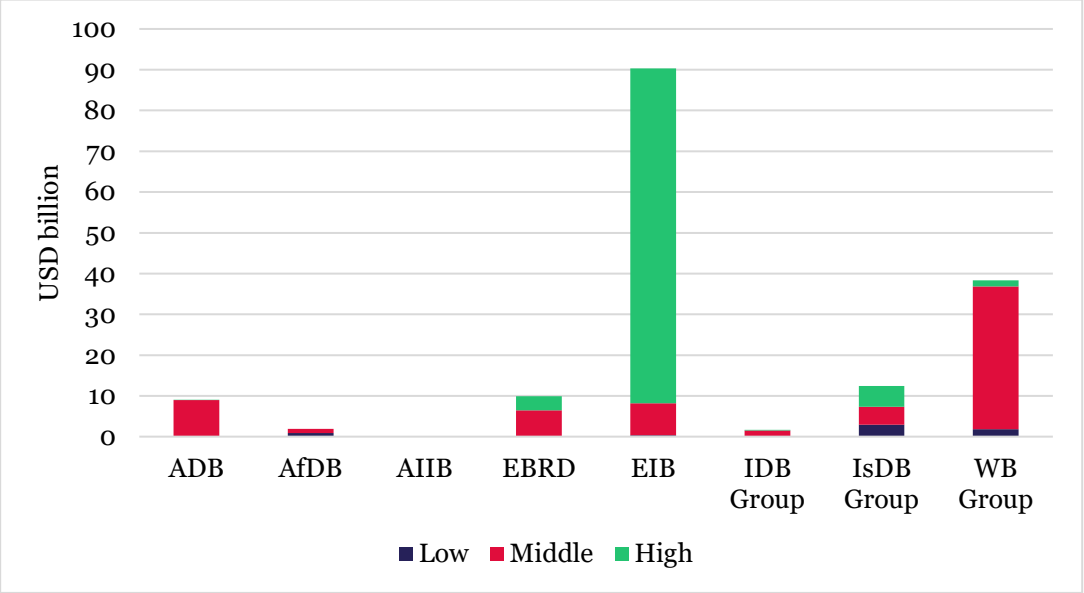
MDBs have taken a number of steps to attract and facilitate investment from private and institutional investors in development finance projects. One such initiative is the Managed Co-Lending Portfolio Programme (MCPP)[6] launched by IFC. This aims to enable private institutional investors to invest directly in emerging market infrastructure projects. Under this initiative, IFC invests in the junior tranche, a portion of which is guaranteed by the Swedish International Development Cooperation Agency (Sida) in exchange for a

[6] IFC (2017).

premium. Institutional investors may invest in the senior tranche. Other comparable initiatives include ADB's credit-enhanced project bonds and EBRD's syndicated loan activities.

Figure 4 shows the private and institutional investors total long-term co-financing investments for different MDBs as reported in a joint statement by the MDBs in 2016. For 2016, the total long-term private and institutional investor financing amounts to an impressive figure of USD 163.6 billion. But the large majority of investment flows are to middle- and high-income countries, 40% and 56% respectively. Only 4% represents investment in low income countries. In contrast, AfDB's activities are primarily in low- and middle-income countries, with 45% and 55% of its total private financing respectively being to such countries.

Figure 4: Mobilization of private sector financing



Note: This table shows the breakdown of private and institutional investors financing in low, middle- and high-income countries for ADB, AfDB, AIIB, EBRD, EIB, IDB Group, IsDB Group and WB Group. For AIIB, 0.005 USD billion is invested in middle-income countries. Source is MDB (2016).

3. Description of the transaction

3.1 Synthetic securitisation

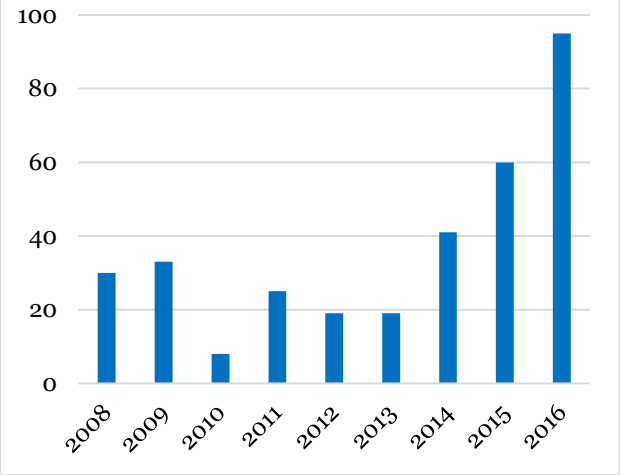
This section describes the Synthetic Securitisation Transaction (SST) implemented by the AfDB. Since the financial crisis, SSTs have emerged as an important way for banks to transfer risk in order to economise regulatory and economic capital and to reduce provisions volatility. The European Banking Authority provides a detailed introduction to the SST market in Europe, reporting survey-based statistics on the size and composition of the market (see EBA (2015)). Deutsche Bank Research (2017) extends the data and describes the evolution of the market towards simple, plain vanilla structures with much shorter documentation than was previously the case.

The market is bilateral in that deals are typically unrated and are placed privately with buy-side institutions such as hedge funds, pension funds and insurers. The data in Figure 5 shows steady growth in issuance since 2013 and indicates that the large majority of underlying assets are either large corporate or SME loans. The impetus to SST issuance has largely been attributable to the relatively conservative nature of risk weights for corporates under Basel 3 rules. The introduction in Basel 3 of Standardised Approach floors to Internal Ratings Based (IRB) capital is likely to increase further the pressure on banks to transfer the risk of their corporate exposures through SSTs or other measures (see Bernardi, Perraudin and Yang (2016)). Figure 5 shows the evolution of SST issuance in Europe up to 2016. Since the crisis, volumes grew markedly as banks have tried to economise on the high capital charges for corporate exposures.

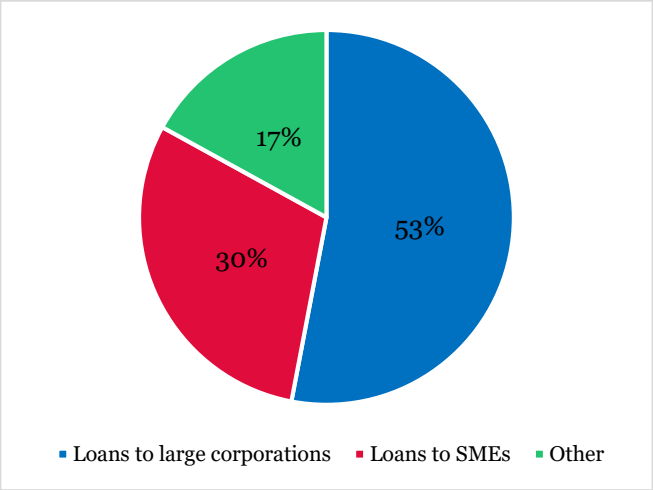
A primary motive for AfDB in transferring risk via an SST is clearly to economise on 'ratings agency capital' rather than regulatory capital (which, although the primary preoccupation of commercial banks, does not apply to AfDB as it is not regulated, per se). Beyond managing 'ratings agency capital', AfDB's objectives are closely comparable to those of commercial bank issuers. Specifically, MDBs and commercial banks share motivations behind SSTs such as the optimisation and turn-over of economic capital (i.e. lending headroom) and reducing P&L volatility driven by the IFRS 9 provisioning requirements.

Figure 5: The bilateral synthetic CDO market in Europe

Panel a) Bilateral SSTs in Europe (EUR billion)



Panel b) EU SST by asset class (% of 2015 issuance)[7]



Note: Volumes reported in a) stem from the activity of 12 large European issuers. Panel b) represents bilateral deals only. Sources are EBA (2015) and Deutsche Bank Research (2017).

3.2 Participants

Table 1 shows the participants in the AfDB SST and their various roles. We shall discuss the tranche structure of the SST at more length below but in summary the AfDB retained the equity tranche and the senior tranche. The Mariner fund International Infrastructure Finance Company II LP, and Africa50 Infrastructure Fund provide *pari passu* funded credit protection for a junior mezzanine tranche while the European Commission has agreed to provide unfunded credit protection for a senior mezzanine tranche.

Table 1: Summary of various participants involved in the SST

Participants	Role
African Development Bank	Originator
European Commission	Investor (Unfunded guarantee)
International Infrastructure Finance Company II, L.P.	Investor (credit protection)
Africa50 Infrastructure Fund	Investor (credit protection)
Mizuho International	Structurers and advisors to AfDB
Clifford Chance	Legal advisors to AfDB
Standard and Poor's	Rating evaluation service
Kroll	Integrity due diligence
Latham & Watkins	Legal advisors to IIFC

Note: This table presents the various participants and their roles in the Room2Run synthetic securitization transaction. The source is AfDB.

[7] It is worth noting that the private nature surrounding many SST deals leads to inaccuracy in estimating the volume and sector distribution of transactions. Structured Credit Investor contends in its 2018 Guide to Capital Relief Trades, "As a private and secretive market, objectively assessing its size – and which trades are making that real difference – is notoriously difficult. SCI data shows around €4bn of deal flow in each of the last few years. Market participants estimate around €30bn of CRT tranches have been placed since the crisis, referencing portfolios of anything up to 12 times that figure" (see SCI (2018)).

Mariner Investment Group, LLC is a US investment advisory firm specialising in management of alternative asset portfolios across a range of markets. Along with those of its associated advisors, Mariner assets under management equal $8.4 billion as of 31 March 2019. One of the funds managed by Mariner is the International Infrastructure Finance Company II, L.P.. This was established to serve as a flexible counterparty to global infrastructure lenders to enhance capital management in the context of increasingly stringent financial regulations.

Africa50 is an infrastructure investment platform that invests in projects that combine public and private sector funding. Africa50 was established as an independent infrastructure fund following the Declaration on the Program for Infrastructure Development in Africa in 2012. It focuses on national and regional projects in the energy and transport sectors.

The new European Commission EFSD Guarantee is part of the EU's External Investment Plan launched in 2017. This plan aims to encourage investment in Africa and regions neighbouring the EU. The European Fund for Sustainable Development (EFSD) combines existing investment facilities and the EFSD Guarantee instrument to leverage additional financing for investments in Africa and the EU Neighbourhood region. The Plan focuses on a number of priority investment areas. These include (i) sustainable energy and connectivity, (ii) micro, small, and medium enterprises financing, (iii) sustainable agriculture, rural entrepreneurs and agro industry, (iv) sustainable cities and digitalization for sustainable development. The EFSD is participating in the SST on the understanding that risk capital released from the SST will be redeployed by the AfDB into renewable energy.

3.3 Loan Pool

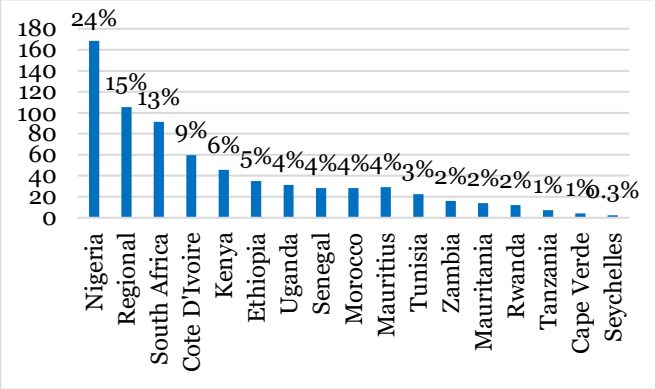
This section describes the Room2Run reference portfolio. The determination of the optimal reference portfolio from the eligible portfolio was a critical factor to achieving the desired risk capital reduction results.

The Room2Run reference portfolio was selected to provide sufficient granularity with no single-obligor representing more than 5% of the reference portfolio. The reference portfolio consisted of 45 loans across 36 obligors, all assets being operational and performing. The portfolio split is approximately 50% project finance loans and 50% loans to financial institutions, including loans and credits to regional commercial and development banks. The loans to financial institutions are lines of credit earmarked for particular development objectives, primarily related to infrastructure.

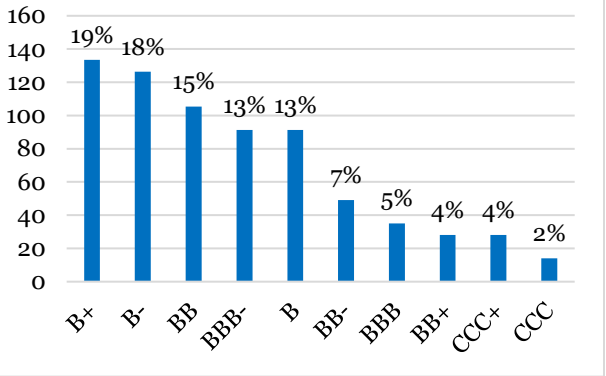
The reference portfolio carries a credit risk profile similar to the AfDB's overall eligible non-sovereign loan portfolio, which exhibits credit quality in the vicinity of B+ equivalent according to AfDB's internal credit scale. The portfolio does not include projects that are in the construction phase, non-performing loans, equity, or loans on a "negative watch" for potential default.

Figure 6: Reference Portfolio Distribution

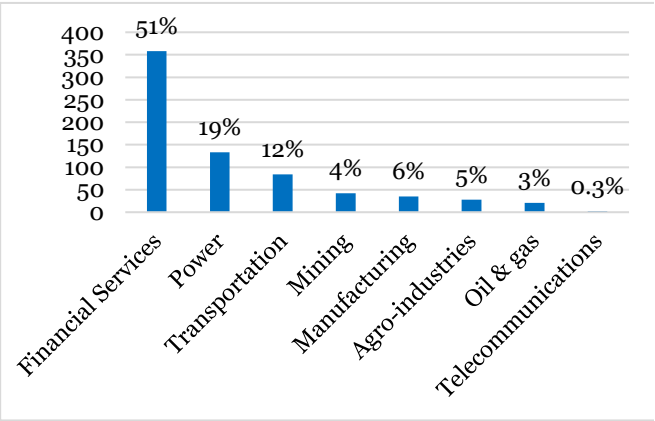
Panel a) Distribution by country



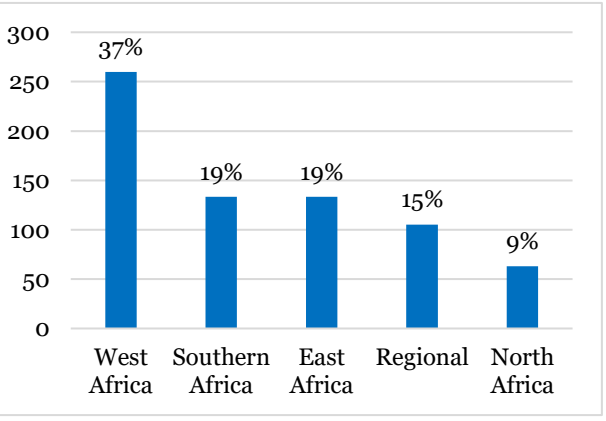
Panel b) Distribution by ratings



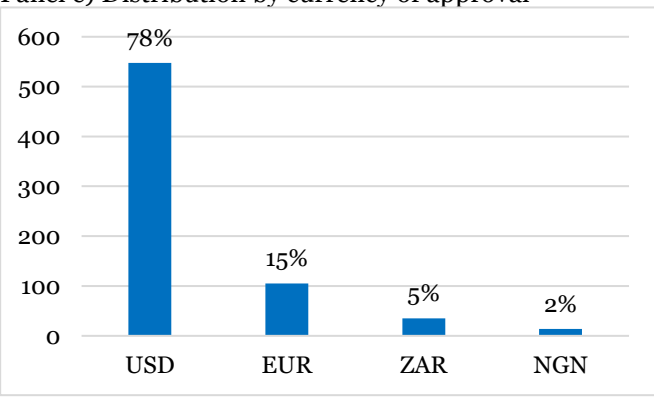
Panel c) Distribution by sector



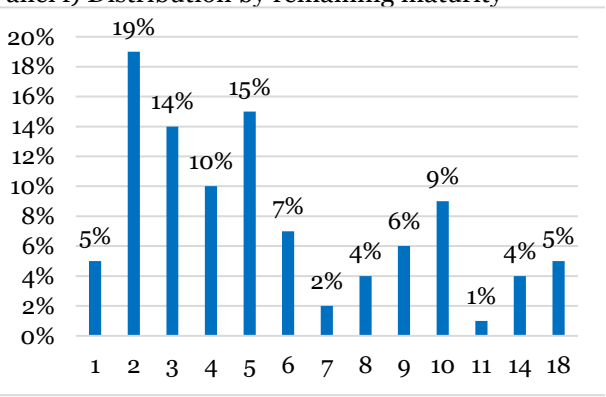
Panel d) Distribution by region



Panel e) Distribution by currency of approval



Panel f) Distribution by remaining maturity

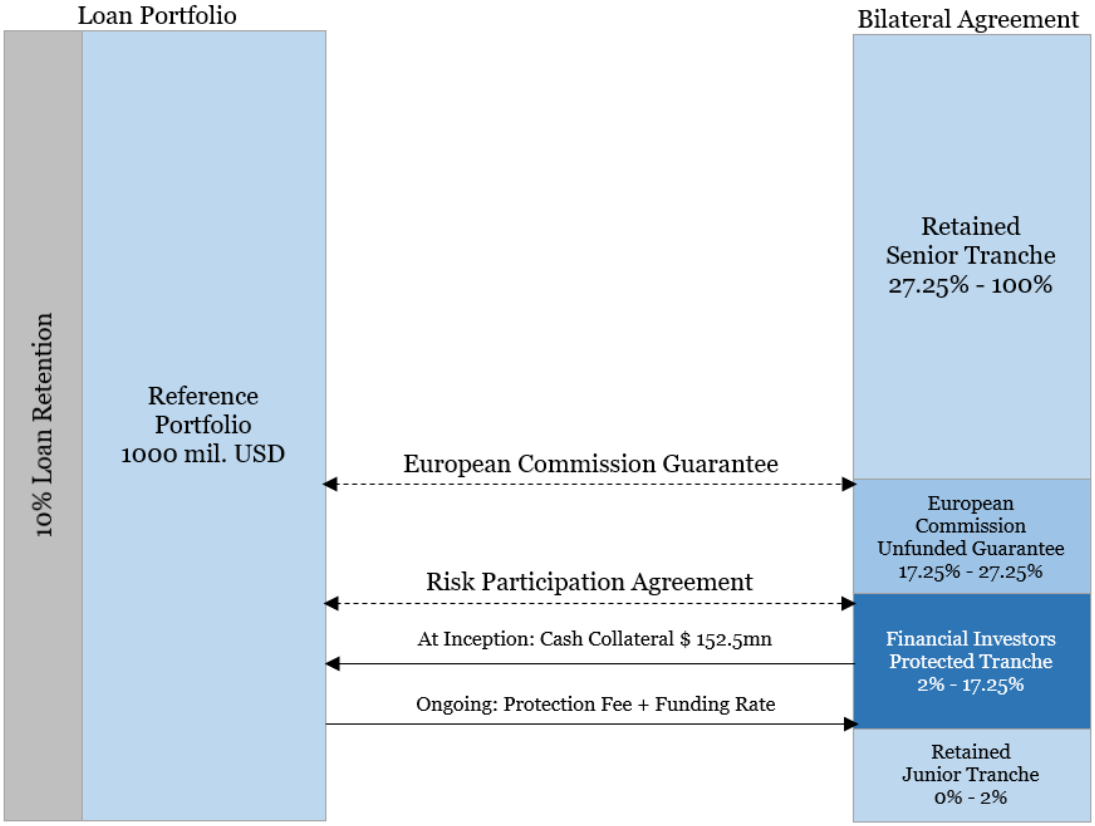


Note: The figures are in UA million. Maturity is in years. The breakdown is as of initial portfolio in October 2018.

3.4 Risk Tranching

The tranching employed in AfDB's SST balances several objectives. These are (i) to economise on capital (rating agency and economic), (ii) to limit the cost of the transaction to the bank, (iii) to be consistent with the pricing expectations of counter-parties, and (iv) to leave the bank with appropriate skin-in-the-game ex post such that it retains the incentive to monitor and manage the credit risk of the loans efficiently. Needless to say, economising on rating agency capital requires that the deal satisfy certain constraints in the treatment of the deal adopted by the ratings agencies and, in particular, S&P.

Figure 7: Structure of the SST



Note: This figure provides an overview of the Room2Run (R2R) Synthetic Securitization Transaction (SST) recently implemented by the AfDB and a group of external investors.

The requirement to have skin-in-the-game has been largely satisfied through the bank's retention of the junior and senior tranches of the SST. Alternative approaches have been employed in other SSTs to ensure that originators remain suitably incentivised ex post. For example, the originator could retain a vertical tranche consisting of a fraction of all the tranches. But the structure adopted by the AfDB is also common in SSTs. The AfDB's junior tranche is relatively thin (0% to 2%), and is slightly less than the Expected Loss on the portfolio (2.73%). As the S&P treatment involves a more than dollar for dollar reduction to the bank's capital saving, a retention of a thicker junior tranche would have been prohibitively costly to AfDB.

The investor group comprising the Mariner and Africa50 funds provides funded credit protection under the SST on a tranche of 15.25% thickness with attachment and detachment points 2% and 17.25%. The European Commission meanwhile provides unfunded protection for a 10% thickness tranche attaching at 17.25%. Key considerations in this structure are pricing and rating agency treatment. SST investors such as those in the investor group expect to earn yields in excess of 10%. This in effect constrains the thickness of the junior mezzanine tranches that could be considered. The S&P treatment of the SST (which will be discussed more below) implies that a tranche with attachment point in excess of 18% could attract a rating of A. While 18% is much less than 27.25%, a significant buffer was necessary to ensure that the AfDB's retained senior tranche retain an A-grade rating in all likely circumstances.

Table 2 summarises collateral arrangements for the SST transaction. The investor group posts collateral through the purchase of a balance sheet note issued by AfDB. Immediately upon purchase, the investors have granted security over such note in favour of AfDB to support their obligations to AfDB under the SST. In this way, AfDB is not exposed to the counter-party risk of either IIFC II or Africa50. The European Commission, meanwhile, is not required to post collateral because of its AA rating.

Table 2: Cash collaterals

Participant	Collateral (mil. USD)
IIFC II	122.5
Africa50 Infrastructure Fund	30
European Commission	-

Note: This table presents the cash collateral provided by the investors to AfDB. Source is AfDB.

3.5 Comparison Transactions

The R2R transaction is highly innovative in that it represents the first occasion that an MBD has synthetically transferred loan credit risk to private sector investors using a securitisation approach. Note that other MDBs have employed securitisation technology. For example, the EIB uses securitisation to obtain credit protection from the European Commission on some of its Junker programme exposure. Furthermore, three decades ago, early on in the development of the securitisation market, IFC performed some securitisation-based risk transfer transactions. In 1995, it securitized $85 million of a $100 million loan to Apasco, a Mexican cement company by issuing asset-backed certificates. Four U.S. insurance companies purchased the certificates at that time.[8] Also in 1995, IFC securitized US$400 million of its own loans to privately-owned companies in eleven emerging markets in Asia and Latin America in order to create headroom for lending in its balance sheet. [9] As far as we know, this was the first issuance of asset-backed securities by a multilateral institution. European institutional investors, including insurance companies, banks, and pension funds invested in these securities.

4. The main challenges

4.1 Capital Relief Recognition Methodologies

In this section, we consider the primary challenges facing MDBs in implementing securitisation-based risk transfers. We start by focussing on the ways in which ratings agencies evaluate such transactions. Both Moody's and Fitch regard risk transfer constructively in the sense of understanding that it may boost a financial institution's capacity to take on risk. Until now, their approaches have been more qualitative than quantitative, however. So, at least when securitisation is pursued to a moderate degree, their methodologies do not directly constrain an MDB's actions. In contrast, the major quantitative element in the S&P approach means its ratings methodology may directly limit the scope for securitisation. More specifically, S&P's treatment of the retained tranches significantly impacts the opportunities to economise on 'rating agency' capital through securitisation.[10]

Under the RACF, S&P applies Risk Weights (RWs) to different tranches of securitisations according to tranche rating. Table 3 shows the RWs corresponding to different ratings according to S&P's 2010 and 2017 RACF methodologies. Thus, a crucial consideration for the AfDB in designing an SST is the rating/risk weight that the agency would assign to the tranches that the AfDB would retain. Since the thin junior tranche is assigned a RW of 1250%, the main issue is how the retained senior tranche will be treated.

How might S&P determine an appropriate rating for a senior tranche of an SST? The agency has an elaborate and well-developed methodology that it employs within its securitisation business for assigning ratings to tranches of different levels of seniority and with different underlying asset pools. The methodology is based on a Monte Carlo simulation of correlated defaults. The agency is transparent about the assumptions employed regarding correlations and recoveries and supplies an Excel-spreadsheet-based implementation

[8] See IFC (1995) and S&P (2001).
[9] See IFC (1995).
[10] Please note that Moody's may follow S&P's example and begin modifying its ratings approach to incorporate the benefit of SSTs for MDBs. In a recent Request for Comment (4 January 2019), related to updating its rating methodology for MDBs, Moody's has also proposed formally to include credit risk mitigation through securitisation as a positive factor in its evaluation of an institution's credit quality.

called CDO Evaluator. The output of CDO Evaluator is a Monte Carlo simulation-based estimate of the distribution of pool losses. The rating of a particular tranche is determined by comparing the attachment point (expressed as a fraction of pool par value) with quantiles of the pool loss distribution.

Table 3: Risk weights under S&P's RACF

Securitization rating	2010	2017
AAA	20	20
AA	20	30
A	50	50
BBB	100	100
BB	626	626
B	1250	1025
CCC-C	1250	1250
Not rated	1250	1250

Note: Risk weights are in percent. The column headed 2010 presents Risk Weights (RW) for securitisation tranches based on S&P's 2010 methodology. The column headed 2017 shows the RWs implied by S&P's 2017 methodology.

To illustrate, suppose that a CDO Evaluator simulation implies that the attachment point of a tranche equals the 99% quantile of the loss distribution, i.e., pool losses will exceed the attachment point only 1% of the time. If the deal has a maturity of 5 years, using Table 4, one may determine a rating for the tranche of A. The argument is that the tranche attachment point gives the level of pool losses that can be sustained without the tranche suffering any losses. If the tranche for a 5-year deal can withstand a 1% chance of losses, then its rating must be no lower than A (since the threshold for A is 2.027% for this maturity). However, the tranche cannot achieve an AA rating as its attachment point implies that it would not survive a 0.514% level of losses.

Table 4: CDO Evaluator loss quantiles for assigning tranche ratings

Year	AAA	AA	A	BBB	BB	B	CCC
1	0.001	0.018	0.248	0.692	2.637	8.633	21.520
2	0.006	0.074	0.566	1.638	5.805	16.260	36.354
3	0.017	0.172	0.963	2.844	9.345	23.028	46.710
5	0.060	0.514	2.027	5.992	16.984	34.371	59.769
10	0.373	2.339	6.360	16.922	35.516	53.614	74.722
15	1.097	5.621	12.752	29.565	50.443	65.366	81.750
20	2.293	10.166	20.414	41.903	61.863	73.281	86.126
25	3.929	15.602	28.598	53.191	70.707	79.002	89.192
30	5.910	21.541	36.785	63.286	77.735	83.355	91.484

Source: S&P (2016). The tranche rating quantiles for the full range of maturities (1-30) can be found in the S&P methodology document.

The three key inputs to a CDO Evaluator simulation are (i) assumed values for default probabilities, (ii) mean recoveries in the event of default, and (iii) correlations. S&P determines correlations based on diversification across geographical regions and sectors. LGDs are based on country groupings. The LGDs assumed in CDO Evaluator (version 7.3) for BB-rated, senior secured first lien loans are 25%, 40% and 69% for the three country groups (labelled A, B and C) considered by S&P. Most developed countries fall into Group A with a few exceptions such as Italy that has a creditor-friendly insolvency regime which is assigned to Group B. The large majority of African countries are in Group C. (South Africa is an exception being in Group B.)

LGDs have a very direct and proportional impact on quantiles of loss distributions. If LGDs are doubled, so are all the quantiles of loss distributions. So, if an attachment point of 20% is required to obtain an A rating for a deal involving the UK (a Group A country according to S&P), an attachment point of 20% multiplied by 0.69/0.25, i.e., 55%, will be necessary to achieve the same rating for Group C country loans.

In fact, the LGDs typically recorded by AfDB on its infrastructure loans are relatively low, being in the region of 20%. Nevertheless, the rating implied by CDO Evaluator for an AfDB SST are strikingly conservative. Example calculations suggest that an SST in which the AfDB retains a senior tranche attaching at 27.5% and a junior tranche detaching at 2% implies a higher RW for the pool than retaining it on balance sheet, despite the substantial credit protection provided by the structure.

Such paradoxical results commonly arise when inconsistent approaches are employed in calculating capital for on and off-balance sheet assets. Duponcheele et. al. (2013) criticised the degree of non-neutrality early proposals for Basel 3 securitisation capital charges arguing that inconsistencies meant capital could be higher for a senior claim on securitised assets compared with directly holding assets on balance sheet.

Given rating agency regulations, we understanding that customising its CDO Evaluator calibration for MDB SSTs was not possible for S&P to meet the timeline of the R2R transaction. But the agency was willing to consider another treatment for the Room2Run deal that, while different from its CDO Evaluator approach, remained consistent with methodologies already employed by the agency. Specifically, S&P determined that it was possible to apply the RACF itself to assess the risk weight of the senior tranche of an SST. Helpfully, S&P issued a note on how this approach would apply to MDB SSTs (see S&P (2018b)).

To understand how such an approach may be developed, consider the following mental experiment. Suppose a portfolio of loans were to be spun off from an MDB in order to create a new multilateral lender. How would S&P rate the new multilateral lender? If all aspects of the institution (Business Profile, relationship with shareholders etc) were the same for the new entity as for the parent MDB, the rating would largely depend on a RACF calculation based on the spun off loans and the capital with which the new entity was endowed.

A similar 'mini RACF' may be applied in rating the senior tranche of an SST. Collectively, the tranches below the senior tranche provide credit protection to the senior tranche which is comparable to that provided by equity capital. Dividing the par value of these junior tranches by total RWAs for the pool assets yields a quasi-RAC ratio applicable to the senior tranche. A rating for the senior tranche may then be deduced from the set of rating-specific cut-off points that S&P employs with the RACF (see S&P (2017c)). For example, achieving ratings no less than A, AA, and AAA requires RAC ratios exceeding the levels 8%, 10% and 23%, respectively.

Table 5: RWs applied to AfDB's deal

Tranche	RW (%)
Junior tranche	1250
Investor tranche	3
EC tranche	3
Senior tranche	50

In fact, S&P has not gone quite as far as just described in that it has so far been willing only to employ a 'mini RACF' for assigning a rating to senior tranches of single A. The agency's logic in this is that the RWs employed in the RACF are calibrated to an A-grade stress. In other words, the RW for a given asset class is supposed to equal the fractional losses that one may expect on the asset class in question in a crisis that an A-rated bank may be expected to survive. In the RACF calculations, the ratio of a bank's equity to its total RWAs (calibrated at the A-grade level) is compared to a set of cut-off points to assess the institution's rating. Because its Risk Weights are calibrated for an A-grade, S&P has been willing to use them to judge that a tranche is 'at least A-grade' but has not so far accepted the possibility of using cut-off points to assign Risk Weights to tranches consistent with higher tranches.

The RWs of S&P's methodology when we applied it to the Room2Run deal are given in Table 5. Based on our understanding of the S&P 2010 RACF methodology, the Pool Loss Rate (PLR) consistent with an A-grade senior tranche is estimated to be about 18.7%. Since the attachment point of the senior tranche is 27.25%, the rating of the senior tranche is no less than A and so the RW for this tranche is 50%. One reason for AfDB in maintaining such a large buffer (from 18.7% to 27.25%) between the attachment point of the senior tranche and the PLR was the fact that S&P was in the process of changing its RACF RWs for MDBs. The new RWs issued by S&P in December 2018 to bring MDB RWs into line with the 2017 methodology for commercial banks imply substantially higher RWAs for the Room2 Run reference portfolio. When we use this methodology, the PLR for the R2R pool is estimated to be about 22.5% instead of 18.7%.

4.2 Assessment of Value for Money

While commercial bank SSTs are often evaluated in an informal way, as a public institution, AfDB wished to follow a relatively formal approach to considering a transparent measure of Value for Money (VFM). The bank chose to devise its VFM measure based on a benefit to cost analysis. Specifically, VFM is measured using the ratio of the percentage reduction in the RWA (before and after SST) to the percentage reduction in the loan margin.

In this section, we replicate a VFM calculation using public data for the AfDB. It is interesting to employ public data because this may be applied under a range of assumptions to other MDBs and the scope for further SSTs by these institutions may be examined. In applying the approach, we consider a range of different tranche structures and examine which leads to the optimal VFM.

For our public data AfDB calculation, we use as reference portfolio (RP) the 'Financial Institutions (FI)' and 'Corporate' exposures in the AfDB's Non-Sovereign (NS) portfolio.[11] From the most recent S&P rating report for the AfDB, one may infer the NS's EAD and $RWA_{Before\ SST}$. The averaged NS risk weight (RW) is calculated as:

$$RW = \frac{Total\ RWA_{Before\ SST}}{Total\ NS\ EAD} = \frac{RWA_{FI}+RWA_{Corporate}}{EAD_{FI}+EAD_{Corporate}} \quad (1)$$

Here, $EAD_{FI} = RWA_{FI}/RW_{FI}$ and $EAD_{Corporate} = RWA_{Corporate}/RW_{Corporate}$.

The RWA of the Reference Portfolio after SST is given by:

$$RWA_{After\ SST} = \sum_{i=1}^{4} EAD_i \times RW_i \quad (2)$$

Where EAD_i is the outstanding in RP and the RW_i is the corresponding risk weight for i={Junior Tranche, Investor Tranche, EC Tranche, Senior Tranche}. The junior tranche is assigned a RW of 1250%. The investor and EC are assigned a RWs of 3%, which is same as the RW assigned to sovereigns rated AA- and above. The senior tranche is assigned a RW of 50% which is the RW for a A-rated securitization tranche.

The A-grade rating of the senior securitization tranche is based on a calculation of the Portfolio Loss Rate (PLR). The approach we take to estimating this is set out in Box 1. In summary, we find the PLR to be about 18.7% and 22.5% under the 2010 and 2017 criteria, respectively. Since the PLRs are less than the detachment point of 27.25%, the senior tranche is rated A.

We now turn to an analysis of tranching. We will initially analyse the R2R transaction and then subsequently apply the same arguments to possible SSTs by other MDBs.

We consider four tranches: junior (retained), private investor, public investor and senior (retained). Let the thickness of the four tranches be denoted: h_1, h_2, h_3 and h_4. Following the AfDB SST, let the corresponding Risk Weights be 1250%, 3%, 3% and 50%. Assuming the cost of the private investor tranche is c_1 , the cost of the public investor tranche is c_2 and the bank margin is m. It follows that VFM ratio is defined as in equation (3).

[11] Note that the 'Corporate' category is further broken down to 'Corporates' (95%) and 'Construction and Real Estate' (CRE) (5%).

$$f(h) = \frac{\%Reduction\ in\ RWA}{\%Reduction\ in\ Bank\ Margin} = \frac{\left(\frac{RWA_{After\ SST}}{RWA_{Before\ SST}} - 1\right)}{\left(\frac{Margin_{After\ SST}}{Margin_{Before\ SST}} - 1\right)} = \frac{\frac{12.5h_1 + 0.03(h_2+h_3) + 0.5h_4}{RW_{Before\ SST}} - 1}{\frac{m-(h_2 \times c_1 + h_3 \times c_2)}{m} - 1} \quad (3)$$

Our objective is to maximize the VFM ratio, $f(h)$, so we formulate the optimisation problem in equation (4).

$$\max_h f(h) = \max_h \left(\frac{\frac{12.5h_1 + 0.03(h_2+h_3) + 0.5h_4}{RW_{Before\ SST}} - 1}{\frac{m-(h_2 \times c_1 + h_3 \times c_2)}{m} - 1} \right) \quad (4)$$

subject to the following constraints

$$\begin{gathered} h_1 + h_2 + h_3 + h_4 = 1 \\ RW_{Before\ SST} - (RW_1 h_1 + RW_2 h_2 + RW_3 h_3 + RW_4 h_4) \geq 0 \\ h_1 + h_2 + h_3 \geq PLR \\ m - (h_2 \times c_1 + h_3 \times c_2) \geq 0 \\ c_1 = -\frac{1}{\tau} log\big(1 - EL_{Thick}(h_1, h_1 + h_2)\big) + \beta \times h_2^2 \end{gathered} \quad (5)$$

Here, $RW_i, i = 1,2,3,4$ are the RWs of the four tranches.

The constraints may be characterised as follows.

- The first constraint requires that the percentage tranche thicknesses of the tranches sum to 1.
- The second constraint requires that the total RW after SST should be no greater than the total before SST (where the current value is inferred from S&P report).
- The third constraint states that the detachment point of protection should be greater than the PLR so that the senior tranche is rated A.
- The fourth constraint requires that the cost be less than the bank margin. We estimated bank margin m as the weighted averaged of the margins of individual loans from the AfDB R2R deal. We will apply this averaged margin both for AfDB but also, subsequently, to other MDBs.

If the thickness of the investor tranche changes, one might expect that this would be reflected in a different spread c_1. To make the pricing depend on the tranches, we must include additional modelling.

Appendix 2 describes a simple analytical pricing approach. This implies that tranche spreads depend on the attachment and detachment points and on the following parameters: (i) a loan default correlation, (ii) deal maturity, (iii) loan LGD, and (iv) the spread on pool loans. Employing this pricing approach amounts to including the additional constraint that appears in equation (5). This may be summarised as follows:

- The fifth constraint states that the cost of the private investor tranche is the tranche spread, where τ is the maturity and EL_{Thick} can be calculated using equation (A2.7) from Appendix 2.[12]

To take an example, if we assume the following parameter values ρ_{Pool}=15%, $\tau = 6$, LGD=20% and S_τ^{B+}=162 bps (see Appendix 2 for a justification of these assumptions), we obtain an investor tranche spread of 10.78% which is broadly consistent with the spread required by the investors in the AfDB deal.

It should be noted that the analytical pricing model here employed (and detailed in Appendix 2) has several theoretical and practical limitations. It assumes that each individual loan in the securitized portfolio defaults when an associated, Gaussian, latent variable falls below a threshold. The model does not utilize stochastic LGDs, which would allow for greater risk sensitivity and makes a simple assumption about risk adjustment.

In the context of Room2Run, specifically, the approach raises some additional concerns. First, it makes no allowance for concentration risk in that the spread is the same no matter how large or small the size of the exposure.

[12] See Duponcheele, Perraudin, and Totouom-Tangho (2013).

Additionally, as outlined in Appendix 2, there are significant limitations in the way we calibrate the model. In particular, we calibrate risk-adjusted default probabilities in a very simple way based on historical averages of bond spreads and LGD assumptions. Prices are not calibrated, as would be desirable, to traded and observable prices in the market.

In negotiations of risk transfer transactions like Room2Run, comparable investments available in the market are generally highly influential in price negotiation. Due to the private and secretive nature of the securitization market, it is unlikely that data will become available to appropriately account for this critical element of pricing determinations into estimation for similar deals in the future. The lack of benchmarking to market prices may be regarded as a significant drawback of the approach presented here.

4.3 Tranching Results

We begin by analysing the AfDB deal using the VFM approach just described. The results are shown in Table 6. The first two rows show results assuming the same tranching structure as in the R2R SST.

The first row of Table 6 is calculated using loan data corresponding to the actual R2R portfolio whereas the second row contains results assuming that the portfolio is representative of AfDB's entire corporate portfolio (not focussed so much on infrastructure). The Portfolio Loss Rate (PLR) in the penultimate column and the RW before SST show that the credit quality of this latter portfolio is higher than the R2R portfolio. The benefit cost ratio is correspondingly lower. It is interesting to note that our pricing approach implies that the fair spread for the junior and senior mezzanine tranches is 11% and almost zero as compared to the proposed spreads in the deal of 10.63% and 0.15%.

Table 6: Analysis of tranching structure for the AfDB deal

MDB	h2	h3	h4	RW before SST	RW after SST	h2 spread	h3 spread	PLR	Benefit to cost
AfDBR2R	15.3	10.0	72.8	170	62	10.63	0.15	18.3	148
AfDB	15.3	10.0	72.8	98	62	10.63	0.15	9.4	85
20% ceiling for h2 tranche thickness									
AfDB	16.5	10.0	71.5	195	62	11.0	0.15	18.6	142
AfDB	16.5	5.0	76.5	195	64	11.0	0.15	18.6	140

Note: All data are in percent. The calculations reported in the first block use the same tranching structure and pricing as in the actual R2R deal. Row 1 shows results based on the actual R2R portfolio whereas row 2 consists of results for AfDB's entire portfolio assuming half are FI and half are corporate. The results in the second block assume a representative part of AfDB's entire corporate portfolio is securitised and use the optimization to find the optimal tranche thickness for h2 tranche. The thickness of the European Commission tranche is fixed at 10% in row 3 whereas it is set to 5% in row 4. h3 tranche spread is set to be 15 bps. The pricing of the h2 tranche is calculated using the pricing model described above.

The second block in Table 6 contains results for an SST in which the pool is representative of the entire AfDB corporate book but the tranching is allowed to deviate from that employed in the deal. We consider two cases: in row 3 the senior mezzanine tranche is set to 10% whereas in the fourth row it is set to 5%. The VFM ratio is increasing in the investor group junior mezzanine tranche. We limit this tranche thickness to no more than 20% in the second block a constraint that then binds in the optimisation. The fair spread for the junior mezzanine tranche in this case is 11%.

Table 7 shows the results when the tranching analysis is applied to the corporate loans of a set of MDBs. Only MDBs that have corporate loans and for which RW before SST are greater than 74% are considered. We suppose that the weighted average bank margin for these other banks is the same as the figure of 3.8% corresponding to the R2R pool loans.[13] Again, the junior tranche is assumed to be 2% for all banks and that of the senior mezzanine tranche is set to 5% throughout.

[13] We have not been able to find data on the margins charged by different MDBs for their non-sovereign loans. Typically, their websites will say that the spread is determined on a case by case basis for different projects. In fact, the tranching

For banks with relatively high-quality corporate exposures, the VFM ratio attained is lower, there is a relatively low interior maximum for the junior mezzanine tranche thickness, and the benefits derived from securitisation would appear to be relatively low. In these cases, the third constraint listed above prevents the thickness of tranche 2 from being zero.

Note that, if one prices tranches in an actuarially fair way, the benefit to cost ratio for many calibrations is close to monotonically increasing, so the optimal thickness of tranche 2 tends to be high or low. We have assumed in this analysis that spreads include a concentration risk component penalising thick tranches. This leads to the interior tranche optimum. Without this, additional constraints must be placed on the problem to prevent tranche thickness growing or shrinking beyond what is the common market practice. Further details of this are provided in an appendix.

Table 7: Tranching structure for different Multilateral Development Banks

MDB	h2	h3	h4	RW before SST	RW after SST	h2 spread	h3 spread	PLR	Benefit to cost	Loan margin
MDB 1	16.6	5.0	76.4	184	64	11.6	0.15	17.7	136	3.8
MDB 2	16.8	5.0	76.2	151	64	11.4	0.15	14.6	120	3.8
MDB 3	17.0	5.0	76.0	135	64	11.3	0.15	13.0	110	3.8
MDB 4	1.5	5.0	91.5	89	71	78.0	0.15	8.5	67	3.8
MDB 5	16.9	5.0	76.1	144	64	11.4	0.15	13.7	116	3.8
MDB 6	16.5	5.0	76.5	193	64	11.7	0.15	18.4	139	3.8
MDB 7	18.3	5.0	74.7	98	63	10.4	0.15	9.4	73	3.8
MDB 8	0.7	5.0	92.3	79	71	90.2	0.15	7.7	59	3.8
MDB 9	0.1	5.0	92.9	74	72	100.5	0.15	7.1	128	3.8
MDB 10	0.9	5.0	92.1	82	71	86.3	0.15	7.9	62	3.8
MDB 11	17.0	5.0	76.0	138	64	11.3	0.15	13.2	112	3.8
MDB 12	1.0	5.0	92.0	83	71	85.1	0.15	8.0	63	3.8
MDB 13	16.6	5.0	76.4	179	64	11.6	0.15	17.3	134	3.8
MDB 14	1.0	5.0	92.0	83	71	85.1	0.15	8.0	63	3.8
MDB 15	16.7	5.0	76.3	159	64	11.5	0.15	15.3	124	3.8
MDB 16	18.0	5.0	75.0	103	63	10.6	0.15	9.8	79	3.8
MDB 17	16.9	5.0	76.1	141	64	11.3	0.15	13.5	114	3.8
MDB 18	16.9	5.0	76.1	145	64	11.4	0.15	14.2	116	3.8
MDB 19	0.9	5.0	92.1	81	71	87.6	0.15	7.9	62	3.8

Note: All data are in percentage. We consider securitisations of loans representative of the entire corporate portfolio of each MDB. The thickness h3 of the senior mezzanine tranche is assumed to equal 5%, while that of the junior tranche is 2% in all cases.

In any case, the main conclusions to draw from Table 7 are that for multiple MDBs, significant reductions in corporate lending risk weights are available through securitisation. The structure selected by AfDB in the R2R transaction are not too far from what appears optimal for these other MDBs. Another interesting point to note is that the pricing of around 11% is reasonably in line with market practice.

results (although not the optimal VFM level) are unaffected by changes in the margin. The reason may be understood by inspecting the VFM cost-benefit ratio that is maximised. The denominator of the VFM ratio consists of: *(m-expression)/m -1=-expression/m*. So, the ratio itself is proportional to m. Changing *m*, therefore, just changes the optimal ratio without affecting the values of h_2 that maximises it. The only reason this might not happen is if the constraint to the optimisation: $m - (h_2 \times c_1 + h_3 \times c_2) \geq 0$ binds at the optimal value. This does not occur, however, for the cases reported in our results. Note that since the VFM ratio is proportional to the margin, its value *is* affected by changes in the margin.

5. Implications for the future

The AfDB's R2R transaction exemplifies two aspects of an MDB strategy that could contribute significantly to development finance in coming years.

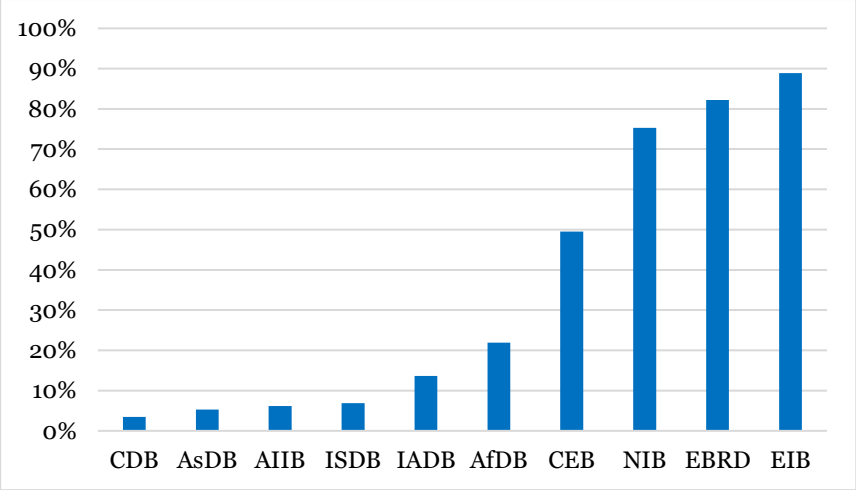
- Risk transfer could permit MDBs to respond substantively to the ambitious objectives set out in the UN's Sustainable Development Goals. The G20 (2015) encourages MDBs to engage in risk transfer, suggesting Exposure Exchanges within the MDB community and corporate loan securitization to non-MDBs.
- SSTs that transfer risk to the private sector could serve to mobilise a much more substantial pool of risk bearing capital than will ever be feasibly available from the public sector.

To these benefits, one may add the potential catalytic effects of involving private sector investment in EM countries. The impact of multilateral lenders in encouraging investment by the private sector has been investigated by several researchers.

Corsetti, Guimaraes, and Roubini (2006) employ a formal model to analyse the trade-off between official liquidity provision and debtor moral hazard. They show how an international financial institution may prevent liquidity runs by coordinating agents' expectations and thereby increasing the number of investors willing to lend to the country for given economic fundamentals. Chapman, Fang, and Stone (2011) present a formal model to show catalytic effects arising from the interpretation by market actors of the IMF's motivation in lending. They conclude that if market actors believe IMF financing and conditionality reduce the risk of financial crisis, they may respond with private investment, creating a catalytic effect[14].

On the empirical side, in an early study, Bird and Rowlands (2000) assess the catalytic effect of IMF and World Bank lending and conclude that the catalytic effect is complex and relatively weak but is still potentially significant. More recently, Broccolini, Lotti, Maffioli, and Stucchi (2018) look for evidence of the mobilization effects of lending by multilaterals on the number of deals and the total size of private inflows. They conclude that MBDs can play an important role in mobilizing private sector financing, contributing to the 2030 Agenda goals.[15]

Figure 8: Non-sovereign lending by MDBs



Note: The figure presents the percentage of non-sovereign lending across different MDBs. Sources are their 2017 annual financial reports. For CEB sovereign refers to sovereign, state owned financial institutions and IFI and non-sovereign refers to sub-sovereign administrations and financial institutions, other financial institutions and non-financial institutions. For AfDB, sovereign refers to public sector and non-sovereign refers to private sector.

[14] The catalytic effect means the effect of IMF program on international investment flows.
[15] In a related study of IMF programmes, Mody and Saravia (2003) examine whether IMF-supported programs influence the ability of developing country to tap international bond markets and whether reduce spreads the at which these countries can issue bonds. The authors find evidence consistent with a positive effect of IMF-supported programs.

A simple but important additional argument is that public lenders may choose to assume some of the fixed costs of establishing new asset classes and pioneering innovative deals forms that otherwise may discourage private sector investment activity. This is likely to be all the more relevant for markets subject to pervasive informational frictions and agency problems like the EM loan market.

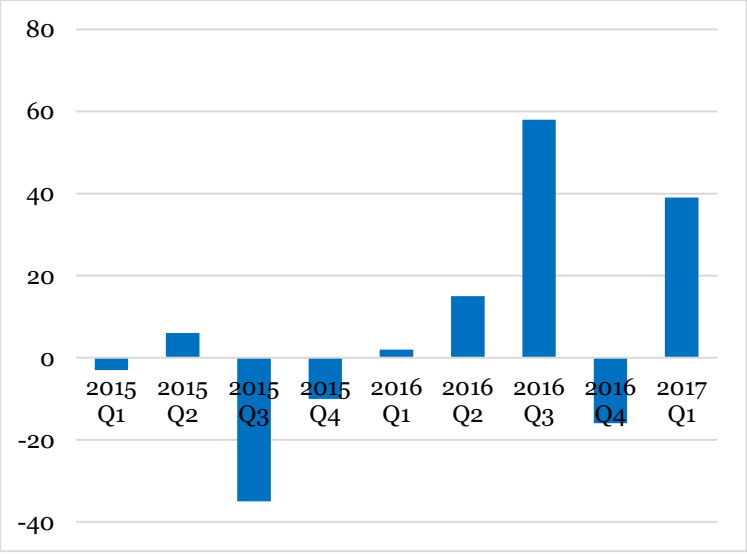
The calculations of the last section suggest that a range of MDBs could substantially cut the Risk Weights on their corporate lending by engaging in SSTs like Room2Run. Furthermore, in many cases the VFM trade-off is comparable in magnitude to that enjoyed by the AfDB. How material would this be in terms of freeing up room for additional lending by MDBs?

Figure 8 illustrates the wide variation across MDBs in the relative importance of corporate lending. For most MDBs, corporate loans represent a relatively small fraction of their total loan book. Exceptions are several of the primarily European multilateral lenders, namely the European Investment Bank (EIB), European Bank for Reconstruction and Development (EBRD), Nordic Investment Bank (NIB) and Council of Europe Development Bank (CEB). All of these lend more than 50% of their loans to the corporate private sector.

While these institutions are engaged in development finance, their primary mandate relates to economic development in medium- or even high-income countries within their immediate region. So, the contribution they can make to poverty reduction and economic development in low income countries is limited as is, in consequence, their effectiveness in boosting the 2030 development goals.
The MDBs that appear in Figure 8 that have mandates to lend to low income EM countries devote significant but not large fractions of their lending to corporate borrowers, with the AfDB being the one institution of this type for which corporate lending exceeds 20% of total loans. These MDBs might choose in future to boost their corporate lending. This would be consistent with statements made by several senior policy-makers in the MDB community emphasising engagement with private sector projects and activities. In this case, SSTs could offer a channel for optimizing economic capital.

But the other implication one might draw from Figure 8 is that, since the bulk of their portfolios consists of sovereign debt, MDBs should consider applying an SST approach to their sovereign loans as well. Perraudin and Yang (2018) discuss at length how sovereign loan securitisation might be viewed by MDB's sovereign lenders which right now crucially bolster the credit standing of MDBs by treating their claims as effectively senior. This Preferred Creditor Treatment (PCT) is widely regarded by ratings agencies and investors in MDB bonds as an important argument for why these institutions should enjoy very fine pricing in international debt markets.

Figure 9: Money flowing in and out of EM Mutual Funds



Note: Source is BNY Mellon (2017). Figures are in $billion

The implications of the R2R transaction for MDB risk capacity are certainly important but one should not ignore the other reason why the deal is of significance: the extension it makes to the range of investments available to buy-side institutions in developed country financial markets. Innovative securitisation transactions often revolve around making a new or previously illiquid asset class available to a wide set of investors. The R2R transaction offers a template for such developments in the case of EM infrastructure loans (and potentially MDB sovereign loans).

The investment channel exemplified by the R2R deal still requires intermediaries. The complexity of due diligence, pricing and structuring means that specialised funds must play an important (if not a key role) role. And, early on as the market develops, it may be that ultimate investors with an ethical focus to investing make a significant contribution to the volume of funds involved.[16]
In the longer run, one might expect that a wider set of investment institutions including EM mutual funds would play a role in the SST market based on MDB-originated loans. Investors commonly access EM debt via mutual funds since secondary market liquidity is often low and trading costs are high.[17] Fund managers often offer funds specialised in different combinations of country/region, currency and product types so as to match investor preferences and risk appetite. As one may see from Figure 9, however, net investment flows in this market remain volatile (as indeed was suggested by the data in Figure 1).

6. Conclusion

This study chronicles the recent R2R Synthetic Securitisation Transaction (SST) between the African Development Bank (AfDB) and a group of outside investors. We describe the nature of the deal, analyse it using our understanding of the models applied by rating agencies and discuss its wider significance for the risk position of the AfDB and for MDBs generally.

The R2R transaction represents a transfer of about a fifth of AfDB's total non-sovereign loans. Since such non-sovereign loans make up about a fifth of the bank's entire loan book, the scale of the transaction remains small compared to the AfDB's overall balance sheet. Nevertheless, the implications of the deal are considerable as R2R opens the possibility of a pipeline of new non-sovereign origination that escapes the normal constraints placed on MDB lending by ratings agency criteria.

We have shown in Section 4 of this paper that similar transactions would be feasible for a number of other MDBs. For these institutions, the Value for Money indicator employed by the AfDB (the ratio of the percentage reduction in the RWA (before and after SST) to the percentage reduction in the loan margin) would be broadly comparable to what has been achieved by the AfDB if tranching were designed appropriately.

A crucial factor in permitting the R2R transaction to proceed was S&P's decision to apply its RACF Risk Weights in determining Risk Weights for the retained senior tranche of R2R, rather than to employ the CDO Evaluator approach typically used in the agency's securitisation ratings business. This decision may have been driven by concerns about the appropriateness of the parameters of the CDO Evaluator for emerging markets. Given our conclusion that SST has important applications for MDBs, this suggests some reconsideration of risk parameters for emerging markets might be appropriate .

S&P's decision to employ what might be termed a 'mini RACF' approach was a sensible step. However, the logic of using the mini RACF for SSTs could be taken further. Because the RACF Risk Weights are calibrated by the agency against a single-A stress, the agency is willing to employ the mini RACF approach to judge that tranches merit Risk Weights consistent with at least an A grade. But it would be possible for the agency to use the different rating grade thresholds in the RACF rules to assign Risk Weights to tranches consistent

[16] The volume of such funding globally is substantial. Socially responsible investing (SRI), or social investment, also known as sustainable, socially conscious, "green" or ethical investing, is any investment strategy which seeks to consider both financial return and social/environmental good to bring about a positive change. The GSIA (2016) estimates the global SRI assets to be $22.89 trillion in 2016 which corresponds to 26.3% of the total managed assets.
[17] The Emerging Market Debt (EMD) asset class primarily consists of bonds issued by entities domiciled in Emerging Market countries. The asset class is subdivided into (i) hard-currency sovereign debt (ii) hard-currency corporate debt, (iii) local-currency sovereign debt and (iv) a small volume of structured debt.

with higher ratings (for example, AA or even AAA). This would extend the approach and make it possible for MDBs considering conservative tranche structures to earn recognition in reduced RWAs.

While the R2R deal is highly significant for MDB finances and development finance more generally, the importance of the deal for the EM debt class should also be emphasised. Developed country investment funds often find it challenging to identify sound debt investments in EM countries. The approach pioneered by the R2R transaction offers a roadmap. MDBs may be thought of as a highly effective origination mechanism. Their experience in selecting and monitoring debt-financed projects in complex investment environments and their engagement with public authorities that typically exert major influence over the success or otherwise of such projects permits them to obtain favourable credit performance from their loans. Combining the MDB 'origination technology' with the expertise in due diligence, pricing and structuring offered by specialised funds specialised in SSTs of bank originated assets creates a replicable channel for significant investment volumes.

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Appendix 1: MDB Lending Headroom

This appendix explains how we estimate lending headroom for MDBs under three types of scenarios: i), No capital increase and no callable capital, ii), No capital increase but include callable capital, iii), 25% capital increase and with callable capital. We assume the ratio between purpose related exposure (PRE) and total RWA after MLI adjustment is unchanged under each scenario.

$$r = \frac{PRE}{Total\ RWA\ after\ MLI\ adjustment} \tag{A1.1}$$

Under each scenario, we first determine the target RAC ratio threshold and infer the maximum RWA given adjust common equity (ACE), and then estimate the lending headroom.

The scenarios we implemented are described as follows.

1. No capital increase and no callable capital scenario - optimizing RWA while maintaining "AAA"

$$headroom = \left(\frac{ACE}{RAC\ ratio\ threshold\ for\ "AAA"} \times r - PRE\right) \times (1 - 25\%) \tag{A1.2}$$

We deduct 25% from the headroom as additional liquidity requirement when expend lending while maintain "AAA" rating.

2. No capital increase and no callable capital scenario - optimizing RWA while maintaining "AA+"

$$headroom = \left(\frac{ACE}{RAC\ ratio\ threshold\ for\ "AA+"} \times r - PRE\right) \times (1 - 50\%) \tag{A1.3}$$

We deduct 50% from the headroom as additional liquidity requirement when expend lending while maintain "AA+" rating.

3. No capital increase and include callable capital scenario – optimizing RWA while maintaining "AAA"

$$headroom = \left(\frac{ACE + "AAA"\ callable\ capital}{RAC\ ratio\ threshold\ for\ "AAA"} \times r - PRE\right) \times (1 - 25\%) \tag{A1.4}$$

Only "AAA" callable capital is included when the target rating is "AAA"

4. No capital increase and include callable capital scenario – optimizing RWA and falling to "AA+"

$$headroom = \left(\frac{ACE + "AAA"\ and\ "AA+"callable\ capital}{RAC\ ratio\ threshold\ for\ "AA+"} \times r - PRE\right) \times (1 - 50\%) \tag{A1.5}$$

"AA+" callable capital is included in addition to "AAA" when the target rating is "AA+".

5. 25% capital increase and include callable capital scenario – Business as usual

Under this scenario, the PRE to capital ratio is assumed to be constant, so the headroom is simply estimated as:

$$headroom = PRE \times 25\% \tag{A1.6}$$

6. 25% capital increase and include callable capital scenario – optimizing RWA while maintaining "AAA"

$$headroom = \left(\frac{ACE \times 1.25 + "AAA"\ callable\ capital}{RAC\ ratio\ threshold\ for\ "AAA"} \times r - PRE\right) \times (1 - 25\%) \tag{A1.7}$$

7. 25% capital increase and include callable capital scenario – optimizing RWA and falling to "AA+"

$$headroom = \left(\frac{ACE \times 1.25 + "AAA"\ and\ "AA+"\ callable\ capital}{RAC\ ratio\ threshold\ for\ "AA+"} \times r - PRE\right) \times (1 - 25\%) \tag{A1.8}$$

Under the 25% capital increase scenario, the additional liquidity requirements are all assumed to be 25% for both "AAA" and "AA+" cases.

We study 8 "AAA" rated MDBs: AfDB, ADB, EBRD, EIB, IADB, IBRD, IFC and IsDB.

We add 10% margin to the RAC ratio threshold. 25.3% for extremely strong financial profile, 16.5% for very strong financial profile and 11% for strong financial profile.
IFC does not have callable capital. None of the sovereigns providing callable capital to ISDB had "AAA" or "AA+" foreign currency rating.

The input data and headroom estimations are shown in Table A1.1.

Table A1.1: Input data and headroom estimations for each MDB

MDB	AfDB	ADB	EBRD	EIB	IADB	IBRD	IFC	ISDB
RAC before adjustments	18	26	15	16	30	23	12	26
RAC after adjustments	20	16	23	15	21	22	21	31
RWA after MLI diversifcation	44.5	104.7	70.4	471.5	126.3	170.3	107.2	25.1
"AAA" callable capital	10.6	25.3	5.7	60.5	10.5	36.9	0	0
"AA+" calabble capital	6.1	22.8	3.4	8.2	50	46.4	0	0
ACE	8.9	17	16.2	69.6	26.3	37.1	22.8	11.2
Purpose related exposure (PRE)	23	69	30	475	92	175	40	19
Business profile	Very strong	Extremely strong	Very strong	Extremely strong	Very strong	Extremely strong	Very strong	Very strong
Required finance profile for AAA	Extremely strong	Very strong	Very strong	Very strong	Extremely strong	Very strong	Very strong	Very strong
Reqiured RAC ratio for AAA	25.3%	16.5%	16.5%	16.5%	25.3%	16.5%	16.5%	16.5%
Required finance profile for AA+	Very strong	Very strong	Strong	Strong	Very strong	Very strong	Strong	Strong
Reqiured RAC ratio for AA+	16.5%	16.5%	11.0%	11.0%	16.5%	16.5%	11.0%	11.0%
No callable capital - optimizing while maintaining "AAA"	0	0	9	0	0	42	9	24
No callable capital - optimizing while maintaining "AA+"	2	0	16	81	12	28	19	28
No Capital Increase Scenarios – Optimizing while maintaining "AAA"	13	75	20	240	11	214	9	24
No Capital Increase Scenarios – Optimizing and falling to "AA+"	28	96	34	396	146	287	19	28
25% Capital Increase Scenarios – Business as usual	6	17	8	119	23	44	10	5
25% Capital Increase Scenarios – Optimizing while maintaining "AAA"	16	88	28	319	25	257	18	33
25% Capital Increase Scenarios – Optimizing and falling to "AA+"	48	157	63	713	241	474	42	57

Note: Source: S&P (2017a) and MDBs annual reports.

The headroom estimations in Munir and Gallagher paper are summarized in table A1.2.

Table A1.2: Financial data and headroom estimations from Munir and Gallagher paper

MDB	AfDB	ADB	EBRD	EIB	IADB	IBRD	IFC	ISDB
ICR	AAA	AAA	AAA	AAA	AAA	AAA	AAA	AAA
SACP	aa+	Aaa	aaa	aa+	aa+	aaa	aaa	aaa
Total callable capital	81.5	135.5	24.8	233.6	164.9	247.5	-	54.8
"AAA" callable capital	10.6	25.3	5.7	60.5	10.5	36.9	-	-
"AA+" calabble capital	6.1	22.8	3.4	8.2	50	46.4	-	-
ACE	8.9	17	16.2	69.6	26.3	37.1	22.8	11.2
Purpose related exposure (PRE)	22.8	69.3	30	475.2	92.4	174.9	39.7	18.6
No Capital Increase Scenarios – Optimizing while maintaining "AAA"	13	69	20	239	11	214	9	24
No Capital Increase Scenarios – Optimizing and falling to "AA+"	21	78	28	396	91	258	18	29
25% Capital Increase Scenarios – Business as usual	6	17	8	119	23	44	10	5
25% Capital Increase Scenarios – Optimizing while maintaining "AAA"	16	88	28	319	25	257	18	33
25% Capital Increase Scenarios – Optimizing and falling to "AA+"	44	159	64	713	241	582	42	57

Appendix 2: Value for Money Calculations

Portfolio Loss Rate Calculation

We need to compute the portfolio loss rate considering the whole of the NS portfolio as the reference portfolio. In the following, for simplicity, we assume a homogenous NS portfolio.

i) Compute the unexpected loss (UL):

$$UL = \frac{RWA_{Before\ SST}}{12.5} = \frac{RWA_{FI}+RWA_{Corporate}}{12.5} \quad \text{(A2.1)}$$

ii) Compute the three-year normalized expected loss (EL):

For financial institutions, the one-year normalized expected loss is calculated as:
$EL_{FI} = EAD_{FI} \times LR_{FI}$, where the LR_{FI} is one-year normalized loss rate which depends on BICRA scores of the FIs.

For corporates this is calculated as:
$EL_{Corporate} = EAD_{Corporate} \times 0.95 \times LR_{Corp} \times 0.75 + EAD_{Corporate} \times 0.05 \times LR_{CRE}$,
where the one-year normalized expected loss rate LRs depend on the economic risk group.

Note that here in calculating PLRs and elsewhere where we compute S&P Risk Weights, we employ what we understand to be the agency's 2010 methodology for MLIs rather than the new methodology announced in December 2018. We use the old methodology because we wish to use data from individual MDB ratings reports which are currently only available under the old methodology.

The underlying BICRA and economic risk groups can be inferred from the averaged RW in the S&P report. The one year expected loss of the entire NS portfolio is calculated as:

$$EL_1 = EL_{FI} + EL_{Corporate} \quad \text{(A2.2)}$$

Then the three-year normalized expected loss is three times the one-year normalized expected loss.

$$EL_3 = 3 \times EL_1 \quad \text{(A2.3)}$$

iii) Compute the total loss (TL) as,

$$TL = UL + EL_3 \quad \text{(A2.4)}$$

iv) This gives the portfolio loss rate (PLR) as:

$$PLR = \frac{TL}{Total\ outstanding\ in\ SST\ RP} = \frac{TL}{EAD_{FI}+EAD_{Corporate}} \quad \text{(A2.5)}$$

Table A2.1: Input data of MDBs for PLR calculation

MDB	Institutions RWA	Corporate RWA	Institutions RW	Corporate RW	Total MLI adjustments	BICRA group	Economic risk group (BICRA)	FI LR (bps)	Corporate LR (bps)	Corporate real estate (LR bps)	PLR
ADB	295,900	707,300	42	146	0	5	7	20	99	297	14.24%
AfDB	346,900	354,100	65	195	0	6	8	37	115	345	18.58%
AfDBR2R	49,700	70,400	141	200	99	9	9	121	133	400	21.69%
BSTDB	47,200	134,700	115	184	0	8	8	87	115	345	17.70%
CABEI	102,600	106,700	56	151	0	5	7	20	99	297	14.64%
CAF	350,800	294,800	29	135	0	4	6	9	85	255	13.00%
CEB	253,000	32,900	28	89	0	4	3	9	53	159	8.49%
EBRD	919,200	2,095,800	32	144	0	4	6	9	85	255	13.72%
EDB	90,100	347,600	100	193	0	7	8	59	115	345	18.42%
EIB	4,650,300	17,583,400	19	98	0	2	4	5	62	186	9.44%
EIF	24,500	23,400	32	79	0	4	3	9	53	159	7.69%
EUROFIMA	57,900	19,500	13	74	0	1	2	4	45	136	7.09%
FLAR	79,300	83,000	23	82	0	3	3	6	53	159	7.93%
IADB	380,500	542,000	32	138	0	4	6	9	85	255	13.24%
IBRD	426,300	8,300	18	83	0	2	3	5	53	159	8.01%
ICD	82,600	71,900	84	179	0	7	8	59	115	345	17.30%
IDA	63,300	3,700	19	83	0	2	3	5	53	159	8.01%
IFC	1,852,000	2,941,900	55	159	0	5	7	20	99	297	15.28%
IIB	22,000	44,800	90	103	0	7	4	59	62	186	9.84%
IIC	66,200	70,000	46	141	0	5	6	20	85	255	13.48%
ISDB	146,600	204,100	45	145	0	5	7	20	99	297	14.16%
NIB	130,300	1,003,900	12	81	0	1	3	4	53	159	7.85%

Note: The source for this data is S&P (2017a).

Tranche Pricing

Consider a perfectly granular portfolio with total par value normalised to equal unity made up of homogeneous 1-period loans. Suppose that a given loan in the portfolio (with subscript i) defaults if a normally distributed latent variable, Z_i, falls below a threshold, $-c$ where $PD = N(-c)$ is the probability of default for each homogeneous loan. We may express the latent variable for the ith loan as follows:

$$Z_i = \sqrt{\rho_{pool}}\ Y + \sqrt{1-\rho_{pool}}\ \epsilon_i \tag{A2.6}$$

Here, Y is a common factor, ϵ_i is an idiosyncratic shock and both Y and ϵ_i are standard normal random variables. Appendix 1 of Duponcheele et al (2013) shows that the Expected Loss (EL) on a tranche attaching at A and detaching at D equals.

$$\begin{aligned} EL_{Thick}(A,D) &= \frac{(1-A)EL_{Senior}(A)-(1-D)EL_{Senior}(D)}{D-A} \\ EL_{Senior}(X) &= \frac{LGD\times\bar{N}_2-X\times PD_{Tranche}(X)}{1-X} \\ \bar{N}_2 &\equiv N_2\left(N^{-1}(PD), N^{-1}\left(PD_{Tranche}(X)\right), \sqrt{\rho_{pool}}\right) \\ PD_{Tranche}(X) &= N\left(\frac{N^{-1}(PD)-\sqrt{1-\rho_{pool}}N^{-1}(X/LGD)}{\sqrt{\rho_{pool}}}\right) \end{aligned} \tag{A2.7}$$

In the above equation, $EL_{Senior}(X)$ equals the expected loss for a senior tranche with attachment point X and $N_2(,,)$ is the bivariate cumulative standard normal distribution function. This formula is well-known in the literature. It resembles expressions in Pykhtin and Dev (2002) and Pykhtin (2004) which, in turn, build on the work of Vasicek (1991).

The inputs we need for the above calculation are the pool exposure probability of default and Loss Given Default denoted *PD* and *LGD*, and the correlation parameter ρ_{Pool}. If we know the Expected Loss on the pool, EL_{pool}, and the pool loan *LGD*, we can infer $PD = EL_{pool}/LGD$ and write equation (A2.7) with inputs EL_{pool} and *LGD*.

The above yields Expected Losses for a thick tranche in terms of pool Expected Losses EL_{pool}, loan Loss Given Default, *LGD,* and loan correlation ρ_{pool}. Both pool and tranche Expected Losses here are under

historical distributions, i.e., they correspond to Expected Losses as used, for example, by rating agencies or accountants calculating provisions.

As is well known in pricing theory, one may derive the values of prices in a frictionless market by calculating expected, discounted payoffs using risk-adjusted distributions. It is important to note that the results expressed in equations (A2.6) and (A2.7) remain correct if one replaces the actual PDs with risk-adjusted probabilities of default. (We will assume here that loss rates given default are constant and hence not subject to risk-adjustment.)

Hence, (A2.6) and (A2.7) represent pricing expressions that may be used to deduce risk-adjusted expected losses for a provider of tranche protection to the pool. To calculate the risk-adjusted expected loss using these equations, requires the inputs of risk-adjusted PD, an LGD rate and a pool correlation parameter.

Consider a pool of credit exposures (bonds or loans) with a given rating R. Suppose we observe the market spread, $S_\tau^{(R)}$, that investors require to hold these exposures. The risk-adjusted Expected Loss, $EL_{Risk\ adjusted}$, for such loans with an EAD of 1 unit may be calculated as:

$$EL_{Risk\ adjusted} = 1 - exp\left[-S_\tau^{(R)}\,\tau\right] \tag{A2.7}$$

Here, τ is the maturity of the loans. $EL_{Risk\ adjusted}$ may be thought of as the discount in value of the defaultable loans because of credit risk. If the loans have a constant LGD, we can infer from this a risk-adjusted probability of default using

$$PD_{Risk\ adjusted} = \frac{EL_{Risk\ adjusted}}{LGD} \tag{A2.8}$$

Note that the LGD one uses to infer $PD_{Risk\ adjusted}$ should be that appropriate to the instruments in question. For example, if spreads are taken from bond markets, one may presume that the LGD is similar to that commonly observed in historical bond market data such as 50% for senior unsecured bonds.

In contrast, the LGD that we employ in evaluating the expression $EL_{Thick}(A, D)$ should then be appropriate to the pool of loans under consideration which may well be lower. Given a value for the correlation parameter ρ_{Pool}, we can infer a tranche spread using:

$$S_{Tranche} = -\frac{1}{\tau} log(1 - EL_{Thick}(A, D)) \tag{A2.9}$$

Note that equation (A2.9) just inverts the relationship between risk adjusted Expected Losses and spread employed in (A2.7) and applies it for the exposure tranche rather than for the pool loans.

In the analysis of SSTs, we employ the above approach. The steps we follow are as follows.

1. We take rating which corresponded to the credit quality of AfDB loans and deduce a reasonable spread from historical averages of bond spreads for the same rating.
2. From an estimate of the LGD appropriate for bonds, we inferred a risk-adjusted default probability, $PD_{Risk\ adjusted}$, for AfDB loans.
3. Using (A2.7) and (A2.9), we then derived an expression for the spread on a given tranche in the SST solely as a function of the attachment and detachment points, A and D.
4. Plugging this expression into the benefit cost ratio, we were then able to optimise this ratio with respect to the detachment point D.

The above approach yields a spread that makes no allowance for concentration risk in that the spread is the same no matter how large or small the size of the exposure. Such a pricing approach implicitly assumes frictionless markets in which investors are only exposed to undiversifiable factor risk. To allow for concentration risk on the part of the investors in tranche 2, we add to the spread a term: $\beta \times h_2^2$. As h_2, doubles, this adjustment quadruples in magnitude.