



Università
Ca' Foscari
Venezia

Dauphine
UNIVERSITÉ



PARIS
SCIENCES
& LETTRES

**Università Ca' Foscari Venezia
Université Paris Dauphine - PSL**

Professional Master Thesis

Double Master's Degree in:
Quantitative Finance and Risk Management
Economics and Finance, International track

Assessing Exchange Rate Risk: risk measures, applications in international development institutions

Examination Committee: Prof. Monica Billio, Prof. Martine Carré-Tallon

Candidate: Andrea Gligor

Ca' Foscari student ID: 907661

Dauphine student number: 22500367

Academic year 2025/2026

Index of contents

1. Introduction.....	3
2. Presentation of my internship	4
2.1 The company and the business model.....	4
2.1.1 Institutional identity.....	4
2.1.2 Regulatory framework.....	5
2.1.3 The business model and financial positioning.....	6
2.1.4 Geographical and currency exposure.....	9
2.2 Organization and position within the company.....	10
2.3 Work and activities carried out.....	10
2.3.1 ALM and Liquidity Management.....	10
2.3.2 GEMs Annual Assemblies.....	11
2.4 First impressions and personal perspectives.....	12
2.4.1 Environment and Company culture.....	13
2.4.2 Personal challenges.....	14
2.4.3 Critical reflection on the sector.....	14
2.4.3.1 Technical observations.....	14
2.4.3.2 Reflections on the GEMs assemblies.....	15
2.4.3.3 Reflections on the LCLF.....	16
2.4.3.4 Motivation and career.....	16
3. Academic Research.....	17
3.1 Literature review.....	17
3.1.1 The Coverage problem.....	17
3.1.2 CAR and P&L balancing: A case study.....	18
3.1.3 The research question and the methodology of the literature review.....	22

3.2 What is exchange rate risk?	23
3.3 The risk measures	25
3.4 Definition of best practice	30
3.5 Case study: the Local Currency Limit Framework	33
3.5.1 The LCLF Methodology	35
3.5.2 Application of the methodology	37
3.6 Impact Study	39
3.6.1 Statistical validation	44
3.7 Application of the literature review on the LCLF framework	48
4. Conclusion	50
4.1 Conclusion	50
4.2 Academic contribution of the training	51
4.3 Personal assessment of the work done and perspectives	53
5. Appendices	54
5.1 Bibliography	54
5.2 Company's Evaluation	56
5.3 Appendix A: AFD's organigram and DSR's structure	58

1. Introduction

This thesis was written during my internship at the Agence Française de Développement. It aims to provide an overview of the institution and of the work carried out within the Risk Executive Directorate (DXR). After this introduction, the company, the business model and the work carried out will be presented. The tasks performed on the investment limits in local currency will play a pivotal role in the content of this thesis, as a bridge between the internship and academic studies. In this context, a case study will be presented to illustrate how the choice of a risk measure can influence an institution's risk assessment and decision making process. The case study will examine the model currently used to compute investment limits in local currencies, highlighting how it could be made more statistically robust against adverse market conditions. Since potential losses arising from local currency exposures could undermine the institution's capacity to fulfill its development mandate, implementing a proper risk measure is a crucial strategic tool that provides management with the insights needed for prudent decision-making. This leads to the following research question:

“What are the best practices in exchange rate risk measurement, and to what extent are they suitable for managing the risks of AFD's local currency exposures?”

The third part, which constitutes the core of this thesis, will be dedicated to answering this question. The literature review will investigate the main risk measures, used in the financial industry, to measure exchange rate risk. Building on this review, the study aims to assess which approaches are the most suitable in the specific context of AFD's activities. This internship concludes my double degree in “*Quantitative Finance and Risk Management*” and “*Économie et Finance*”, jointly delivered by “*Ca' Foscari University of Venice*” and “*Université Paris - Dauphine*”. In this respect, beyond the technical aspects, the conclusion of this work also offers personal reflections on the internship experience and its implications for my academic and professional orientation.

2. Presentation of my internship

2.1 The company and the business model

2.1.1 Institutional identity

My internship was undertaken at the Agence Française de Développement, specifically in the Market Risk and Asset Liability Management Department (RMB). The AFD is the French public development agency founded by General Charles de Gaulle in 1941¹, during the Second World War. Originally under the name “Caisse Centrale de la France Libre (CCFL)”, it is one of the oldest bilateral development institutions in the world. A commonly used definition is the following: financial institutions created by governments with an explicit official mission to fulfill policy objectives. However, due to the heterogeneity of these institutions, there is no consensus on the definition of what a public development bank (PDB) is. AFD acts as an instrument of the French State for development and international aid. Its mission is defined by law (AFD, 2022)², notably in the article L515-13:

“Contribute to the implementation of the State's foreign development aid policy, notably by financing:

a) On a priority basis, access to essential services in least developed countries, and particularly in the priority countries of French development policy³, specifically through grant operations and concessional loans;

b) Global public goods, economic convergence, and the fight against climate change in developing countries; “

The *raison d'être* of the institution shapes its strategy and therefore its operations. The French development strategy is defined by the Committee on International Cooperation and Development (CICID), established by Act no. 2014-773 (Ministère de l'Europe et des Affaires étrangères, n.d.)⁴, chaired by the Prime Minister and ministers responsible for international cooperation. The AFD is the holding institution of two other institutions:

¹<https://www.afd.fr/fr/notre-histoire>

² Agence Française de Développement. (2022). *Statuts de l'Agence Française de Développement*. <https://www.afd.fr/sites/default/files/2022-03-05-26-43/statuts-afd.pdf>

³ Benin, Burkina Faso, Burundi, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Ethiopia, Gambia, Guinea, Haiti, Liberia, Madagascar, Mali, Mauritania, Niger, Senegal, Togo. French Ministry for Europe and Foreign Affairs – *Geographical Priorities*

⁴ Ministère de l'Europe et des Affaires étrangères. (n.d.). *Development assistance*. <https://www.diplomatie.gouv.fr/en/french-foreign-policy/development-assistance/>

Expertise France and Proparco. They share the same purpose as the AFD but due to the complexity of the task, each firm is specialized in order to tackle development issues in the appropriate way. Expertise France⁵ is the consultancy branch of the AFD, second in size in Europe, focused on strengthening public policy in France's partner countries through the creation of projects, providing support and knowledge. Proparco⁶ is the branch that focuses mainly on the private sector: it provides financing to private actors in order to support their contribution to the sustainable development objectives.

2.1.2 Regulatory framework

The AFD has a dual legal classification: a Public Establishment of an Industrial and Commercial nature (EPIC) and also a financial firm. In other words, it can be described as a public institution with a defined development-centered mandate that operates like a bank. This classification is defined in its statutes. It is supervised by the ACPR (*L'Autorité de contrôle prudentiel et de résolution*), which is the supervisory authority attached to the *Banque de France*. Due to this dual status, the AFD is highly regulated: it must comply with banking prudential regulations and with standards set by the OECD (*Organization for Economic Co-operation and Development*), in particular the DAC (*Development assistance committee*). This regulatory framework reflects policymakers' intent to mitigate negative externalities and to define clear risk-taking boundaries, notably:

- Reputational risk
- Mission drift risk
- Systemic risk
- Business continuity risk

Being the arm of the French state, AFD's investments have a non-negligible reputational risk exposure that needs to be accounted for. If the bank defaults, the consequences are not only financial but also reputational. AFD's funds must be used for investments whose objectives are linked to the institution's mandate; the bank cannot invest in projects that have a negative impact or go against the values expressed in its statute. Due to its role in the economy and its budgetary capacity, the AFD plays a countercyclical role both in France and in the countries where investments are made. If the bank were to default, it could start a systemic crisis, endangering

⁵Expertise France. (n.d.). L'agence française de coopération technique. <https://www.expertisefrance.fr/>

⁶Proparco. (n.d.). *Accueil*. <https://www.proparco.fr/>

multiple countries. Phenomena like moral hazard or excessive risk-taking could undermine the business continuity of the firm, causing financial damage to all AFD's stakeholders. To preserve its role, dedicated legislation was put into place.

2.1.3 The business model and financial positioning

The AFD business model and environment are presented in Figure 1:

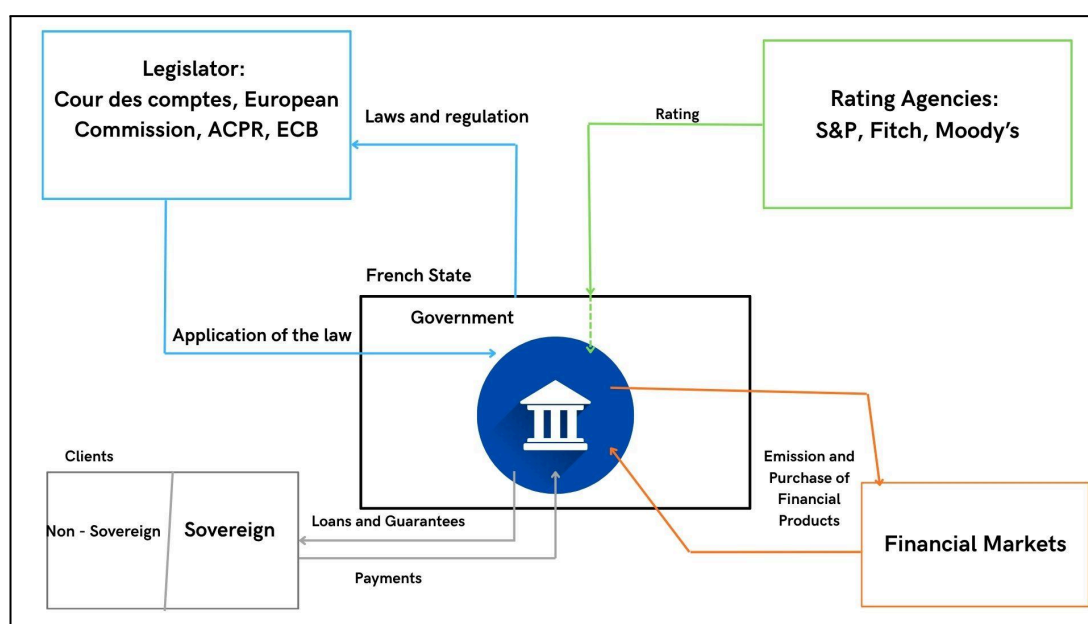


Figure 1⁷: AFD Business Model and Institutional Environment

The AFD has a total balance sheet of approximately €70 billion as in 2024. The bank provides loans and grants to sovereign and non-sovereign counterparties, in order to fulfill its mandate. The balance sheet of the bank is presented in Figure 2:

⁷ Figure 1: Author's elaboration based on AFD internal documents

5.3.1 Consolidated economic balance sheet		
Assets		
<i>In millions of euros</i>	2024	2023
Loans (net outstanding)	50,872	48,155
• Gross outstandings	52,336	49,522
• Individual impairment	- 1,424	- 1,314
<i>of which calibration of the reserve account⁽¹⁾</i>	- 930	- 812
• Collective impairment	- 304	- 323
• Accrued interest	263	270
Financial hedging derivatives and collateral	5,072	5,355
Accruals and other assets	1,292	1,480
Equity investments and other securities	3,433	3,053
Short-term cash assets	10,618	9,905
Fixed assets	1,041	768
TOTAL ASSETS	72,327	68,717
<small>(1) Methodological change in the accounting treatment of the reserve account: – Sovereign outstandings are presented net of asset impairments; – Impairment losses on undisbursed balance recognised as off-balance sheet items continue to be recognised as a liability in the aggregate of provisions.</small>		
Liabilities		
<i>In millions of euros</i>	2024	2023
Market borrowings	53,466	50,519
Treasury loan	843	842
Financial hedging derivatives and collateral	4,611	4,902
Accruals and other liabilities	2,903	2,391
Provisions	882	915
• <i>of which calibration of the reserve account</i>	285	494
Equity (Group share)	9,422	8,990
• <i>off which Group income</i>	344	371
Non-controlling interests	200	165
TOTAL LIABILITIES	72,327	68,717

Figure 2⁸: AFD's Consolidated balance sheet

In order to sustain this level of activity the bank relies on two different forms of financing:

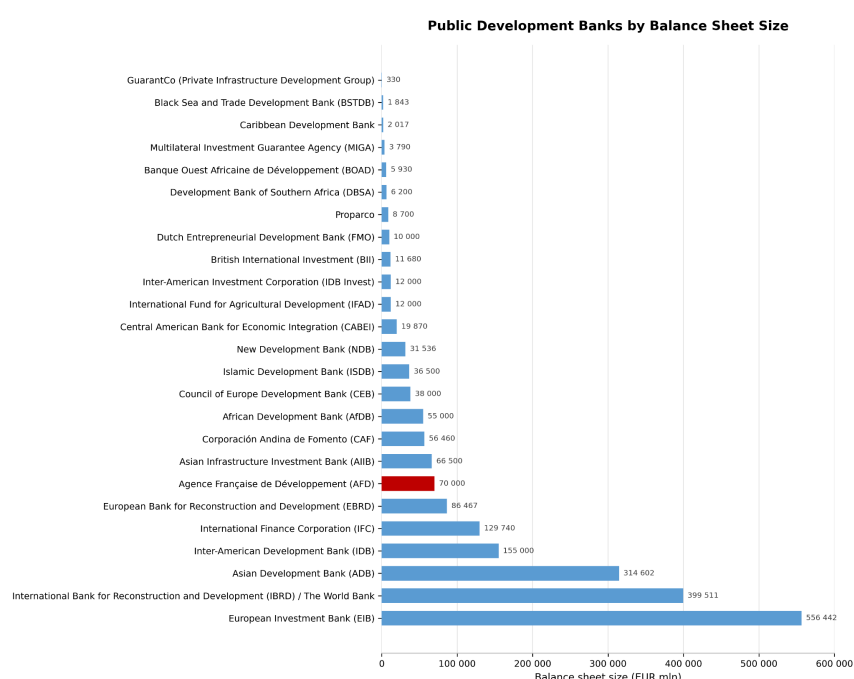
1. Issuance of debt instruments on financial markets
2. Funds from the State and the European Union

Unlike a commercial bank, the Agence Française de Développement finances itself in financial markets, mainly by issuing bonds. Looking at the balance sheet, excluding derivatives and risk funds, market borrowings account for 98.45% (€ 53,466 million) of the resources of the bank while the funds given from the state account for 1.55% (€ 843 million). The main buyers of AFD bonds are institutional investors. The resources that the bank will have at its disposal are established annually in the “annual funding program” by the Executive Financial management department (Département de la direction financière - DEF). In 2025, AFD issued a total of € 8.2 billion through twenty-nine issues⁹. These trades were carried out over six public transactions: four bonds in euros, one in US dollars, one in British pounds. When buying loans and financial products, investors look at the counterparty's rating in order to price the cost of money. The higher the rating, the lower the cost of lending. Cheaper funding will result in a lower interest rate that the bank can charge its counterparties. Lower loan prices will result in more accessible and numerous loans, leading to greater diplomatic

⁸ [Financial Reports | AFD - Agence Française de Développement](#)

⁹ Agence Française de Développement. (2026). *AFD's 2026 funding program*. <https://www.afd.fr/en/press-releases/afds-2026-funding-program>

power and more impactful development results. A key element, therefore, is the rating. It is issued by the three main rating agencies: Standard & Poor's, Fitch and Moody's. It reflects not only its capital ownership structure, fully owned by the French State, but also its financial condition. Every shift in the rating of the state is reflected in the bank's rating. Thanks to its structure and business model, the AFD has managed to sustain multiple projects: a €39 million sovereign loan for water and sanitation infrastructure in Kisumu, Kenya, and an €85 million loan to improve public transport in Addis Ababa, Ethiopia. While these examples illustrate how AFD's business model translates into concrete development outcomes, they also raise the question of how AFD's financial structure compares to other institutions pursuing similar development mandates. To this end, it is useful to position AFD within the broader landscape of multilateral and bilateral development banks (MDBs).



Graph 1¹⁰: Public Development Institutions by Balance Sheet size

Observing the global landscape of public development banks, AFD is strategically positioned in the upper-middle tier of the sector. With a balance sheet of 70 billion euros, the agency operates on a more compact scale compared to multilateral giants like the European Investment Bank (EIB) or the World Bank, whose volumes are

¹⁰ Graph 1: Own elaboration on published balance sheets, 2024. Data gathered from financial reports (2024- 2025) of the mentioned institutions by the author

measured in the hundreds of billions. However, AFD is significantly larger than many regional or specialized institutions present on the international market. The AFD ranks 7th in terms of balance sheet size. These institutions are very different from each other but they overall rely on the same business model. What really differs between financial institutions is the ownership structure. It completely changes the challenges in terms of financial sourcing, management and legal statutes. MDBs and bilateral development banks have the following differences: MDBs are owned by multiple states, which grants them the triple-A rating, due to the very low probability of a multiple state default. MDBs benefit also from the Preferred Creditor Status or Treatment (PCS), which means that the bank is expected to be repaid in full even if a sovereign borrower restructures its bilateral or commercial debts. PCS rarely appears in actual legal contracts and is not strongly backed by international law. Rather, it operates as a "market practice" or "market custom" that has proven highly resilient. AFD, on the other hand, is owned by the French State and it does not benefit from PCS. The position of the AFD is not weakened: the bank benefits from the backing of the French State, but this exposes the bank to France's geopolitical situation.

2.1.4 Geographical and currency exposure

The geographical exposure of loans is not evenly distributed: as in 2024, the most important geographical zone was Africa (40% of total activities), followed by Asia and East Europe (28%)(Universal Registration Document 2024). The bank has also approved smaller volume loans and multi-country loans to Latin America and to island economies across major ocean regions. All of this is possible thanks to a network of 85 different agencies in 150 countries, with 3,600 active employees. Given the international nature of AFD's activities, a significant part of its operations is conducted in multiple currencies. Funding is raised in hard currencies such as euros or dollars. Operations in developing countries are carried out with cross-currency swaps. This financial instrument enables the institution to maintain a euro- and dollar-based balance sheet without taking on the risk of having assets in weak currencies. However, despite this hedging strategy, the exchange rate risk remains a potential threat for the bank. If a counterparty defaults, the bank is still obliged to pay the cash flows of the swap without receiving the corresponding payments. A misalignment between the flows of the swap and those of the loan, should an event affect the life of the latter, could expose the net income to high fluctuations. The net income of the AFD needs to be stable over time to ensure the bank's missions of economic stability and countercyclical

role. Consequently, the measurement and management of exchange rate risk represent a key challenge within AFD's Asset-Liability Management framework.

2.2 Organization and position within the company

AFD is organized into eight directorates, of which the Risk Executive Directorate (DXR) is the most relevant to this internship. Within DXR, risk monitoring is delegated to Group Risk Management (DRG), and specifically to its Financial Risk Monitoring division (DSR), whose mandate is to consolidate the group's financial risks (credit, market, portfolio, ALM) and ensure their oversight (Figure 3). My internship was carried out within DSR's Market Risk and Balance Sheet management team (RMB), responsible for monitoring the ALM-related risks affecting the balance sheet: interest rate, liquidity, and exchange rate risk. The team is also responsible for performing second-level controls. A detailed breakdown of AFD's organizational structure (Figure 3) and the DSR division's internal structure and staffing (Figure 4) is provided in Appendix.

2.3 Work and activities carried out

The main subjects to which I contributed were the following:

- Liquidity management and Local currency risk's framework
- GEMs Annual Assemblies

Due to the different stakeholders and the nature of each of the subjects, they will be presented separately.

2.3.1 ALM and Liquidity Management

On the liquidity management side, I was in charge of computing the stressed liquidity indicator (ILS - *Indicateur de liquidité stressée*). This indicator consists of two computations: the financial projection of the cash inflows and the cash outflows of the bank's portfolio at the date of the computation, and the same projection but delayed by two weeks. This reporting exercise is necessary to verify that the bank has sufficient High Quality Liquid Assets (HQLA) to survive a systemic crisis. Depending on the asset class and on the features of each holding, stresses or discounts are applied simulating a complete deterioration of quality of the assets and a distressed market situation in

which the firm is unable to refinance itself. The stresses are computed based on the S&P's credit and default risk estimations, and also on the maturity of the asset. The results of the computation are two time series that can be represented by two graphs, showing the evolution of liquidity over time. A consistent production frequency must be maintained to provide management with timely information. It serves as a decision-making tool, used by the Financial Executive Directorate to monitor and to manage the liquidity of the bank, both from a regulatory point of view and an operational framework. The indicator is also needed by the management in order to steer the seasonality of liquidity. When liquidity approaches the internal limit of 12¹¹ months, the treasury could decide to issue debt taking into account all the information at their disposal, if the market conditions are favourable. The reporting containing the calculation of this indicator must also be defended before the treasury committee. Alongside liquidity management, the team was also engaged in the revision of the Local Currency Limits Framework (LCLF). Within this project, I worked on the proposal to develop the current framework in order to make it more statistically solid. The main task was to conduct an impact study of the result of the model after changing the measure used to assess the volatility of local currencies: from the volatility computed by Bloomberg to a VaR (Value at Risk) based metric. After the change of the metric and the re-run of the model, it was possible to compare the result with the old one and observe how the limits would have evolved if the metric were actually changed. The results of this study will be presented as a case study of this literature review. These tasks provided practical insight into the complexity of balance sheet risk management in a development institution. In particular, the work on local currency exposures highlighted the importance of selecting appropriate risk measurement models, directly motivating the research developed in this thesis.

2.3.2 GEMs Annual Assemblies

While contributing to the work of the RMB team, I had the opportunity to work on the GEMs (Global Emerging Market risk database) annual assemblies. The subject was transverse and involved multiple people in the department. I actively contributed to the work with the management of the division and the department: my N+2 (the manager of my manager), and the vice-director of the risk department. I was involved from the preparation of the content for the assemblies to actively representing the AFD during

¹¹Fictitious data, used for illustrative purposes only.

the working groups. Starting from its creation the GEMs database organizes annual conferences in a country home to a development institution. This year marked the first time France, and specifically the AFD, hosted a one-week conference in Paris. The GEMs¹² is a database created by the joint effort of the European Investment Bank (EIB) and the International Finance Corporation (IFC). It gathers data from Public Development Institutions, especially default rates and recovery rates registered on loans issued to actors present in emerging economies. This database aims to demonstrate that the default rates recorded are not as high as private sector investors perceive. This demonstration would improve the risk perception of investors, enhancing their investment opportunities and therefore producing capital movements towards new profitable markets. This catalyzing effect would benefit both investors that are searching for new profitable opportunities and emerging countries, which could see a boost to their economies. The annual assemblies that took place in March 2026 in Paris had as their main objective to discuss with the members the procedures and internal policies to adopt and to discuss the next steps of the project with the aim of publication of the data. The central discussion of the conferences was the election of the observer role of the steering committee, which was gained by AFD. The Observer to the Steering Committee represents the interests of the General Assembly and takes part in the Steering Committee meetings as an invited participant, without voting rights. The role is held by an elected representative from one of the member institutions that are not represented in the Steering Committee. The vote was held the first day, seeing the AFD's executive risk vice director against the senior risk management officer of another financial institution. The vote was important due to the underrepresentation of highly regulated bilateral development banks in the steering committee and for the opportunity of France to bring its interest and needs to the committee, for instance the overrepresentation of Latin America in the GEMs data compared to Africa, where AFD has a larger exposure. The underrepresentation of African data in the GEMs database reflects a broader challenge in emerging market risk measurement: the scarcity of reliable financial data for less liquid currencies, a limitation that will emerge again in the context of the Local Currency Limit Framework.

¹²GEMs Consortium. (n.d.). *Global Emerging Markets Risk Database*.
<https://www.gemsriskdatabase.org/>

2.4 First impressions and personal perspectives

2.4.1 Environment and Company culture

Being at the beginning of my professional career, my initial perception of Risk Management was inevitably partial: I expected a highly theoretical, self-referential function, detached from day-to-day operations. This experience at AFD has completely overturned that perspective, showing me the tangible and immediate implications of this sector, such as the direct application of credit limits. Far from being an ivory tower dedicated to running quantitative models for mere bureaucratic purposes, the risk department proved to be the essential engine ensuring the institution's proper functioning, stability, and long-term sustainability. Every activity and interaction I experienced during this internship provided valuable insights and led me to reflect on whether I see myself pursuing a career in development finance and/or in risk management. Before starting this experience, I had never had the opportunity to work on Asset-Liability Management (ALM) subjects. However, the motivation to work for a development institution, combined with the opportunity to acquire new technical skills, strongly encouraged me to pursue this internship. At first glance, one of the most striking aspects of the working environment was its strong international dimension. Due to the nature of its activities, AFD promotes diversity across teams and departments, fostering cooperation between individuals from different backgrounds. I have managed to interact with colleagues with very different backgrounds and career paths from all over the globe. This provided me with insights into possible career paths, new perspectives about work and life. Diversity and inclusion are only a part of AFD culture at a social level. At a professional level, values such as humility, a strong sense of hierarchy, the ability to carve out one's own position, the capacity to develop deep expertise, and a safe culture of error make the AFD a good working environment for everyone who seeks meaning in their work. Although I found the work deeply meaningful due to the relevance of the topics, it required adapting to an unexpected degree of hierarchy and formal communication. I did not expect to encounter an environment characterized by such a strong "political" dimension. After a natural initial adjustment period, this context rapidly transformed into a precious growth opportunity. Not only did it allow me to understand firsthand the value of internal diplomacy and relational intelligence, but it also gave me the privilege of consistently interfacing with highly professional individuals such as the department director and my N+2 manager. Thanks to this, I learned how to navigate and manage professional relationships. What really stands out are the social values promoted in the conferences proposed, in the

events organized, in the exchanges that took place every week in one of the three buildings of the bank, near Gare de Lyon.

2.4.2 Personal challenges

A fundamental phase of my internship journey was undoubtedly the onboarding process. Given the cross-functional nature of my role, I benefited from a dual operational onboarding: one focused on the GEMs assemblies, and the other centered on liquidity management and ALM. This duality offered a unique perspective on two distinct training methodologies. The GEMs onboarding required close mentoring and frequent one-on-one interactions, driven by tight event deadlines and a steep learning curve. Conversely, the ALM track favored a higher degree of autonomy, allowing me to proactively structure my own learning process. Despite these structural differences, one constant remained: the crucial impact of my mentors. Their extensive expertise and complete availability were decisive in helping me overcome a natural initial hesitation to ask questions. The first period was indeed challenging: the language barrier and my insecurities about not being prepared enough to contribute meaningfully raised multiple doubts. However, these uncertainties were quickly dispelled thanks to the overall support I received from the entire department. This warm welcome translated into practical inclusion, from multiple occasions where I was asked to share my experience in department meetings, to being introduced to new sports that played a key role in my integration. AFD's institutional culture deeply permeates relationships and work arrangements, translating into a work pace that alternates between physiologically steadier phases and peaks of high intensity, especially ahead of crucial regulatory milestones like the CORIS (*Comité des Risques*). What really motivated me to complete this internship and to overcome the initial challenges was my desire to do something good and to have an impact. Knowing that my actions could make a positive difference for someone was enough motivation for me. Building technical expertise was a further driver of my commitment.

2.4.3 Critical reflection on the sector

2.4.3.1 Technical observations

From a technical perspective, I observed the flexibility and importance of programming tools such as Python and VBA, particularly in the context of liquidity management. I also gained insight into the interaction between internal policies, regulatory requirements, and project management, especially in the implementation of

second-level controls. Another key takeaway was the central role played by regulation. Compared to my previous experience at Banca del Veneto Centrale, where I worked in corporate credit risk analysis, the impact of regulation was significantly more pronounced at AFD. As a financial institution supervised by the ACPR while also operating under broader banking prudential frameworks, AFD must comply with a complex regulatory environment. Understanding these regulatory constraints was initially challenging, especially due to the language barrier, but it was essential to fully grasp how the institution operates within the financial system.

2.4.3.2 Reflections on the GEMs assemblies

Despite having a limited point of comparison with the private banking sector, my involvement in out-of-ordinary matters such as the organization of GEMs and the impact study on the LCLF made the experience particularly challenging and far from simple day-to-day administration. Regarding the GEMs initiative, I observed that activities related to data submission, communication, and preparation for the annual assemblies were carried out alongside daily operations. As a relatively recent project, GEMs is not always prioritized by all institutions, given the workload associated with core activities. During the assemblies, I had the opportunity to interact with representatives from several multilateral institutions (IFC, CEB, IADB, CDP¹³). The discussions highlighted key challenges such as data homogeneity, participation costs, and differences in institutional statutes. A particularly important insight was that not all members use GEMs data in their internal risk models, but treat them as a benchmarking reference against which their own estimates can be tested. This caution matters, because it sits uneasily with the trajectory the initiative has been asked to follow. In line with the recommendations of the G20 Independent Review of Multilateral Development Banks' Capital Adequacy Frameworks, GEMs is meant neither to remain an in-house pooling exercise among its members nor to be outsourced to a third-party provider: the consortium itself is expected to become the reference database on emerging-market credit risk, performing for developing economies a function comparable to that of the credit rating agencies, so that private investors can price sovereign and corporate risk in these markets more accurately and capital can flow more readily to developing economies. If the very institutions that generate the data use it mainly as a benchmark rather than as a modelling input, the authority that this

¹³ IFC: International Finance Corporation, CEB: Council of Europe Development Bank, IADB: Inter-American Development Bank, CDP: Cassa Depositi e Prestiti.

reference function presupposes becomes harder to establish. The assemblies also revealed a tension between the stated objectives of the initiative and the political dynamics inherent to inter-institutional governance. Participation and engagement varied significantly across institutions, suggesting that strategic interests and visibility considerations sometimes take precedence over technical collaboration.

2.4.3.3 Reflections on the LCLF

Finally, my work on the Local Currency Limit Framework allowed me to apply theoretical models studied during my academic training. The impact study conducted on the LCLF contributed to the ongoing discussion on the methodological evolution of the framework. During the work, I realized that in a highly regulated environment such as AFD, there is often a preference for simpler and more robust models that remain closely connected to real-world constraints. Proposed methodological improvements are typically addressed through dedicated annual projects, once core operational priorities have been fulfilled. This highlights a key structural challenge: changing established frameworks is difficult, especially in the absence of widely accepted industry best practices and due to limited comparability across institutions. This structural inertia is not accidental. In institutions whose primary mandate is stability and continuity of financing, methodological conservatism serves a protective function: simpler models are more auditable, more defensible to regulators, and more easily communicated to diverse governance bodies. The gap between academic innovation and institutional practice is therefore not a failure of competence, but a rational response to the constraints of operating in a highly regulated, politically accountable environment.

2.4.3.4 Motivation and career

The gap between academic innovation and institutional practice described above is one of the main motivations that pushed me to conduct this literature review, in order to gain an overview of where academic research stands, and whether it can be applied to a development institution. Overall, this intellectually stimulating experience has been fundamental in clarifying my ambitions. I realized that, to shape my ideal career path within an institution with a development mandate, I need to continue exploring and engaging with the various operational functions. I have become aware of my profile's versatility: although my personal inclination allows me to perform effectively in front-office roles, I deeply appreciate the middle and back office for the invaluable

overarching view they provide of the complex institutional machinery. Finally, fieldwork has solidified a great certainty within me: the dynamism of the operational sector and the job market is the path I wish to pursue, strongly preferring it over pure academic research.

3. Academic Research

3.1 Literature review

3.1.1 The Coverage problem

One of the main topics I worked on was the Local Currency Limits Framework (LCLF) at AFD. The bank's purpose is to foster development. To this end, it uses different strategies such as investing in developing countries. To do so, it is necessary to invest in markets and currencies that are not fully integrated into the global financial system due to the perceived riskiness, stemming from the limited availability of financial data. A robust framework to protect the bank is necessary in order to ensure the continuation of its mission, its role and its operations: including loan issuance and its macroeconomic and countercyclical role. One of the main risks that a financial actor may encounter by investing in these markets is exchange rate risk: a meaningful component of market risk. This exposure affects banks' resilience and thus their capacity to meet regulatory objectives, for instance, the capital adequacy ratio. It is a key supervisory requirement designed to strengthen the resilience of the banking sector. According to the Basel III global regulatory framework¹⁴ (BCBS, 2011, p. 14, para. 50), currently codified under Chapter RBC20 of the Consolidated Basel Framework, the Capital Adequacy Ratio (CAR) is designed to ensure that banks maintain sufficient capital to absorb potential losses. In the European legal framework the requirement is defined under Article 92(3) of the Capital Requirements Regulation¹⁵ (CRR - EU No 575/2013), which formally defines the total capital ratio as "the own funds of the institution expressed as a percentage of the total risk exposure amount". The Pillar 1 regulatory minimum is 8%, calculated through the following formula:

$$CAR = \frac{\text{Total Own Funds}}{\text{Risk-Weighted Assets (RWA)}} \geq 8\%$$

¹⁴ Basel Committee on Banking Supervision (2011). *Basel III: A global regulatory framework for more resilient banks and banking systems*

¹⁵ Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012 (Consolidated version). Available at: EUR-Lex.

The regulatory minimum of 8% represents only the Pillar 1 floor. In practice, an institution's effective capital requirement is higher once the Capital Conservation Buffer, any applicable Countercyclical Buffer, and its institution-specific Pillar 2 Requirement are layered on top under the CRD IV/CRR framework (CRD IV, Directive 2013/36/EU)¹⁶. For AFD specifically, the effective regulatory minimum stood at 11.97% as of end-2024, against which the Group reported an actual capital adequacy ratio of 15.26% (Fitch Ratings, 2025; AFD, 2024 Universal Registration Document)¹⁷. This ratio offers a useful example of how exchange rate risk affects a financial institution. The numerator corresponds to the bank's "Tier 1" and "Tier 2" capital. The denominator consists of the bank's assets, weighted by their risk (risk-weighted assets). "Tier 1" capital is divided into two different categories: "CET1" and "AT1". The first one includes the bank's shares, reserves and retained earnings. The second one includes hybrid subordinated instruments such as contingent convertible bonds. Tier 2 capital comprises subordinated debt and instruments with a defined maturity. A simplified example is provided in the next section.

3.1.2 CAR and P&L balancing: A case study

A bank, with a simplified balance sheet, has a capital of 10 million euros. For the purposes of this example, the term 'capital' refers to the bank's equity. In a context similar to that of AFD, the institution has found a profitable investment opportunity in a developing country. It is worth noting that this example can be applied to any long-term investment denominated in a currency different from that of the bank's capital, provided it does not qualify as a net investment in a foreign operation, a case in which exchange differences would be recognised in other comprehensive income rather than in profit or loss. The project costs 100 million in local currency. The institution needs to decide how to finance it. Funding the project by borrowing in local currency would eliminate the exposure at source, but local currency debt markets in developing economies are often shallow and short-dated, and such funding is rarely available at the maturities

¹⁶ European Parliament & Council. (2013). Directive 2013/36/EU on access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms (CRD IV). Official Journal of the EU, L 176.

¹⁷ Fitch Ratings. (2025). Agence Française de Développement, Rating Report, 24 September 2025. <https://www.afd.fr/sites/default/files/2025-09/rating-report-afd-september-2025>. Agence Française de Développement. (2025). 2024 Universal Registration Document. <https://www.afd.fr/en/ressources/2024-universal-registration-document.pdf>

required. The exposure therefore has to be managed rather than avoided. The bank funds it with its own resources, which must therefore be converted into local currency, exposing its capital to exchange rate movements. Two strategies are possible: the first is to hedge the resulting foreign exchange exposure with a swap; the second is to leave it open, thereby creating a structural FX position. The objective of the first strategy is to protect income from significant exchange rate fluctuations. The swap fixes the euro value of the bank's own funds: whatever the movement of the exchange rate, capital remains unchanged, and no exchange gains or losses are recognised. Consider now the case in which the local currency appreciates: the EUR-equivalent value of the asset increases, raising the bank's Risk-Weighted Assets. Own funds, whose euro value is locked in by the swap, do not appreciate alongside it. This mismatch would therefore lead to a lower CAR, potentially triggering regulatory intervention. On the other hand, under the second approach, the bank would not use a hedging instrument to cover the capital. If, in this case, the local currency were to appreciate, the capital would be affected. CAR sensitivity may be reduced by such a movement; however, the resulting profits or losses would need to be recognised in the bank's income statement, or in other comprehensive income where the exposure qualifies as a net investment in a foreign operation. This recognition will make financial performance more volatile and unpredictable. This example and the scenarios can be shown in the Tables below:

Capital	10 000 000 €
Project	100 000 000 COP
Hedging costs	3%
FX Risk weight	8%
Exchange Rate COP/EUR	10,00 €

Table 1¹⁸: Input Data

Scenario	FX change	Project value in Euro	Hedging cost	P&L Unhedged in Euro	Capital hedged in Euro	Capital unhedged in Euro
A	10%	11.000.000 €	-300.000 €	1.000.000 €	9.700.000 €	11.000.000 €
B	0%	10.000.000 €	-300.000 €	0 €	9.700.000 €	10.000.000 €
C	-10%	9.000.000 €	-300.000 €	-1.000.000 €	9.700.000 €	9.000.000 €

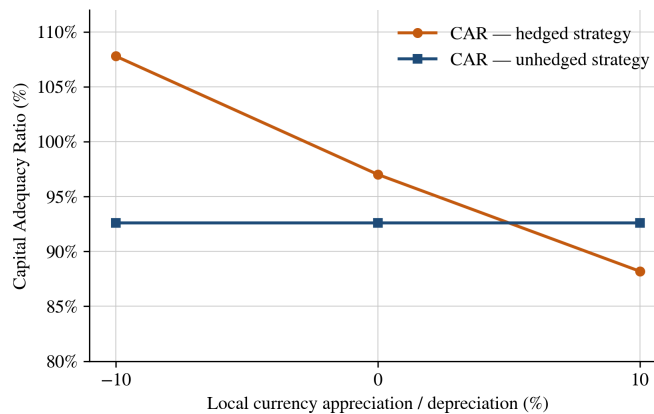
Table 2: Project's scenarios

¹⁸ Table 1,2,3: Fictitious Data used by the Author for illustrative purposes

Scenario	RWA Hedged	RWA Unhedged	CAR Hedged	CAR Unhedged
A	11.000.000 €	11.880.000 €	88,18%	92,59%
B	10.000.000 €	10.800.000 €	97,00%	92,59%
C	9.000.000 €	9.720.000 €	107,78%	92,59%

Table 3: Impact of the strategies on RWA and CAR

It is possible to observe in the following graphs the impact of the two strategies:



Graph 2¹⁹: Capital Adequacy Ratio in the two strategies

The absolute CAR levels shown above (88%–108%) are an artefact of the deliberately minimal balance sheet used for illustrative purposes, and are not representative of a real institution's capital position; what matters for the argument developed here is the *direction and relative magnitude* of the shift between the hedged and unhedged scenarios, not the absolute levels themselves. This example shows how exchange rate risk affects a bank and why it is complex from the point of view of a financial institution to cover it. Due to the very high level of simplification of the proposed model some aspects may go unnoticed, but the difference between the two strategies is clear. By entering into a swap, the bank stabilises the economic value of its exposure but leaves the capital ratio exposed; by forgoing the swap, it stabilises the ratio but transmits exchange rate movements to its own funds. The trade-off is therefore between which of the two variables the institution is prepared to let fluctuate. Crucially, hedging instruments act on the value of the exposure and hence on the numerator of the ratio, but cannot neutralise the effect on the denominator, which responds only to the

¹⁹ Graph 2: Capital Adequacy Ratio in the two strategies, based on fictitious data

euro-equivalent value of the asset. In short, the swap protects the income statement at the expense of the capital ratio, while the open position protects the capital ratio at the expense of the income statement. The two strategies that were previously shown can be taken by the bank depending on several factors such as:

1. The business model of the bank
2. The cost of hedging
3. The approval of the regulator

From a regulatory perspective, investments in currencies other than that of the bank's capital are risky due to their exposure to exchange rate fluctuations. Regulators have therefore imposed additional capital requirements on banks to account for that risk and to limit their risk appetite while controlling for moral hazard. As described by the European Banking Authority (EBA, 2025)²⁰, these additional capital requirements result in an extra cost for the bank unless the position qualifies as structural. The regulator allows the exclusion of such positions from the net open foreign exchange position, subject to prior supervisory permission, provided the institution demonstrates that the position is of a non-trading, structural nature and deliberately taken to protect the capital ratio. The exemption materially relieves the capital charge on the open position, freeing capacity for lending, though the exemption removes only the market risk charge: credit risk-weighted assets continue to translate at the closing rate, so the ratio remains sensitive to exchange rate movements through the denominator. In the illustrative figures of Table 3 the exemption is not applied: the unhedged scenario carries the 8% add-on, which is why its risk-weighted assets exceed the euro value of the asset. Were the exemption granted, the add-on would disappear and the unhedged ratio would settle at a higher, equally stable level — which is precisely the outcome the supervisory permission is designed to enable. The two objectives are mutually exclusive not because of an accounting mismatch, but because hedging acts on the numerator of the ratio while the denominator responds only to the euro-equivalent value of the asset. If the bank tries to manage both CAR and P&L simultaneously, it will fail to effectively protect either. The institution needs to choose to hedge the capital ratio or the income statement.

²⁰ European Banking Authority. "Final Report: On Draft Regulatory Technical Standards on the treatment of structural FX positions under Article 104c of Regulation (EU) No 575/2013 (Capital Requirements Regulation)." EBA/RTS/2025/09.

3.1.3 The research question and the methodology of the literature review

This trade-off is particularly relevant for development institutions such as AFD, whose objectives extend beyond profitability to include stability and long-term financing capacity. The choice is between stabilising the income statement and stabilising the Capital Adequacy Ratio. For instance, the AFD has chosen to protect its income statement rather than having a conservative approach based on the capital. This choice is discretionary and can be explained by the Board of Directors' preference for stable profits in order to improve the investment's programming. Having chosen this strategy, the bank needs to maintain a high capital buffer on its balance sheet, one that can on the one hand guarantee the respect of regulation and on the other hand sustain changes in exchange rate position. A strong framework establishing the limits of the investments in local currency is necessary in order to maintain the bank's defined policies. The Local Currency Limits Framework (LCLF) establishes the internal limits of the bank's portfolio in local currency. The work I carried out on this topic during my internship focused on studying the impact of a change in the metrics used to assess exchange rate risk of local currencies. The approach and the methodology used to define the portfolio's limits will be explored more in depth in the case study. The study outlined how critical, at both strategic and operational level, it is for banks to model and measure exchange rate risk appropriately. This raises a broader question regarding standard market risk measures: which measures are the most used ones and which ones are fully appropriate for development institutions operating in less liquid and more volatile currency environments. This will be the subject developed in this literature review. The research question is the following:

What are the best practices in exchange rate risk measurement, and to what extent are they suitable for managing the risks of AFD's local currency exposures?

To address this research question, the literature review follows a structured, thematic approach, consisting of the following core stages:

1. **Identification of support inquiries:** After the formulation of a clear and specific question, some support inquiries were defined to endorse the process such as:
(a) What is exchange rate risk? (b) What are the metrics used in the sector to measure exchange rate risk? (c) What is a "best practice"? (d) What are the criteria used to choose a risk measure?
2. **Literature search:** The literature review was carried out using relevant databases such as: *Google Scholar, Scopus and Web of Science*. Keywords

used in the research include “Exchange rate risk”, “Exchange rate risk measures”, “currency risk management” (...). The focus was primarily on recent peer-reviewed journal articles, working papers, and books published in English, supplemented by seminal earlier contributions, to ensure up-to-date literature. Institutional reports from multilateral bodies such as the G20, GIF, and IMF are included where they provide authoritative, up-to-date evidence directly relevant to the practice of development institutions.

3. **Literature Selection and Synthesis:** Sources were evaluated and selected based on their direct relevance to the research questions, particularly their applicability to development finance. Rather than employing rigid quantitative extraction, the selected literature was analyzed thematically. This narrative synthesis compares different risk measurement methodologies and identifies prevailing patterns in the current discourse.
4. **Reporting of results:** The findings of the review are presented thematically, focusing on the implications for development finance. The discussion offers a critical interpretation of the current knowledge and contextualizes these findings within the operational reality of institutions like AFD, ultimately providing a foundation for the subsequent case study.

3.2 What is exchange rate risk?

A clear definition of exchange rate risk is necessary in order to define the scope of the research. All types of firms are affected by exchange rate risk: directly or indirectly. Hereinafter, the term “direct exposure” will be used to signify an asset or liability position or economic position expressed in a currency that is different from that of the equity. A firm that has its business model entirely in one country is seemingly not exposed to exchange rate risk but this player is not in an isolated system. If the firm has a supplier, and that supplier has foreign clients, the firm will indirectly be exposed to exchange rate risk. This shows that exchange rate risk affects every economic activity and thus it is crucial to take it into account in the risk mapping. A definition of this exposure is the following: the uncertainty linked to the unexpected variation of the exchange rate of a currency (Adler & Dumas, 1984)²¹. A possible variation of the exchange rate could lead to a loss for the company, in terms of liabilities and assets, net profit and its stock value. Three types of exchange rate risk can be identified

²¹ Adler, M., Dumas, B., 1984. *Exposure to currency risk: definition and measurement*. *Financial Management* 13, 41-50.

(Shapiro, 1996; Madura, 1989)²²: transaction risk, translation risk, and economic/forecast risk. The first type of exchange rate risk affects a firm that is directly exposed to fluctuations of the exchange rate. An example could be a firm that has cash flows in a foreign currency. This type of risk concerns the firm's ongoing operations, and the potential losses could be seen in the income statement. The second element of this classification, translation risk, affects a firm that does not have a direct exposure to a foreign currency. An example of this is when a holding company has a subsidiary firm in another country and it needs to value that subsidiary on its balance sheet. This risk affects the balance sheet and in particular the company's equity participations. Losses are propagated through the overall balance sheet. The third, economic/forecast risk, is the risk of changes in the value of the projected cash flows of the activity of the firm. It affects every kind of firm. This risk covers every aspect of the economic activity, from revenues to expenses viewed through a forward-looking lens. It is possible to define exchange rate risk in the context of emerging markets (G20, GIF, & IMF, 2024)²³. This exposure causes a structural mismatch: projects generate revenues in local currency while investors rely on hard currency for capital and operating expenses. Since emerging economies are highly vulnerable to external shocks and currency volatility, unhedged exposures threaten both project viability and macroeconomic stability. Managing these complex institutional currency dynamics demands rigorous risk measurement. This framework introduces the measurement methodologies analyzed in Section 3.3 and establishes the operational context for the *Asset and Liability Management* strategies examined in the AFD case study. One of the main activities carried out by a multilateral development bank is investing in developing countries. The AFD does not have foreign currencies in its balance sheet, as seen in section 2.1.4., thanks to the use of cross-currency swaps. At first sight the indirect nature of the exposure suggests translation risk, but the example used above to illustrate that category does not align with the institution's case. More precisely, the scenario described in Section 2.1.4, where a counterparty default leaves AFD obligated to honour the swap's cash flows without receiving the corresponding loan repayments, constitutes a contingent transaction exposure: it only crystallises upon a specific credit event, rather than existing as a standing balance-sheet translation exposure.

²² Madura, J, 1989, *International Financial Management*, 2nd ed. (St. Paul, Minnesota: West Publishing Company). Shapiro, A.C, 1996, *Multinational Financial Management*, 5th ed. (Hoboken, New Jersey: Wiley).

²³ G20, Global Infrastructure Facility (GIF), & International Monetary Fund (IMF). (2024). *Addressing Exchange Rate Risk in Infrastructure Projects in EMDEs*. Report for the G20 Infrastructure Working Group under the Brazilian Presidency.

Classifying it under either heading is therefore an approximation, not an exact categorical fit; the underlying economic mechanism combines elements of both transaction and translation risk. Translation and economic risk are not developed further, given their limited applicability to the case study.

3.3 The risk measures

From a contingent transaction perspective, one of the worst scenarios that could happen is the “crash risk” (Okot et al., 2022)²⁴: the risk of sudden and catastrophic depreciations against the dollar. If realized, the financial erosion that would follow could be major. Losses can be prevented only if an appropriate risk management framework exists. A risk measure can be defined as a mapping from the distribution of a portfolio's future value to a real number expressing the capital required to make that position acceptable (McNeil, Frey & Embrechts, 2015)²⁵. Risk metrics evolved through time, as outlined by this literature review. This evolution has mainly been driven by the search for a metric able to overcome the limitations of existing ones. The academic literature is progressively distancing from parametric models based on normality distribution assumptions, moving to more advanced assessments. The contemporary research is concentrated on metrics that can capture the asymmetric dependencies and non-linear relationships. This shift is clearly attributed to real-world evidence: tail risk is becoming considerably important and therefore measures capable of capturing it are the focus of research. The availability of greater computational power and high-frequency data has opened new possibilities of exploring new models within the risk measures framework by complementing existing statistical approaches with Machine Learning and Deep Learning techniques. This evolution is comprehensively captured by Zaeviski and Nedeltchev (2023)²⁶, whose study aptly titled "From Basel III to Basel IV and beyond" provides the analytical starting point for this section. Comparing VaR, Expected Shortfall, and Expectile-based measures across five stochastic models calibrated on the S&P 500, the authors frame the search for a risk measure that is simultaneously coherent and elicitable as the central methodological challenge shaping the field's

²⁴ Okot, Anjelo; Kaltenbrunner, Annina; Perez Ruiz, Daniel (2022) : *Determinants of the exchange rate, its volatility and currency crash risk in Africa's low and lower middle-income countries*, EIB Working Papers, No. 2022/12, ISBN 978-92-861-5371-6, European Investment Bank (EIB), Luxembourg,

²⁵ McNeil, A. J., Frey, R., & Embrechts, P. (2015). *Quantitative Risk Management: Concepts, Techniques and Tools* (Revised ed.). Princeton University Press.

²⁶ Zaeviski and Nedeltchev, From BASEL III to BASEL IV and beyond: Expected shortfall and expectile risk measures, *International Review of Financial Analysis*, Volume 87, 2023, 102645

evolution since the 2008 crisis. Their findings, situated explicitly within the shift from Basel III toward anticipated Basel IV requirements, offer the empirical backbone against which the individual measures discussed below are examined: VaR, ES, expectiles, and downside-risk metrics. The traditional benchmark for risk measurement is the Value-at-Risk (VaR) (Papaioannou, 2006)²⁷. This metric, and its variations, are widely used to assess market risk. Market risk, in turn, is a broader category of risks that can affect a firm's business cycle and also includes exchange rate risk. The Value-at-Risk is used to measure the potential loss in portfolio value over a specified time frame at a given confidence level. The VaR is traditionally used with parametric techniques such as Monte Carlo simulation based on assumed or stochastic distributions, or non-parametric techniques such as historical simulation. This metric has two principal limits: on the one hand it is silent about the size of losses beyond the chosen quantile. On the other hand, the VaR suffers from the lack of sub-additivity: the VaR of a portfolio could be higher than the sum of the VaRs of its components. These two limits would result in analysis that may discourage efficient capital allocation and diversification. In response to these limitations, a regulatory change introduced an alternative to VaR. The Fundamental Review of the Trading Book (FRTB), finalized by the Basel Committee in 2019, represents a structural shift in how regulators expect market risk to be quantified. Under its Internal Models Approach, Value-at-Risk was replaced by Expected Shortfall (ES) as the primary capital measure, precisely because the crisis of 2008 exposed VaR's inability to capture the severity of tail losses (BCBS, 2019)²⁸. This regulatory transition signals that the industry standard for risk measurement has moved, and institutions that still rely exclusively on VaR are, from a normative standpoint, operating on an outdated benchmark. Understanding this shift is essential to evaluating the appropriateness of any risk measurement framework, including AFD's. This is also why the VaR is estimated together with the ES. This measure, also called the Conditional Value-at-risk (CVaR) or the Tail Risk, is the expected value of the loss, conditional on that loss exceeding the VaR threshold. Through this assessment it is possible to mitigate the drawbacks of the VaR. A combination of VaR and ES is a solid statistical solution to measure risk (Acerbi & Tasche, 2002)²⁹. One of the main drawbacks of the ES comes from its difficult

²⁷ Papaioannou, M. (2006). *Exchange rate risk measurement and management: Issues and approaches for firms* (IMF Working Paper No. WP/06/255). International Monetary Fund.

²⁸ Basel Committee on Banking Supervision (2019). *Minimum capital requirements for market risk*. Bank for International Settlements, Basel.

²⁹ Acerbi, C., & Tasche, D. (2002). On the coherence of expected shortfall. *Journal of Banking & Finance*, 26(7), 1487–1503. [https://doi.org/10.1016/s0378-4266\(02\)00283-2](https://doi.org/10.1016/s0378-4266(02)00283-2)

backtestability, or in other words, it is not an elicitable risk measure. In order to backtest it, a great amount of historical data would be necessary. Other solutions were explored in order to overcome the limits of the existing risk measures such as expectiles (Zaevski & Nedeltchev, 2023). This risk measure is a combination of an expectation and a quantile. From a statistical perspective, the expectile represents an asymmetric generalization of the arithmetic mean. While the standard mean acts as an equilibrium point that minimizes squared distances from all observations using identical weights, the expectile introduces a differentiated penalty system. This asymmetry allows the measurement's center of gravity to shift toward the tails of the distribution. Consequently, the metric can capture the magnitude of extreme losses with far greater sensitivity than traditional approaches (Zhang et al., 2023)³⁰. Ziegel (2016)³¹ proves that expectiles are the only law-invariant risk measures that are simultaneously coherent and elicitable, which makes the expectile-based VaR (EVaR) the unique resolution of the trade-off between the two properties. This last property will be explained more precisely in the next sections; it is a statistical property strongly appreciated for a risk measure. Parallel to the development of the EVaR, risk metrics were developed to be more focused on downside risk. Downside risk can be defined as the potential loss caused by events that could lead to devaluation of an investment. Parallel to these developments, a distinct strand of research focuses on capturing specifically the downward component of risk, filtering out favorable price movements to isolate the dynamics of loss. One measure is particularly relevant here. The Maximum Drawdown (MDD) captures the largest peak-to-trough decline in portfolio value over a specified observation period. Unlike VaR and ES, which are point-in-time measures computed at a given confidence level, MDD is path-dependent: it follows the actual sequence of price movements and records the worst cumulative loss experienced. The main limitation of MDD for regulatory purposes is that it resists standard backtesting and lacks the axiomatic properties (coherence) that make VaR and ES suitable for capital requirement calculations. The metrics presented are not exhaustive due to statistical flexibility of the measures; numerous variants exist, only the most relevant are presented here. The table below shows the cited risk measures. Risk measures are indicators used in order to assess the potential loss of an event transforming data variability into an economic and financial indicator that can be used for decision making

³⁰ Zhang, F., Xu, Y., & Fan, C. (2023). Nonparametric inference of expectile-based value-at-risk for financial time series with application to risk assessment. *International Review of Financial Analysis*, 90, 102852

³¹ Ziegel, J. F. (2016). Coherence and elicibility. *Mathematical Finance*, 26(4), 901–918.

purposes. A solid risk measure is viable only if it is used on high-quality data, outputted by a risk estimation model. A discussion of the underlying risk estimation models falls outside the scope of this review. For reference, estimations of VaR and ES can be strengthened using exchange-rate volatility models like GARCH accompanied by Dynamic Conditional Correlations and Copula functions (Engle, 2002; Patton, 2006)³² that are considered the standard for the industry (Müller & Righi, 2024)³³, or by Extreme Value Theory approaches that fit the tail of the distribution directly rather than reading it from the empirical sample (Embrechts, Klüppelberg & Mikosch, 1997; McNeil & Frey, 2000)³⁴. These are estimation methods rather than risk measures: they change how a given measure is computed, not which measure is chosen, and the choice of the measure is the object of the present review.

³² Engle, R. (2002). Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroskedasticity models. *Journal of Business & Economic Statistics*, 20(3), 339-350. Patton, A. J. (2006). Modelling asymmetric exchange rate dependence. *International Economic Review*, 47(2), 527-556.

³³ Müller, F. M., & Righi, M. B. (2024). Comparison of Value at Risk (VaR) multivariate forecast models. *Computational Economics*, 63(1), 75-110.

³⁴ Embrechts, P., Klüppelberg, C., & Mikosch, T. (1997). *Modelling Extremal Events for Insurance and Finance*. Springer. McNeil, A. J., & Frey, R. (2000). Estimation of tail-related risk measures for heteroscedastic financial time series: an extreme value approach. *Journal of Empirical Finance*, 7(3-4), 271-300.

Risk Measure	Definition	Interpretation	Properties	Limit overcome
VaR	Maximum expected loss over a specific time horizon at a predefined confidence level.	A threshold that the portfolio's losses will not exceed with a certain probability.	Elicitable. Not subadditive (lacks axiomatic coherence).	
ES	Expected value of losses conditional on them exceeding the VaR threshold.	Quantifies the average severity of extreme tail losses.	Coherent (subadditive). Not elicitable.	Overcomes VaR's lack of subadditivity and its inability to capture tail risk severity.
EVaR	A measure based on expectiles, which minimize an asymmetric squared loss function.	Generalizes the mean by asymmetrically weighting probabilities, making it sensitive to the magnitude of extreme values.	Coherent (subadditive). Elicitable.	Overcomes VaR's lack of coherence and ES's lack of elicibility, greatly simplifying backtesting.
Maximum Drawdown	The maximum percentage (or absolute) loss recorded in historical peak to the subsequent trough, before a new peak is reached.	It measures the exact loss an investor would have incurred if they had bought at the absolute peak and sold at the lowest subsequent trough within a given period.	Not Elicitable.	Overcomes the limitation of point-in-time measures or those based solely on the terminal distribution.

Table 4³⁵: Risk Measures, a comprehensive review

It is possible to conclude that despite Artzner et al.'s (1999)³⁶ foundational demonstration that VaR violates the subadditivity axiom, the measure has proven remarkably persistent in industry practice. Zaeviski and Nedeltchev (2023) argue that this persistence is not merely regulatory inertia: VaR's simplicity, elicibility, and direct interpretability as a loss threshold continue to make it attractive for internal risk communication, even where ES is mandated for capital calculation under FRTB. This creates a practical tension that the literature has not fully resolved: while Acerbi and Tasche (2002) established ES as the coherent, theoretically superior alternative, its lack of elicibility long undermined confidence in its backtestability, a gap only partially

³⁵ Table 4: Created by the author

³⁶ Artzner, P., Delbaen, F., Eber, J. M., & Heath, D. (1999). Coherent measures of risk. *Mathematical Finance*, 9(3), 203-228.

closed by Candila, Gallo and Petrella (2023), who apply mixed-frequency quantile regression to jointly forecast both measures with improved backtesting performance. Expectile-based measures (EVaR) resolve this trade-off analytically, yet their limited adoption in practice, noted by Zaeovski and Nedeltchev (2023), suggests that theoretical superiority alone does not guarantee industry uptake, reinforcing the argument developed in Section 3.4 that the choice of a risk measure is ultimately governed as much by institutional and regulatory context as by statistical optimality and pragmatic usage.

3.4 Definition of best practice

The question of which risk measure performs best in practice has been addressed directly by Emmer, Kratz and Tasche (2015)³⁷, who compare VaR, Expected Shortfall and expectiles not on axiomatic grounds alone but against the requirements that arise in operational use: backtestability, robustness to estimation error, suitability for capital allocation, and interpretability for non-technical audiences. Their conclusion is that no measure dominates across all criteria, and that the relevant exercise is therefore one of matching properties to intended use rather than ranking measures in the abstract. The framework developed in this section adopts that logic and extends it with the context-specific variables that emerged from the case study, in order to produce a selection grid applicable to the constraints of a development institution. The selection of the correct measure is a recurring challenge, one that risk management teams (RMTs) explicitly address across multiple contexts. To deconstruct this challenge, it is useful to first outline the current trends faced by RMTs, and then delve into the formal procedures applied when selecting a risk measure. This approach ultimately highlights the best practices for choosing the most appropriate metric. RMTs encountered new demands, pushed by management's needs and real-world turmoil to adopt more integrated frameworks that overcome the traditional, reactive approach to risk management. In an effort to fulfill this trend, supplementing the previously regulatory-identified exposures, RMTs must now take into account additional risks: operational risks, strategic risks, climatic risks (Hudáková et al., 2026)³⁸. These new threats need to be incorporated into the risk management process. The risk

³⁷ Emmer, S., Kratz, M., & Tasche, D. (2015). What is the best risk measure in practice? A comparison of standard measures. *Journal of Risk*, 18(2), 31–60.

³⁸ Hudáková, M., Kuricová, A., & Masár, M. (2026). Dynamics of the Approach to Enterprise Risk Management in the Context of Economic Growth and Global Crises. *Administrative Sciences*, 16(3), 141.

management process (Institute of Risk Management, n.d., building on ISO 31000:2018)³⁹ steps are the following:

1. Establishment of the context and the objectives of the risk management team
2. Identification of the sources of potential losses and opportunities
3. Analysis in order to comprehend the nature and the cause of the identified risks
4. Assessment and valuation of the threats in order to prioritize the most impactful and the most probable
5. Determination of the measures to be adopted in order to control and mitigate the risk
6. Response to the threats with the most appropriate means
7. Monitor and constant review of all the risks and response decisions
8. Escalation and communication to the management

Selecting a risk measure is not an isolated event, but rather the outcome of a structured process that accounts for multiple variables; indeed, the definitive choice only takes place at Step 5. To define the relevant best practices, it is crucial to first recall the fundamental purpose of risk measures: they must guide managerial actions and support forward-looking decisions, such as investment sequencing and dynamic capital allocation. Nevertheless, this selection cannot be made in absolute terms, as the specific context of the problem dictates the key variables that ultimately drive the choice of the correct measure. Furthermore, a primary distinction must be made between qualitative and quantitative approaches. The choice between one category and the other depends on: availability of historical data, level of precision required by the management, time available for the decision, technical capabilities at the team's disposal. These variables need to be considered also when selecting a quantitative risk measure. Qualitative risk measures depend on descriptive scales and heuristic judgement. This type of assessment may be useful when the data relative to a certain event might be scarce. The main benefit is flexibility but the main drawback lies in the fact that it may be affected by cognitive bias (Aven & Thekdi, 2022)⁴⁰. Quantitative measures on the other hand, are based on statistical models that can be backtested and verified. These types of measures respond to the need to comply with financial norms and the degree of precision necessary to build internal models aligned with the company's strategy. In light of this, and given the framework of the present literature review, qualitative measures fall outside the scope of this analysis. When it comes to

³⁹ Institute of Risk Management (IRM). A Short Guide to the Risk Management Process. <https://www.theirm.org/media/2517823/8-short-guide-risk-management-process.pdf>

⁴⁰ Aven, T., & Thekdi, S. (2022). *Risk Science: An Introduction*. Routledge.

choosing an appropriate quantitative risk measure, as seen above, statistical properties take a pivotal role in the choice: in particular coherence and elicibility, which determine theoretical reliability and the checkability of the metric (Candila et al., 2023)⁴¹. Coherence consists of four properties (Artzner, Delbaen, Eber & Heath, 1999): translation invariance (adding a certain amount of cash to a position reduces the required risk capital by that same amount), sub-additivity (the risk of a combined position cannot exceed the sum of its parts, the property that makes diversification meaningful), positive homogeneity (scaling a position scales its risk proportionally), and monotonicity (a portfolio that performs worse in every state of nature requires equal or greater risk capital). Financial institutions systematically prioritize measures satisfying sub-additivity, since a metric lacking this property cannot support diversification as a risk-reduction strategy. Elicibility, formalised by Gneiting (2011)⁴², is the property that satisfies the needs of reproducibility and empirical validation. A risk measure is elicitable if there exists a function (loss function) that can be minimized in order to obtain the same results provided by the measure. This procedure can be explained as backtesting. Beyond the statistical properties previously discussed, practitioners select the most appropriate risk measure based on: the context and the information gap it aims to bridge, ensuring that management is equipped with all the necessary insights to make informed, data-driven decisions. In order to understand the context and provide management with reliable insights, it is essential to consider qualitative variables such as accuracy, trustworthiness, and interpretability. In the normative setting, the choice of a metric is guided by backtesting and trustworthiness. A prime example of a managerial decision that heavily relies on these metrics is dynamic capital allocation. Risk measures are the indicators used in order to reallocate capital towards projects and segments that are more profitable or that contribute differently in terms of consolidated risk. As new risk categories such as climate risk gain prominence, the informational needs that risk measures must satisfy evolve accordingly — reinforcing that measure selection criteria are context-dependent rather than fixed, as summarised in Table 5 below. The literature underscores the central role played by risk measures and shows that the criteria guiding the choice of one measure over another are multiple, reflecting different aspects of a company's context. In conclusion, the summary table below outlines the core criteria that must be evaluated

⁴¹ Candila, V., Gallo, G. M., & Petrella, L. (2023). Mixed-frequency quantile regressions to forecast value-at-risk and expected shortfall. *Annals of Operations Research*, 330(1–2), 321–357. <https://doi.org/10.1007/s10479-023-05370-x>

⁴² Gneiting, T. (2011). Making and evaluating point forecasts. *Journal of the American Statistical Association*, 106(494), 746–762

when selecting a risk metric. Accordingly, the best practice selection process can be formalized as follows: first, assessing the operational environment and management's informational needs; second, applying the criteria and variables delineated in this literature review; and finally, integrating the chosen metric into the described risk management framework. Crucially, this selection must be meticulously precise whenever the metric is intended to satisfy the rigorous informational demands of regulatory authorities.

Criteria	Needs that these criteria respond to
Trustworthiness	Normative needs (Backtesting and Tail risk capturing)
Interpretability	Stakeholder's information needs
Computational feasibility	Operativity and time availability needs
Comparable	Competitiveness and Internal's performance review
Context's variables	Operativity, time availability, Data availability, Complexity needs, Necessary Insights

Table 5⁴³: Criteria and needs

The selection of a risk measure should not be based on theoretical superiority alone. Best practice requires aligning the chosen metric with the practical context in which decisions are taken, including governance needs, model limitations, regulatory expectations, and business objectives.

3.5 Case study: the Local Currency Limit Framework

The process outlined will be applied to the following case study in order to assess if the AFD has chosen its risk metrics accordingly. This case study evaluates the impact of changing the risk metric within the Local Currency Limit Framework (LCLF). Recall that one of AFD's core activities is issuing loans or guarantees in developing countries, hedged through a cross-currency swap; to manage this exposure, an internal limit is necessary. In order to protect the business core, the bank has imposed a limit of EUR 4 billion⁴⁴. This limit, subject to review every year, concerns undocumented loans, for which a hedging strategy cannot be justified, and guarantees, both ARIZ and not. ARIZ guarantees are partial credit guarantees provided by AFD to financial institutions to

⁴³ Table 5: Criteria adapted from Emmer, Kratz and Tasche (2015); the backtestability dimension draws on Gneiting (2011) and Candila, Gallo and Petrella (2023). The context-specific variables are the author's own addition, derived from the operational constraints described in Section 3.7.

⁴⁴ In this section the data used will be fictitious in order to preserve the confidentiality of the data.

cover the risk of lending to SMEs (Small and Medium-sized Enterprises) in developing countries. To safeguard the bank's balance sheet equilibrium, this limit ensures that local currency volatility does not affect the expected annual net income by more than 45%. This includes considering the cumulative negative impact from swap closures, guarantee costs, and exchange rate variations. The framework takes a single binding constraint as given — the ceiling on the impact that currency movements may have on the group's annual net income, to be respected in each year of the projection horizon — and derives from it the operational parameters of the local-currency portfolio. Expressing the constraint as an expected impact rather than as a nominal cap is what allows the framework to accommodate the conditional nature of the exposure described above: the loss does not depend on how much the bank has lent, but on how much of what it has lent is expected to default while the currency has moved against it. The Correspondence Factors described below are the mechanism through which this second constraint is translated into operational guidance for the commercial teams. Maintaining a stable balance sheet and income statement is essential for the bank to sustain its role as a countercyclical player and successfully execute its mission of providing loans to developing countries. The mechanism through which a hedged exposure still transmits currency volatility to the income statement deserves clarification. Consider a loan of 100 million in local currency, funded in euros and swapped so that the local-currency repayments AFD expects to receive are exchanged for a fixed euro stream. As long as the borrower performs, the two legs offset and the exchange rate is irrelevant to the result. If the borrower defaults, the loan repayments stop but the swap obligation does not: AFD must either purchase local currency on the market to honour the remaining leg, or unwind the contract at its mark-to-market value. Either route crystallises the exchange rate movement accumulated since inception. Had the local currency moved by 20% over that period, the close-out would translate into a loss of roughly 20 million euros — an amount that never appears while the hedge is matched, and materialises in full once it is not. Volatility therefore enters the income statement conditionally, through the interaction of credit risk and currency risk rather than through either taken alone. This is why the framework does not apply currency volatility to the full nominal exposure, but to the fraction of it expected to default and remain unrecovered, as described in the following section. The same logic extends to guarantees: a call on an ARIZ guarantee denominated in local currency obliges AFD to disburse an amount whose euro cost is unknown at the time the commitment is made.

Before presenting the results of the study, the methodology used to compute the limit is described in the following section.

3.5.1 The LCLF Methodology

The LCLF computation follows a five-stage process: data input, allocation, simulation, risk-weighting, and iterative calibration. The computation starts with the following input data:

1. The actual stock and the remaining disbursement of outstanding loans in local currency
2. The business plan of the bank and Proparco's
3. Volatility of the exchange rates of the currencies used
4. The future projection of the net income of the AFD group

The actual stock describes how many loans the bank has in its books at the moment of the computation and how the repayment plan is expected to go. The business plans contain the amount of planned commitments, the nature of these operations, and the currencies and categories involved. Loans can be divided between documented and undocumented: loans are classified as undocumented if a hedging relationship cannot be justified. A hedging relationship exists if the amortization profile of the loan aligns with that of the hedging instrument. The type of interest rate of the financial product and also the disbursement date, are all elements that are present in the business model. The volatility used in this framework is computed by using the historical volatilities of the exchange rates over each of the last eight years. The maximum between the average of annual historical volatilities and the most current one is chosen as the volatility of the currency. This conservative choice ensures the model does not understate risk during periods of temporarily low market volatility, capturing instead any recent stress signal. To reduce the computational complexity of the model, currencies are divided into three different categories, with volatility as the main criterion:

- Group 1: 0% - 11%
- Group 2: 11%- 20%
- Group 3: >20%

Grouping currencies into three volatility bands, rather than modelling each currency individually, allows the framework to remain computationally tractable across AFD's large and heterogeneous portfolio of local-currency exposures, while still capturing the key driver of FX risk with sufficient granularity for capital allocation purposes. Before

the computation can begin, the business plan must be restated in terms of the three synthetic currency groups. The plan received from the commercial departments lists individual operations in real currencies; allocation keys redistribute these amounts across the groups, so that the model works with three representative exposures rather than with several dozen individual currencies. These keys are the variable the calibration adjusts: they are set to a first tentative distribution here, and revised iteratively at the final stage until the resulting impact on net income satisfies the internal ceiling. Having obtained these quantities, synthetic models are used to simulate the future flow of the business plan. These synthetic models use standardized disbursement and amortization profiles of the financial products to compute the future outcomes. The models are developed for each instrument and applied to all instruments of a certain category. The simulated cash flows assume that every loan is repaid in full, which is precisely the case in which no exchange rate exposure arises: as long as the borrower performs, the swap and the loan offset each other. The exposure that concerns the framework is therefore the fraction of the portfolio expected to default and to remain unrecovered — the part that leaves the institution carrying an unmatched swap leg. This fraction is obtained as the product of the default rate and the provisioning rate, and is referred to hereafter as the FX ratio: it is the expected loss rate on the exposure, in which the provisioning rate operates as a loss-given-default parameter, the share of the defaulted exposure that is not recovered, rather than as a buffer that removes the exposure from the computation. It is this residual fraction, and not the full nominal amount, to which currency volatility is subsequently applied. Default and provisioning rates are drawn from internal historical data and from rating agencies' estimates. Once the FX position is computed, the model applies the volatility of each currency group. This step makes it possible to estimate the impact that exchange rate movements will have on the result. To this figure, the potential negative financial outcomes below are added:

1. Closing of a swap
2. Extra costs linked to guarantees
3. Exchange rate variations of local currencies

At this stage, an iterative procedure is applied. Changing the allocation keys, it is possible to estimate an impact on the net income that does not exceed the 45% limit. The allocation keys are defined by the RMB team in coordination with the commercial departments responsible for the underlying business plan, which is recalibrated annually alongside the update of the provisional business plan. This ensures that the

framework reflects both the latest currency volatility data and any shift in AFD's planned lending activity. After identifying the optimal global envelope through iteration, the system calculates "Correspondence Factors". These factors act as risk weights. Once the optimal allocation is reached, each factor is derived as the ratio between the net income impact generated by a given category of operations — defined by currency group and by documentation status — and the exposure that generated it. The factor therefore measures the cost of that category in terms of the constraint: how much of the available envelope one euro lent in it consumes. A higher factor signals a proportionally greater draw on the limit. A simple example illustrates the point. Suppose a documented loan in a group 1 currency, taken as the reference category, is assigned a factor of 100, and that a documented loan in a group 3 currency receives a factor of 170. Lending EUR 100 million in the first category consumes EUR 100 million of the envelope; lending the same amount in the second consumes EUR 170 million of it. The two operations are identical in size on the balance sheet, but the second exhausts the limit almost twice as fast, because the higher volatility of a group 3 currency produces a proportionally larger impact on net income for the same exposure. Undocumented loans, which transmit exchange rate movements to the result irrespective of borrower default, carry factors higher still. This is what makes the framework operational rather than merely analytical: rather than being told only that a global ceiling exists, commercial teams can see what each operation costs against it at the moment they structure it, and can arbitrate between volume and currency composition accordingly. Since undocumented loans and highly volatile currencies carry more risk, they "consume" the available limit much faster than stable, documented currencies and loans. This ensures the commercial teams balance their lending activities appropriately. A simplified numerical example, using fictional data, is presented in the following section to illustrate the methodology described above.

3.5.2 Application of the methodology

The work starts by gathering data from the provisional business plan. The Financial Executive Directorate (DEF) is responsible for AFD's plan, and Proparco contributes to it. The bank has a net income of one billion euros, and an actual loan stock of 600 million. On the commercial side, the bank plans to issue 300 million euros per year for three years. A default rate of 6% and a provisioning rate of 67% are assumed. Combining these two parameters yields 4%, hereafter referred to as the FX ratio,

representing the expected loss rate. It is possible, at this stage, to compute the volatility of each currency, in which the bank plans to extend loans, and to regroup them into three classes. In Table 6, generic currencies are used as allocation keys in order to simplify the process.

Group	Allocation	Volatility
XD1	40%	8%
XD2	40%	15%
XD3	20%	25%

Table 6⁴⁵: Repartition of currencies into three different synthetic groups

The total exposure to FX is the sum of the actual stock and the provisional business plan amount, in this case 900 million. The exposure is then computed using the generic currencies as allocation keys. The results of the multiplication are presented in Table 7.

Group	Allocation	Exposure (Mln)
XDI	40%	360
XD2	40%	360
XD3	20%	180

Table 7⁴⁶: AFD exposure per currency group

The FX position is the exposure multiplied by the FX ratio. The impact of the volatility on the net income is then computed by multiplying the FX position by the currency's volatility. Additional costs, assumed for simplicity to be 2 million, are then added to the impact. The resulting impact is well below 45% of the net income of one billion.

Group	FX position	Impact (Mln)
XDI	14.4	1.16
XD2	14.4	2.16
XD3	7.2	1.80

Table 8: Monetization of volatility's impact of the three groups

In practice, unlike in the simplified example above, this procedure is carried out with a forward-looking perspective, using synthetic models. After all the computations are

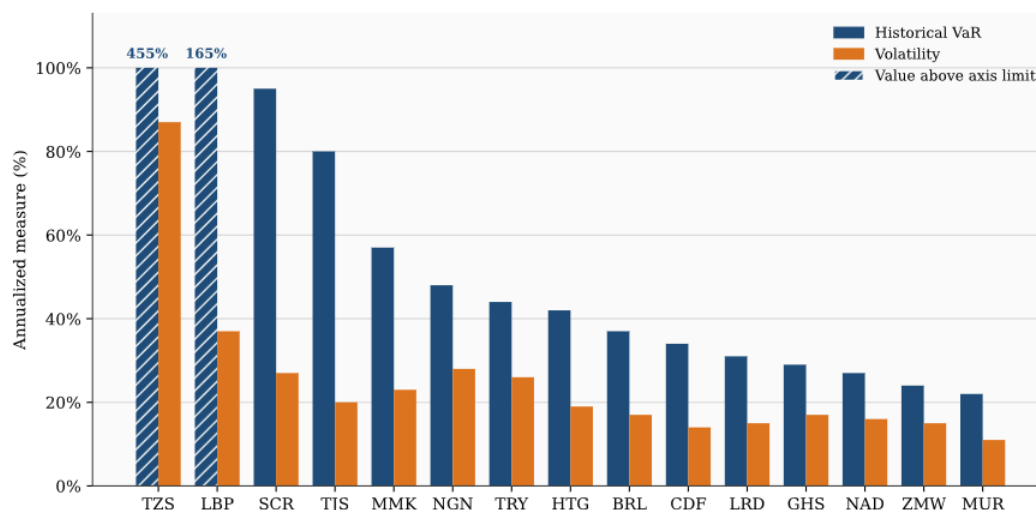
⁴⁵ Table 6: Created by the author, based on fictitious data

⁴⁶ Table 7,8: Created by the author based on fictitious data

done, the total future impact is computed. If, on the one hand, the result would be well below 45% of the net income, the provisional business plans could be changed. The amounts of loans and financial products denominated in local currencies could therefore be increased. If, on the other hand, the amount would be higher instead, it would be necessary to recompute the entire framework by decreasing the total amount of loans expressed in the business plan. After having found the policy-adequate amounts and therefore the linked “Correspondence Factors”, the limit is defined and the business plan is approved. During my internship I explored quantitatively one of the propositions made by a consultant to the AFD, whose analysis aimed to make the methodology more solid and rigorous from a statistical point of view, and to identify the model's most impactful parameters. The proposal examined here concerns the parameter through which exchange rate risk enters the computation. As described above, that parameter is the volatility of the currency: the standard deviation of daily exchange rate changes over a 360-day observation period, sourced from Bloomberg, retained as the greater of the value observed on the calculation date and the 8-year historical average. Volatility, however, is a measure of the dispersion of returns around their mean; it is not a risk measure, since it says nothing about the size of an adverse movement. The proposal was therefore to replace it with a genuine risk measure, and the Historical VaR was put forward as the alternative. Comparing the two requires placing them on a common scale. The Historical VaR is obtained as the 99% quantile of daily log-returns for each calendar year and scaled to an annual horizon via the square-root-of-time rule ($\sqrt{252}$), while the volatility is already expressed on an annualized basis. The scaling implicitly assumes i.i.d. returns; since this assumption is violated in the presence of the fat tails documented in Section 3.6.1, the annualized VaR should be read as a conventional rescaling rather than as a literal annual loss forecast. Even though the VaR and volatility have different statistical natures it was chosen as the appropriate option, in this framework, for different reasons: the statistical properties of the VaR (e.g. Elicitability) and its supposed higher order of magnitude compared to volatility. This greater magnitude, in particular, was a requested property. A more conservative estimate of risk was explicitly sought by management, since a metric that captures a larger potential loss at the same confidence level provides a stronger buffer against underestimating exposure. Holding all other variables constant, if replacing volatility with VaR results in a lower limit, this would confirm that currency volatility is a key and impactful parameter within the methodology, a hypothesis tested in the following section.

3.6 Impact Study

The comparison presented in this section is exploratory in nature: it quantifies the magnitude of the shift from volatility to VaR before any formal validation of the two measures. Section 3.6.1 then subjects this observation to confirmatory statistical testing, examining whether the anomalies identified below reflect genuine tail risk or estimation artefacts. The comparison was done by using the volatility implemented in last year's limit calculation. To compute the Historical VaR, the exchange rate daily prices (2017 to 2025) were downloaded from Bloomberg. The 99% quantile was computed for each currency for each year using log-returns. The VaR used in the computation of the limit was chosen with the same logic used to choose volatility: the maximum between the mean of the computed VaR and the most recent VaR. The result from this process was compared to the volatility in Graph 3 below. The two values falling outside the axis range are themselves informative: an annualized VaR exceeding 100% has no economic interpretation as a loss forecast, and signals that the square-root-of-time rescaling breaks down precisely where the underlying series is dominated by discrete administered adjustments rather than continuous market movement.



Graph 3⁴⁷: Currencies volatility and VaR, a comparison

⁴⁷ Graph 3: Created by the author, currencies volatility and VaR, a comparison. Subset of the 15 currencies with the highest annualized VaR, out of the 64 in the sample. The vertical axis is truncated at 100%; hatched bars indicate values above the limit, reported above the bar. The TZS figure should be interpreted with caution: the underlying price series exhibits prolonged sequences of stale quotes punctuated by large offsetting jumps, suggesting data-quality artefacts rather than genuine market dynamics

As expected, the VaR exceeds volatility for every currency in the sample, but this follows by construction. Under normality the 99% quantile equals 2.33σ standard deviations, the informative comparison is against 2.33σ itself and the question is by how much, and for which currencies, the empirical VaR departs from it.

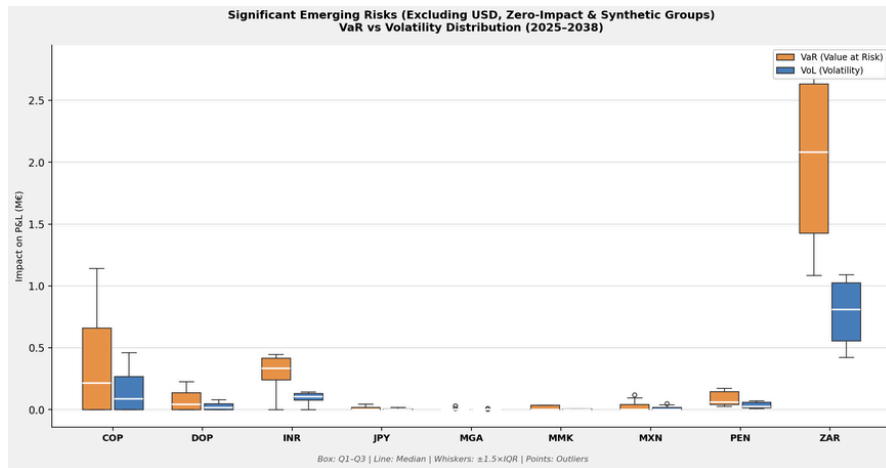
Currency	$ \text{VaR} /(2.33\sigma)$	ES/VaR
TZS	2.31	1.00
TJS	1.94	1.25
LBP	1.48	1.54
IDR	1.23	1.27
SCR	1.12	1.26
EGP	0.79	2.96
ETB	0.58	2.59
<i>Mean</i>	<i>1.18</i>	<i>1.39</i>
<i>Median</i>	<i>1.17</i>	<i>1.28</i>
<i>Gaussian benchmark</i>	<i>1.00</i>	<i>1.15</i>

Table 9⁴⁸: Historical Simulation VaR against its normal-theory benchmark (2.33σ) and Expected Shortfall

Table 9 reports the ratio between the Historical Simulation VaR and 2.33σ , the value VaR would take under normally distributed returns, for the highest and lowest ratios in the sample, together with representative mid-range currencies; both ratios are computed over all 64 currencies of the sample, of which the table reports the extremes and representative intermediate values. A ratio close to one indicates that the currency behaves approximately as the normal distribution predicts; a ratio above one indicates extreme losses larger than volatility suggests. The sample mean of 1.18 (median 1.17) shows that, on average, empirical tails are about 18% larger than the Gaussian assumption implicit in a volatility-based framework. The extremes of the distribution coincide with the currencies flagged by the statistical validation. The highest ratios belong to administratively managed or illiquid currencies (TZS 2.31, TJS 1.94), where infrequent discrete adjustments dominate the empirical quantile while day-to-day volatility remains compressed. The lowest ratio belongs to the ETB (0.58), whose administratively dampened volatility produces almost no VaR violations. The second column extends the comparison beyond the VaR threshold itself. It reports the ratio between the 99% Expected Shortfall and the 99% VaR, both obtained by historical simulation on the same series and aggregated under the same selection rule; the 99% level is retained, rather than the 97.5% adopted under the FRTB, to preserve direct

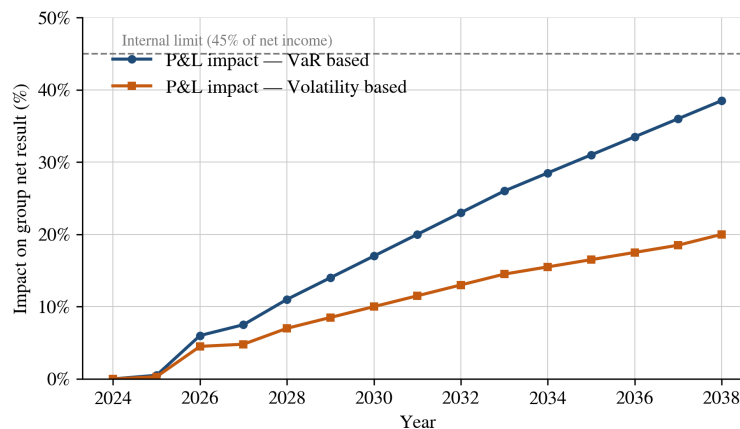
⁴⁸Table 9: Created by the author computed over all 64 currencies

comparability with the VaR already embedded in the LCLF. Under normality this ratio equals 1.15. The sample mean is 1.39 and 84% of currencies exceed the Gaussian value, indicating that the region beyond the VaR is systematically heavier than the normal model implies. The two columns do not rank currencies in the same order, and the divergence is itself the finding. The currencies with the lowest ratios in the first column, ETB (0.58) and EGP (0.79), are both administratively managed, and they record the highest ES-to-VaR ratios in the sample (2.59 and 2.96). The two columns are measuring different things. Where the central bank holds the rate, almost all daily returns are close to zero, so the 99% quantile is small and the currency appears safe: this is what the first column captures. The second column looks beyond that threshold, and finds the opposite picture. The rare days on which the regime gives way produce losses several times larger than the threshold itself. A VaR-based reading alone would rank these currencies among the least risky in the portfolio; the Expected Shortfall reverses that conclusion. Conversely the TZS, which records the highest VaR ratio (2.31), returns an ES-to-VaR ratio of exactly 1.00: the observations in its tail are of identical magnitude, so the average of the tail coincides with its threshold. The ratio thus confirms, from an independent angle, both the core argument for a quantile-based measure and the boundary conditions discussed in Section 3.7, under which neither measure can anticipate risk absent from the historical sample. Using the described methodology, the impact on Profit and Loss (P&L) for each currency was then estimated. The following boxplots present the result, excluding currencies with zero impact and the US dollar, which was treated as an outlier. The USD/EUR pair is excluded for two related reasons. Conceptually, the US dollar is a hard currency in which AFD already holds structural exposure, rather than a 'local currency' subject to the LCLF. Empirically, the absolute size of AFD's USD exposure is large enough that its P&L impact figure dominates the scale of the chart, obscuring the comparatively smaller impacts on the local currencies the LCLF is actually designed to manage.



Graph 4⁴⁹: P&L impacts single significant currencies

Overall, replacing the dispersion measure with a more 'stressed' measure significantly increased the impact on net income. This can also be observed in the projection of the total P&L impact per year in the following graph.



Graph 5⁵⁰: P&L impact on the group net result

The VaR-based projection roughly doubles the estimated impact on the bank's result over the horizon, reaching approximately 39% of group net income by 2038 against 20% under the volatility-based measure. The internal 45% ceiling is not breached, but the margin available for additional local-currency commitments contracts from some 25 percentage points to 6. This matters operationally: the framework is designed to expand the business plan whenever the projected impact remains well below the limit, so a residual margin of this size would materially constrain the calibration of future business plans and require the allocation keys to be revised accordingly. The currencies most affected by the change were: Tajikistani Somoni (official currency of

⁴⁹ Graph 4: Created by the author based on Bloomberg data and fictitious exposures.

⁵⁰ Graph 5: Created by the author based on Bloomberg data and fictitious exposures.

Tajikistan, TJS), Seychellois Rupee (official currency of Seychelles, SCR), Tanzanian Shilling (official currency of Tanzania, TZS). These currencies registered high percentage increases: for instance in magnitude of about 400%, for the TZS, compared to the initial volatility used in the limit calculation. Two non-exclusive explanations can be offered: illiquidity, which widens the gap between compressed daily volatility and the empirical quantile, and the structural inability of volatility to capture tail risk. The conducted study demonstrates the dependency of the LCLF on the choice of the parameter used to measure exchange rate risk. Section 3.6.1 examines these currencies more closely through formal statistical testing, disentangling these explanations currency by currency and distinguishing genuine tail risk from estimation artefacts.

3.6.1 Statistical validation

Three specific tests were chosen to validate the risk model from three distinct angles: data distribution, real-world accuracy, and statistical reliability. Rather than relying on a single metric, this combined approach helps pinpoint exactly where the historical simulation might fail. First, the Kupiec test checks if the VaR model correctly predicts actual market losses. Second, the Jarque-Bera test assesses whether that standard volatility is inadequate because currency returns are not normally distributed. Finally, the bootstrap method ensures that the risk estimates are truly robust and not simply distorted by random data noise or illiquid market conditions. The Proportion of Failures test (Kupiec, 1995)⁵¹ was applied to each currency over the same sample period (02/01/2017 - 31/12/2025), to verify whether the observed frequency of VaR breaches matches the theoretical 1% rate implied by the 99% confidence level. To avoid the circularity of testing an empirical quantile on the same sample used to estimate it, the backtest is conducted out-of-sample: the VaR applied in year t replicates the LCLF selection rule using only information available up to year $t-1$. The results reveal a more nuanced picture than a simple pass/fail assessment: the model fails in two opposite directions, depending on the currency regime.

⁵¹ Kupiec, P. H. (1995). Techniques for verifying the accuracy of risk measurement models. *The Journal of Derivatives*, 3(2), 73-84.

Currency	Violations	Obs.	Violation rate (%)	p-value
ETB	4	2,063	0.19	< 0.0001
LBP	61	2,084	2.93	< 0.0001
TJS	42	1,987	2.11	< 0.0001
SCR	14	1,564	0.90	0.6713
USD	32	2,087	1.53	0.0232
ZAR	18	2,088	0.86	0.5165
<i>Aggregate — all 64 currencies</i>				
Rejections at 5%			32/64 (50.0%)	
Rejections (Bonferroni)			11/64 (17.2%)	
Median violation rate		1.39% (IQR: 0.95–1.73%); target: 1%		
Binomial test vs. 5%				$p < 0.0001$

Table 10⁵²: Proportion of Failures test (Kupiec, 1995)

Table 10 shows that the model is not correctly calibrated across the whole sample. Testing 64 currencies at the 5% level, roughly 3 rejections are expected by chance alone even if the model were perfectly calibrated; 32 currencies are rejected. To confirm that this is not an artefact of running many tests at once, the Bonferroni correction was applied: the significance threshold is divided by the number of tests, so that a currency is rejected only if its p-value falls below 0.05/64, approximately 0.0008. Eleven currencies are rejected on this stricter criterion, which cannot be attributed to multiple testing. The direction of the failures differs. Under administered regimes the model produces far fewer breaches than the 1% target: the ETB records 4 against roughly 21 expected, and the test rejects it for *overestimating* risk. Where a regime break occurs, the model fails in the opposite direction, the LBP recording 61 breaches against the same expectation. The model is therefore miscalibrated in both directions: it under-covers most currencies while over-covering administratively managed ones. The six representative currencies in the table illustrate three distinct regimes. The first regime is that of administered currencies, such as the Ethiopian Birr and, outside the six currencies shown, the Tanzanian Shilling. Here the central bank controls the exchange rate (IMF, 2024)⁵³, daily volatility is artificially close to zero, and the model records almost no violations: the test rejects it for *overestimating* risk. This apparent prudence is misleading. The three largest single-day losses in the entire sample all

⁵² Table 10: Created by the Author. Note: All statistical test metrics, coefficients, and p-values are expressed in absolute decimal units. The number of observations reported here is lower than in Table 12 because the out-of-sample design discards the first year of each currency's series, which serves exclusively to estimate the VaR applied in the following year. The shortfall is approximately 260 days for currencies quoted from the beginning of the sample, and 219 days for the six currencies whose available history starts on 28 February 2019 (BIF, DJF, GNF, HTG, LRD, SCR).

⁵³ International Monetary Fund. (2024). *Annual Report on Exchange Arrangements and Exchange Restrictions 2023*. <https://doi.org/10.5089/9798400260391.012>

come from administered regimes breaking down: the Lebanese Pound's official devaluation of 1 February 2023 (−90%), a further step on 19 February 2024 (−84%), and the Ethiopian Birr's halving of 30 July 2024, following the float announced the previous day. The second regime is that of currencies hit by a regime break or traded in thin markets, such as the Lebanese Pound and the Tajikistani Somoni. Here the model fails in the opposite direction: it *underestimates* risk. The Lebanese Pound records violations on 2.93% of days, three times the 1% target, because the VaR estimated on past data could not anticipate the collapse of the peg in 2023. The TZS presents an additional, distinct issue: a data-quality artefact. Its price series exhibits prolonged sequences of stale quotes punctuated by large offsetting jumps of identical magnitude, which often reverse the following day. The ~400% increase reported in Section 3.6 should therefore be read in this light: it blends genuine administered-regime jumps with data-quality noise, and the two are hard to separate in thinly quoted series. The third regime is that of liquid currencies, such as the South African Rand, for which the model is correctly calibrated. Correct calibration here refers to the adequacy of the measure, not to the calmness of the currency: the Rand is among the more volatile currencies in the sample, and its VaR is correspondingly large, but it floats freely in a deep market and its return distribution is stable enough in shape for a quantile estimated on past data to hold in the following year. The US Dollar is a borderline case: at 1.53% against the 1% target it is rejected at the 5% level, showing that the model slightly underestimates risk even for the most liquid pair in the sample, and not only for the illiquid currencies discussed above. To empirically justify the shift from volatility to a tail-sensitive measure, the Jarque-Bera (1980)⁵⁴ normality test was applied to daily log-returns of all currencies.

	Skewness	Currency
Minimum	−36.0777	UZS
Maximum	8.9361	HTG
Average	−2.4857	
Median	−0.1939	
	Excess Kurtosis	Currency
Minimum	0.8610	FJD
Maximum	1581.3454	UZS
Average	117.2521	
Median	5.0425	
Normality rejected (Jarque–Bera, 5%): 64/64 currencies (100%)		

Table 11⁵⁵: Skewness, excess kurtosis and Jarque–Bera normality test

⁵⁴ Jarque, C. M., & Bera, A. K. (1980). Efficient tests for normality, homoscedasticity and serial independence of regression residuals. *Economics Letters*, 6(3), 255-259.

⁵⁵ Table 11: Author's processing based on daily log-returns.

The data exhibits severe departures from normality. With samples of roughly 2,300 daily observations per currency, the rejection of normality is expected on statistical grounds alone and is not, in itself, the informative result: what matters is the magnitude of the departure. The average excess kurtosis reaches 117.25 against a Gaussian value of zero, and the median currency records 5.04, evidence of pronounced leptokurtosis across the whole sample rather than in a handful of outliers. Together with the VaR-to- 2.33σ ratio of Section 3.6, the two diagnostics are complementary: the test confirms that the normal distribution is the wrong model, while the ratio quantifies the resulting error at roughly 18% of the tail estimate. This provides strong empirical support for the adoption of Historical Simulation VaR to adequately capture extreme tail events. A non-parametric bootstrap (Efron, 1979)⁵⁶ with 1,000 resamples was applied to quantify the estimation uncertainty of the VaR, particularly for currencies with limited historical liquidity.

Currency	Observations	95% CI Lower	95% CI Upper	CI Width
TJS	2246	-0.0398	-0.0191	0.0207
ETB	2322	0.0000	0.0000	0.0000
LBP	2341	-0.0167	-0.0163	0.0004
TZS	2333	0.0000	0.0000	0.0000
USD	2346	-0.0136	-0.0110	0.0026
SCR	1782	-0.0621	-0.0509	0.0112

Table 12⁵⁷: Bootstrap confidence interval widths by currency

The confidence interval width for illiquid currencies is up to an order of magnitude larger than the USD benchmark. The empirical execution provides critical insights into the reliability of the historical Value at Risk estimates across different liquidity regimes. By quantifying the estimation uncertainty through the confidence interval width, a stark divergence emerges between highly liquid benchmark currencies and emerging market regimes. For major global pairs, represented by the USD (USD/EUR), the historical simulation engine produces a highly robust and stable point estimate, evidenced by a remarkably narrow confidence interval width of 0.0026. This confirms that for sufficiently deep markets, the baseline risk model is largely immune to sampling noise. Conversely, the bootstrap diagnostics reveal profound structural vulnerabilities when the model is applied to exotic or illiquid currencies. The Tajikistani Somoni (TJS) and Seychellois Rupee (SCR) exhibit dramatically wider intervals, with the TJS uncertainty spread being nearly an order of magnitude larger than that of the benchmark. The two

⁵⁶ Efron, B. (1979). Bootstrap methods: Another look at the jackknife. *The Annals of Statistics*, 7(1), 1–26.

⁵⁷ Table 12: Created by the Author. Note: Value at Risk boundaries, confidence intervals, and width thresholds are quantified in absolute decimal values (where a value of -0.0100 equates conceptually to a -1.00% daily log-return).

currencies differ in the source of that uncertainty. The SCR is quoted continuously but only from February 2019, so its estimate rests on roughly a quarter fewer observations than the currencies available from the beginning of the sample; part of the width of its interval is attributable to sample length rather than to market depth, which is consistent with its correct out-of-sample coverage in Table 10. The TJS is quoted throughout the period but with pronounced gaps, and there the wider interval does reflect thin trading: it is both imprecisely estimated and genuinely under-covered. The ETB and the TZS show the opposite case. For both, the bootstrap confidence interval collapses to exactly zero width: under an administered regime almost all daily returns are zero, so every resample gives a VaR of zero. The model treats these currencies as risk-free with maximum apparent certainty. Yet this stability is only apparent — both underwent abrupt one-day devaluations. A zero-width interval does not mean the risk is well measured; it means the data, dominated by artificial stability, contains no information about the devaluation the regime is building up. The Lebanese Pound shows the same mechanism in a milder form. Its confidence interval is narrower than the dollar's, even though the LBP is the worst-covered currency in the sample. The peg held for most of the observation window, so almost every daily return is close to zero and the 99% quantile is surrounded by nearly identical observations: each resample returns almost the same value, and the estimate looks precise. What the interval measures, however, is the internal consistency of the sample, not whether the sample contains the risk the currency actually carries. The devaluation of 2023 lies outside the range of behaviour on which the quantile was estimated. Taken together, these three diagnostics support the adoption of Historical Simulation VaR as a statistically superior alternative to volatility for the purposes of the LCLF: it is moderately under-covered at the aggregate level, with miscalibrations concentrated in identifiable and interpretable regimes rather than distributed randomly (Kupiec), and it directly addresses the pronounced leptokurtosis that characterizes emerging market currencies (Jarque-Bera), a feature volatility alone cannot capture. Two currency-specific limitations emerge from these diagnostics; their implications for the LCLF are discussed in Section 3.7.

3.7 Application of the literature review on the LCLF framework

This section applies the criteria established in Sections 3.3-3.4 to the empirical evidence produced in Sections 3.6-3.6.1, in order to assess whether the ongoing shift from volatility to Historical Simulation VaR within the LCLF constitutes a genuine improvement, and to what extent it satisfies the best-practice framework identified in

the literature review. The choice of volatility as a measure to assess the dispersion of exchange rates was appropriate due to the information and operational needs that it satisfies. The AFD context presents different features and challenges that can influence the risk measurement process of exchange rate risk:

- Team's limited resources and moderate computational resources
- Limited data sources (Illiquid emerging currencies)
- Investments' elevated time horizon
- A stringent and regulated environment
- Necessity of communicating interpretable and clear results to committees with different backgrounds

Table 13 identifies five criteria that jointly determine the suitability of a risk measure: trustworthiness, interpretability, computational feasibility, comparability, and context-specific variables. Below volatility and Historical Simulation VaR are evaluated against each of these criteria, drawing on the empirical results obtained in Section 3.6.1.

Criterion	Volatility	Historical Simulation VaR
Trustworthiness	Not formally backtestable	Elicitable risk measure
Interpretability	High; Single number, directly comparable year-on-year	High; Familiar to governance bodies
Computational feasibility	High; standard deviation on Bloomberg data	Moderate; requires historical simulation and quantile estimation across multiple years of data
Comparability	Feasible	Feasible
Context-specific fit	Fails to reflect the heterogeneity of AFD's currency universe: a single dispersion statistic compresses very different risk profiles into a comparable numerical range	Explicitly conservative and quantile-based, which preserves rather than compresses the underlying heterogeneity of the portfolio

Table 13⁵⁸: Applications of “best practices” criteria to the AFD's LCLF context

The last row is the central finding of this section. Because volatility is a second-moment, symmetric statistic, it treats deviations above and below the mean as equally informative, and produces broadly similar numerical outputs for currencies whose actual risk profiles differ substantially. Historical Simulation VaR, by directly reading the extreme quantile of the empirical distribution, does not average this asymmetry away: it generalizes more coherently across a heterogeneous currency universe such as AFD's, precisely because it lets the data determine the outcome,

⁵⁸ Table 13: Created by the author

rather than compressing it through a single symmetric statistic. This distinction, rather than the magnitude difference emphasized in Section 3.6, is the strongest statistical argument in favor of the transition. This conclusion is not unconditional, however.

The validation exercise in Section 3.6.1 identifies two boundary conditions under which VaR's advantage narrows. For administratively managed currencies (ETB, TZS), historical data cannot, by construction, anticipate a devaluation risk that has not yet materialized within the sample, meaning VaR inherits a limitation shared with volatility itself. For genuinely illiquid currencies (TJS, SCR), the point estimate carries substantial sampling uncertainty; the resulting figure should therefore inform, rather than mechanically determine, the corresponding LCLF allocation. Both limitations concern a specific, identifiable minority of AFD's currency universe, but this minority overlaps materially with AFD's core geographic exposure in Sub-Saharan Africa, making the caveat operationally relevant rather than a marginal statistical footnote. While Historical Simulation VaR represents the most suitable option within AFD's current institutional constraints, the literature reviewed in Section 3.3 identifies measures that could further strengthen the framework in the longer term. The Expected Shortfall, reported alongside the VaR in Table 9, could further enhance the statistical solidity of the framework. It overcomes VaR's lack of sub-additivity and its inability to capture tail risk severity. ES's less accessible interpretability and more difficult backtesting remain its main drawbacks. The Maximum Drawdown could be an option, but its path-dependent nature and the difficult backtesting are the main difficulties in implementing it. A risk measure based on expectiles could combine the solidity of the statistical properties of the ES and the VaR, with a less complex backtesting procedure. Expectiles are relatively new risk measures and using them in a regulated and institutional environment could be hard to justify. The transition from a purely dispersion-based metric to a genuine risk measure may not be fully achievable, given the different statistical nature of these tools. Nonetheless, this study shows that a risk measure can be used not only as a portfolio-level KPI, but also as a parameter within a broader model. Statistical properties, interpretability, trustworthiness and comparability are features that transcend the context and make a measure versatile. These features with the correct application of criteria can establish the foundation of a trustworthy risk management model. In direct response to the research question, the evidence developed in this thesis indicates that best practice does not prescribe a universally superior measure, but rather the selection of a measure whose properties match the intended use. Relative to volatility, Historical Simulation VaR dominates on the criteria

that bind in this context: it is elicitable and therefore backtestable, and it preserves rather than compresses the heterogeneity of AFD's currency universe. It does not satisfy coherence, and Section 3.3 identifies ES and expectiles as the natural direction of travel. Its adoption should nonetheless be accompanied by targeted safeguards for the specific subset of currencies where historical data structurally cannot anticipate future risk (administratively managed regimes) or where the estimate itself carries material uncertainty (illiquid regimes).

4. Conclusion

4.1 Conclusion

The literature review and the case study define the best practices to follow in order to choose the appropriate risk measure. The application of a process open to doubt and reformulation is the main pillar for arriving at the indicator best aligned with the challenges of the context. In AFD's case the process is still ongoing: volatility and VaR are both part of the framework's evolution. The VaR approach demonstrates that viable alternatives exist. However, its historical formulation does not account for the temporal structure of volatility, a limitation that GARCH-based models could address. The conducted study on the Local Currency Limit Framework (LCLF) demonstrated the dependency of the results of the model on the choice of the risk measure. It, therefore, highlighted the importance of choosing the most appropriate measure. Volatility was the appropriate measure at the time the original model was built, given the team's resources and data constraints. The evidence developed in this thesis indicates that Historical Simulation VaR is now the more suitable measure. To further challenge the model, expectiles-based risk measures could be used as the proper alternative to both VaR and volatility; this measure offers an appropriate trade-off between statistical properties and practical needs; its main drawback is that it is not yet a standard at the institutional level, and supporting material would need to be produced to justify this choice of metric. The evidence arising from the literature review points out that a unique and best risk measure, in absolute terms, does not exist. The context must be considered and the "best practice" outlined must be put in place to ensure an appropriate trade-off between operational feasibility and statistical complexity. The literature review proposed does not list all the possible variants of risk measures that can be used, but it highlights the importance of questioning the choices made, the need to analyse the features of the environment and the necessity of staying up to date with

research and methodological advances. A lack of analysis of modern approaches is one of the limits of this work. Machine learning approaches and Stochastic modelling could now strengthen the risk management robustness. The ideal procedure, given the lack of comparable players and competitive standards in AFD's environment, would be to benchmark against other PDBs, similarly to the ALM benchmark finalized during my internship. A stronger collaboration between institutions would benefit both the institutions themselves and, ultimately, the borrowers.

4.2 Academic contribution of the training

The courses that I attended during my master's degree gave me the knowledge to understand the office's technical environment and the institution's context. The toughest challenge was the language barrier: writing emails with the proper formality code, making small talk and not completely understanding the conversations or explanations, and dealing with firm-specific processes, language and vocabulary. Reading and constant exposure helped me improve, but the language was not a negligible obstacle. The other main challenges concerned data and coordination rather than software. The stressed liquidity indicator ran on a procedure spread across multiple Excel files and a 500-line Python script I had not written, and it raised data quality issues almost every week; the difficulty was never the computation but locating the origin of a discrepancy, which could lie in a manual entry, in the procedure, in the database, or anywhere along the data pipeline. The GEMs assemblies posed the opposite problem: coordinating participating institutions, service providers and the GEMs secretariat under tight deadlines, while the structure of the conference was still being defined. Neither was a technical difficulty, and neither was something my studies had prepared me for. I was able to meet these challenges thanks to "*Derivatives and Insurance*" and "*Advanced Methods for Risk Management*" courses that I attended respectively during my first and second master's year, in particular the exercises and the knowledge required to pass the exam. The courses "*Corporate Banking and Credit Analysis*" and "*Financial Economics*", that I attended during my first master's year, introduced me to Excel as a computational tool thanks to their group work. The course "*Introduction to Algorithmic trading*", which I was able to attend at Université Paris - Dauphine, provided me with the fundamental Python knowledge to be able to read and understand the code. I was able to contribute to the organization of the GEMs consortium annual assemblies and to conduct the impact study on the Local Currency

Limit Framework because of the challenges I faced during my academic journey. I managed to cope with the confrontation with complex concepts, complicated files and tight production deadlines not because of a particular concept that I learned or a particular course that I attended but thanks to the overall soft skill of tackling complex problems and the ability to learn that university gave me. Moving from the theoretical frameworks and 'error-safe' space that university offers to real consequences, deadlines and real hands-on models was for me the most challenging part, where university could have prepared me better. During my academic journey I had multiple opportunities to do project work, but I always chose people that I knew or that I could trust. If I could go back in time I would have preferred professors to assign groups in order to break comfort zones and force us to create teams with new people. University trained me to interrogate arguments, sources and data, objects that hold still while you examine them. Working inside an institution required a different exercise: reading intentions that are never stated outright, and asking why a given actor was pushing a given position at a given moment. Understanding what was actually happening around me depended as much on this as on any technical analysis.

4.3 Personal assessment of the work done and perspectives on the long term professional project

Driven by a strong commitment to the common good, I dedicated my early academic and professional efforts to the NGO sector and the study of Multilateral Development Banks. Transitioning into my recent internship, however, marked a turning point in how I perceive development finance. I entered the role with an idealized vision of Public Development Banks, viewing them primarily as saviors for those in need. By the end of my experience, I had developed a more pragmatic understanding: rather than operating in a vacuum of high ideals, these institutions are deeply intertwined with diplomatic influence, operating at the complex intersection of finance, policy, and political reality. Far from undermining their purpose, this political anchoring is what allows them to act: backed by sovereign shareholders, they remain one of the main means by which richer countries provide infrastructures, loans, and technical support to people living in developing countries. For instance the AFD finances loans to build power plants to bring electricity to people currently living without. My personal beliefs did not change but my professional aims broadened. Before this experience I could not see myself anywhere other than in an MDB, but now I would be open to working in

other purpose-driven organizations, maybe more focused on model validation matters and more linked with quantitative subjects. The opportunity to exchange views with my N+2 manager, who offered to accompany me in the orientation program offered for V.I.E. professionals, and my colleagues also made me understand that I have time to reach my objectives and helped me to get to know myself better. For me, Multilateral Development Banks (MDBs) were and remain my ideal environment and subject of study, combining employability, international recognition, ambition, intellectually interesting financial topics, and purpose. Working in the risk department or in more “on field” projects, in an international institution, continues to be the main driver but in order to arrive there I would need to acquire more professional knowledge as MDBs hire mid/senior-level professionals. I would be interested in working in international, purpose-driven organizations or projects with a strong risk-management component.

5. Appendices

5.1 Bibliography

Generative AI tools were used to support language editing and as an aid in exploring the literature. All sources were independently verified, and all analysis, results, and conclusions are the author's own.

Acerbi, C., & Tasche, D. (2002). On the coherence of expected shortfall. *Journal of Banking & Finance*, 26(7), 1487–1503.

Adler, M., & Dumas, B. (1984). Exposure to currency risk: Definition and measurement. *Financial Management*, 13(2), 41–50.

Agence Française de Développement. (n.d.-a). *Notre histoire*. Retrieved from <https://www.afd.fr/fr/notre-histoire>

Agence Française de Développement. (n.d.-b). *Financial reports*. Retrieved from <https://www.afd.fr/en/ressources-accueil>

Agence Française de Développement. (2022). *Statuts de l'Agence Française de Développement*.

Agence Française de Développement. (2025). 2024 Universal Registration Document. <https://www.afd.fr/en/ressources/2024-universal-registration-document>

Agence Française de Développement. (2026). *AFD's 2026 funding program*. Press release.

Artzner, P., Delbaen, F., Eber, J.-M., & Heath, D. (1999). Coherent measures of risk. *Mathematical Finance*, 9(3), 203–228.

Aven, T., & Thekdi, S. (2022). *Risk science: An introduction*. Routledge.

Basel Committee on Banking Supervision. (2011). *Basel III: A global regulatory framework for more resilient banks and banking systems*. BIS.

Basel Committee on Banking Supervision. (2019). *Minimum capital requirements for market risk*. BIS.

Candila, V., Gallo, G. M., & Petrella, L. (2023). Mixed-frequency quantile regressions to forecast VaR and ES. *Annals of Operations Research*, 330, 321–357.

Efron, B. (1979). Bootstrap methods: Another look at the jackknife. *The Annals of Statistics*, 7(1), 1–26.

Embrechts, P., Klüppelberg, C., & Mikosch, T. (1997). *Modelling Extremal Events for Insurance and Finance*. Springer.

Emmer, S., Kratz, M., & Tasche, D. (2015). What is the best risk measure in practice? A comparison of standard measures. *Journal of Risk*, 18(2), 31–60.

Engle, R. (2002). Dynamic conditional correlation: A simple class of multivariate GARCH models. *Journal of Business & Economic Statistics*, 20(3), 339–350.

European Banking Authority. (2025). *Draft regulatory technical standards on the treatment of structural FX positions*. EBA/RTS/2025/09.

European Parliament & Council. (2013). *Regulation (EU) No 575/2013 on prudential requirements*. Official Journal of the EU, L 176.

European Parliament & Council. (2013). *Directive 2013/36/EU on access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms (CRD IV)*. Official Journal of the EU, L 176.

Expertise France. (n.d.). *L'agence française de coopération technique*. Retrieved from <https://www.expertisefrance.fr/>

Fitch Ratings. (2025). *Agence Française de Développement — Rating Report*, 24 September 2025.

G20, GIF, & IMF. (2024). *Addressing exchange rate risk in infrastructure projects in EMDEs*. Report for G20 IWG.

GEMs Consortium. (n.d.). *Global Emerging Markets Risk Database*. Retrieved from gemsriskdatabase.org

Gneiting, T. (2011). Making and evaluating point forecasts. *Journal of the American Statistical Association*, 106(494), 746–762.

Hudáková, M., Kuricová, A., & Masár, M. (2026). Dynamics of ERM in the context of global crises. *Administrative Sciences*, 16(3).

Institute of Risk Management. (n.d.). *A short guide to the risk management process*. IRM.

International Organization for Standardization. (2018). *ISO 31000:2018 – Risk management — Guidelines*. ISO, Geneva.

International Monetary Fund. (2024). *Annual report on exchange arrangements and exchange restrictions 2023*. <https://doi.org/10.5089/9798400260391.012>

Jarque, C. M., & Bera, A. K. (1980). Efficient tests for normality and homoscedasticity. *Economics Letters*, 6(3), 255–259.

- Kupiec, P. H. (1995). Techniques for verifying the accuracy of risk measurement models. *The Journal of Derivatives*, 3(2), 73–84.
- Madura, J. (1989). *International financial management*. West Publishing Company.
- McNeil, A. J., & Frey, R. (2000). Estimation of tail-related risk measures for heteroscedastic financial time series: an extreme value approach. *Journal of Empirical Finance*, 7(3–4), 271–300.
- McNeil, A. J., Frey, R., & Embrechts, P. (2015). *Quantitative Risk Management: Concepts, Techniques and Tools* (Revised ed.). Princeton University Press.
- Ministère de l'Europe et des Affaires étrangères. (n.d.). *Development assistance*. Retrieved from diplomatie.gouv.fr
- Müller, F. M., & Righi, M. B. (2024). Comparison of VaR multivariate forecast models. *Computational Economics*, 63(1), 75–110.
- Okot, A., Kaltenbrunner, A., & Perez Ruiz, D. (2022). Determinants of the exchange rate, its volatility and currency crash risk in Africa's low and lower middle-income countries (EIB Working Paper No. 2022/12). European Investment Bank.
- Papaioannou, M. (2006). *Exchange rate risk measurement and management*. IMF Working Paper No. WP/06/255.
- Patton, A. J. (2006). Modelling asymmetric exchange rate dependence. *International Economic Review*, 47(2), 527–556.
- Proparco. (n.d.). *Accueil*. Retrieved from <https://www.proparco.fr/>
- Shapiro, A. C. (1996). *Multinational financial management*. Wiley.
- Zaevski, T. S., & Nedeltchev, D. C. (2023). From BASEL III to BASEL IV and beyond: Expected shortfall and expectile risk measures. *International Review of Financial Analysis*, 87, 102645.
- Zhang, F., Xu, Y., & Fan, C. (2023). Nonparametric inference of expectile-based value-at-risk for financial time series with application to risk assessment. *International Review of Financial Analysis*, 90, 102852.
- Ziegel, J. F. (2016). Coherence and elicibility. *Mathematical Finance*, 26(4), 901–918.

5.2 Company's Evaluation

INTERNSHIP EVALUATION FORM

Student's Name: Andrea Gligor

Company: Agence Française de Développement (AFD)

Company Supervisor: Eric Collet

Internship Period: 5 janvier 2026 au 3 juillet 2026

Mission accomplished during the internship:

- Production bi-hebdomadaire de l'indicateur de liquidité stressé, amélioration et adaptation des outils, analyse, restitution en comité de trésorerie
- Implication dans préparation de l'accueil des assemblées du consortium GEM's (Global Emerging Markets) à Paris en mars 2026.
- Revue méthodologique du calcul des stress sur les taux de changes, intégré au cadre de monnaie locale de l'AFD.
- Contributions diverses aux travaux du pôle : suivi et mise au propre des limites de risque de contrepartie, étude ponctuelle sur le risque de concentration, recette sur l'industrialisation du calcul de l'indicateur de liquidité stressé dans l'entrepôt de données, ...

Evaluation:

- | | | | | |
|---------------------------------|-------------------------------|---------------------------------|---|---|
| - Task Difficulty: | ☐ Easy | ☐ Medium | ☒ Difficult | ☐ Very Difficult |
| - Creativity and Initiative: | ☐ Low | ☐ Medium | ☐ Good | ☒ Excellent |
| - Technical Competence: | ☐ Low | ☐ Medium | ☐ Good | ☒ Excellent |
| - Quality and Rigor: | ☐ Low | ☐ Medium | ☐ Good | ☒ Excellent |
| - Integration into the Company: | ☐ Low | ☐ Medium | ☐ Good | ☒ Excellent |

Overall impression from the company supervisor:

Andrea a pleinement contribué aux travaux du pôle et a pris en charge les sujets confiés avec beaucoup de rigueur. Sérieux, investi et rapidement autonome, il s'est révélé être un collaborateur fiable sur lequel nous avons pu compter. Son implication et la qualité de son travail lui ont permis de s'intégrer très rapidement à l'équipe.

Signature



5.3 Appendix A: AFD's organigram and DSR's structure

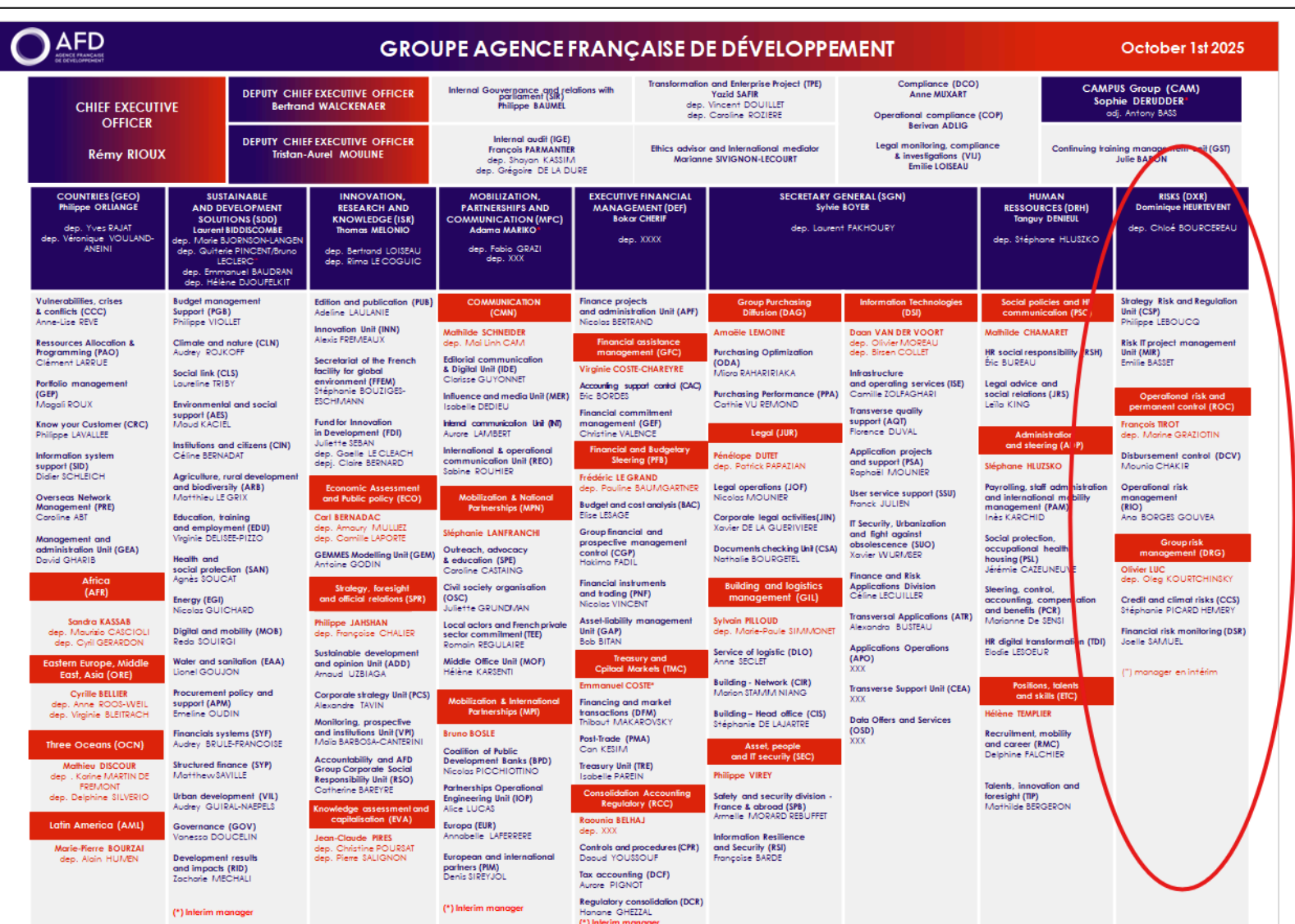


Figure 3⁵⁹: The AFD's organigram

⁵⁹ Figure 3: Intranet - La ruche

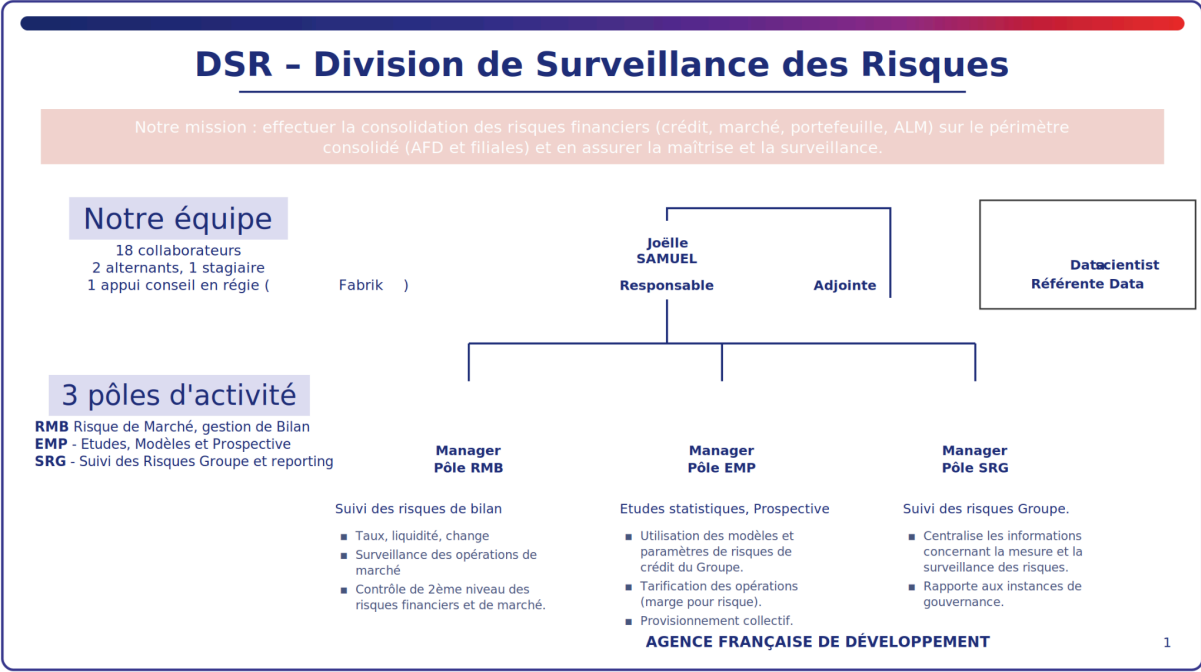


Figure 4⁶⁰: The DSR division

⁶⁰Figure 4: Intranet - La ruche