TUNIS BUSINESS SCHOOL
UNIVERSITY OF TUNIS

Derivatives Project

2023-2024

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- The Teaching Assistants

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I. Introduction

This document holds the comprehensive analysis conducted within the framework of the Derivatives project, under the guidance of **Professor Eymen Erraies** and the help of the **Teaching Assistants**. This analysis is backed by the knowledge that we got equipped with in this course.

The work methodology can be presented as follows :

The analysis process has started with a thorough understanding of the insurance companies in Tunisia : *operations, stock market presence, etc.*

After contacting the potential insurance companies, we collaborated with MAE Assurances with which many meetings were held to insure an efficient work flow.

Then, the calculations of the assets and liabilities duration has been performed, which revealed the type of the insurance company's sensitivity to the interest rate.

With these collected insights, the contacting of banks has been undertaken, resulting in an agreement with Amen Bank about the creation of a swap contract with MAE Assurances.

After having discussed and negotiated the details of the swap calculations and the contract terms with both parties, we finalized the swap agreement.

II. Insurance Companies Research

1. *Analysis of their Characteristics*

In the initial phase of the project, a thorough comprehension of the Tunisian insurance sector was needed. This encompassed an in-depth analysis of *their operations, distinctive attributes, stock market presence*, reputation, etc.
To achieve this objective, comprehensive data on **34 insurance companies** were compiled and evaluated. This assessment facilitated the filter of the list to **15 companies**, which were identified as optimal candidates for potential collaboration: non-listed, non-islamic, and have shown ease of reachability and communication (an engagement in Quality Education SGD and an active presence on their social media platforms).

2. *Contacting Phase*

The contacting of the insurance companies started on the **12th of February until the 8th of March**. The methods of communication used include phone calls, emails, and LinkedIn messages.
During this period, 8 companies were responsive and 4 of them proceeded to have a physical meeting with them (GAT Assurances, AMI Assurances, Assurances At-Takafulia, and MAE Assurances).

Moreover, an explanatory document, as well as a presentation, were prepared and discussed with the directors during the meetings in order to thoroughly explain the project and how they could benefit from it.

❖ Mutuelle Assurances de l'Enseignement (MAE) Contacting

MAE was the insurance company with which we will be collaborating in this project.

A. Timeline

Feb 11, 2024 : The contacting was initiated with the Financial Director, Mme Myriam Ben Abdennebi, through Linkedin.

Mar 1, 2024 : A physical meeting was held in which the Financial Director showed her interest to collaborate with us in this project.

Mar 12, 2024 : The necessary data was sent by MAE Assurances.

Apr 26, 2024 : A physical meeting was conducted to verify the calculations results.

May 9, 2024 : Verification of the assets' duration calculation and inquiry of the liabilities data.

May 31, 2024 : Discussing the swap contract details.

Jun 6, 2024 : Confirming swap contract terms.

III. Risk assessment

A. Definition

Risk assessment through the calculation of **interest rate risk** involves evaluating how changes in interest rates will affect the price of a bond or a bond portfolio. This is typically done using a measure known as **duration**.

1. **Compute the Duration of Resources (Liabilities):** Duration is a measure of the sensitivity of the price of a bond or a bond portfolio to changes in interest rates. It's calculated as the weighted average of the times until those fixed cash flows are received.

   Liabilities= **net premium received**

   - **Automobile** (property and casualty insurance)
   - **Life insurance**

$$D_{liabilities} = \frac{\sum_{i=1}^{n} PV_i \cdot t_i}{\sum_{i=1}^{n} PV_i}$$

PV_i : is the present value of cash flow

t_i : is the time in years until the cash flow is received

n : is the total number of cash flows

2. **Compute the Duration of Allocations (Investments):** The duration of allocations or investments is calculated in a similar way to the duration of resources. It's the weighted average of the times until the fixed cash flows from the investments are received.
    - **BON DE CAISSE** (Zero coupon bond)
    - **COMPTE DE PLACEMENT** (Investment & Savings Account)
    - **CERTIFICAT DE DEPOT** (Certificate of Deposit)
    - **EMPRUNT OBLIGATAIRE** (Bond issue)

$$D_{assets} = \frac{\sum_{i=1}^{n} PV_i \cdot t_i}{\sum_{i=1}^{n} PV_i}$$

3. **Compute the Net Duration:** The net duration is the difference between the duration of the assets and the duration of the liabilities. It gives an overall measure of the interest rate risk.

$$D_{net} = D_{assets} - D_{liabilities}$$

B. Yield To Maturity Calculation

- **Zero coupon rate** :

Calculating **zero-coupon rates** using the **Nelson Siegel model** gives zero-coupon rates expressed exponentially, i.e. continuously.

This model is used by Tunisie Clearing

i. Les taux zéro-coupon exponentiels :

Le calcul des taux zéro-coupon via le modèle de Nelson Siegel donne des taux zéro-coupon exprimés en exponentiel, c'est à dire en continu. Ils sont déduits de la formule du modèle en remplaçant les paramètres par leurs valeurs à la date de calcul et en choisissant la maturité dont le taux sera calculé :

$$t_i = \beta_0 + \beta_1 \times \left(\frac{1 - e^{-i\lambda}}{i\lambda}\right) + \beta_2 \times \left(\frac{1 - e^{-i\lambda}}{i\lambda} - e^{-i\lambda}\right)$$

*8eb2038b-2e32-4588-bf2d-26bbd35e071d.pdf (tunisieclearing.com)

1. *Parameters*

The model includes four parameters:

- β_0 **(Beta Zero)**: Represents the **level factor** or the long-term average yield. It determines the overall level of the yield curve.
- β_1 **(Beta One)**: The **slope factor** captures the sensitivity of the yield curve to changes in short-term interest rates.
- β_2 **(Beta Two)**: The **curvature factor** accounts for the convexity or concavity of the curve.

2. Decay parameters

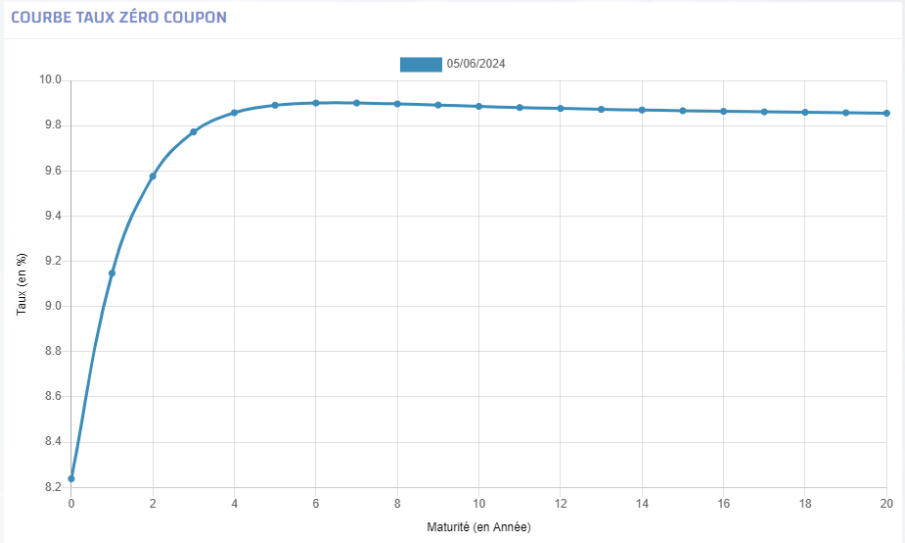
The model also includes two decay parameters:

- **λ (Lambda)**: Controls how quickly the short-term interest rate converges to its long-term average.

$$r(t) = \beta_0 + \beta_1 \frac{1-e^{-\lambda t}}{\lambda t} + \beta_2 \left(\frac{1-e^{-\lambda t}}{\lambda t} - e^{-\lambda t} \right)$$

b0	b1	b2	lambda
0.095288	-0.01479662	0.012641	0.7165927763

The parameter values were determined utilizing the **Solver** function in Excel, with the primary objective of minimizing the squared residual between the continuous Nelson-Siegel rate and the BTA rate obtained from Tunisie Clearing .



C. Asset Duration

- **Credit rating**

Ratings are assigned by credit rating agencies, the largest of which are Standard & Poor's, Moody's, Fitch Ratings and AM Best(specializing in the insurance industry). They use letter designations such as A, B, and C. Higher grades are intended to represent a lower probability of default.

Table 4
SPREADS BETWEEN CORPORATE BONDS AND U S. TREASURIES
1973–87 Averages

Rating	Basis Points
AAA	43
AA	73
A	99
BBB	166
BB	299
B	404
CCC	724

Source Altman (1989)
Note Based on equally weighted averages of monthly spreads per rating category Spreads for BB and B represent data for 1979–87 only, spreads for CCC, data for 1982–87 only

Wayback Machine (archive.org)

Upon reaching out to MAE, we learned that a significant portion, specifically 60%, of their business dealings are conducted with the government and its institutions. The remaining 40% comprises banks and few leasing transactions.

Risk premium= 60% * RP of government + 30% * RP of banks (benchmark TLF)

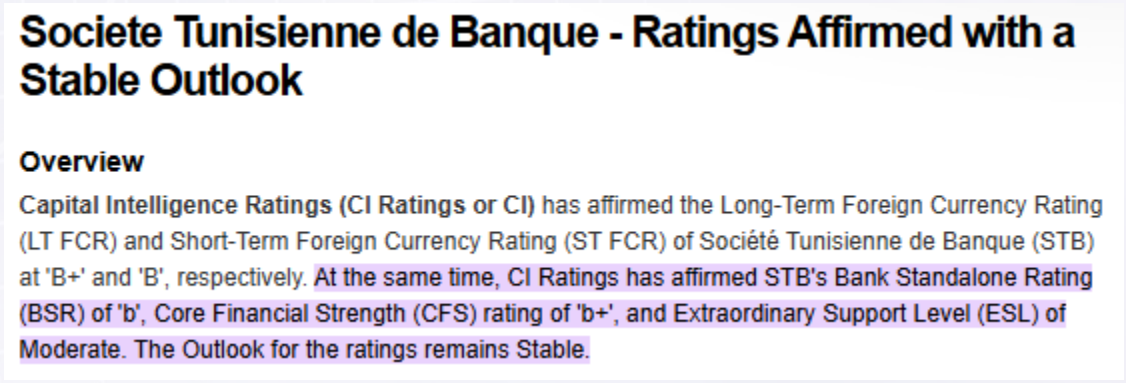
+ 10% * RP of Leasing (benchmark TLF)

Tunisie Leasing et Factoring (tlf.com.tn)

Ratings

National

National Long-Term Rating	BBB(tun)
National Short-Term Rating	F3(tun)



Societe Tunisienne de Banque - Ratings Affirmed with a Stable Outlook

Overview

Capital Intelligence Ratings (CI Ratings or CI) has affirmed the Long-Term Foreign Currency Rating (LT FCR) and Short-Term Foreign Currency Rating (ST FCR) of Société Tunisienne de Banque (STB) at 'B+' and 'B', respectively. At the same time, CI Ratings has affirmed STB's Bank Standalone Rating (BSR) of 'b', Core Financial Strength (CFS) rating of 'b+', and Extraordinary Support Level (ESL) of Moderate. The Outlook for the ratings remains Stable.

stb

The bank that MAE collaborates with most frequently is STB, which is referred to as “bank6” in the data that’s why we choose it as reference here.

- **TMM**

The **FORECAST.ETS** function in Excel was utilized to predict the TMM. This prediction was based on the data from the past two years, which exhibits a seasonal trend. This calculated prediction was then used to determine the coupon of variable bonds (TMM+spread)

Statistique - Money market average TMM (bct.gov.tn)

Indicators	2019	2020	2021	2022	2023	2024
January	7.24000	7.81000	6.15000	6.19000	7.96000	7.98000
February	7.28000	7.84000	6.23000	6.25000	8.02000	7.97000
March	7.90000	7.35000	6.23000	6.26000	8.05000	7.96000
April	7.86000	6.80000	6.25000	6.26000	8.01000	
May	7.83000	6.80000	6.25000	6.60000	8.00000	
June	7.83000	6.80000	6.26000	7.01000	8.00000	
July	7.83000	6.82000	6.29000	7.02000	8.00000	

- **Present value of future CF**

Coupon bond:

If present date < maturity date → discount coupon by yield

If present date = maturity date → discount (coupon+notional) by yield

Amortized bond:

If present date <= maturity date → discount coupon+part of principal by yield

Yield = zero coupon rate annual + default risk premium

- **Time to maturity**

time to maturity= (maturity date - today)/(365 or 360)

today= 04/01/2024 (the date we've started calculating duration)

Compte de placement + certificat de dépôt + emprunt obligataire → 360 base

Bon de caisse —> 365 base

D. Liability Duration

Mae Insurance Company has furnished us with a comprehensive list of all automobile contracts (referred to as 'auto21') along with a detailed list of charges applicable in the event of an accident. Mr. Slim has confirmed that these contracts are renewable for a period of three years.

We have proceeded to add three years to all the dates in the provided data. Utilizing the VLOOKUP function, we have merged both tables based on the 'n_client' column. This allowed us to determine if the date of the accident falls within the contract's start and end dates. Subsequently, we discounted the net premiums, which represent the premiums received by the insurance company after deducting the costs of underwriting.

Furthermore, Ms. Maryem has informed us that they are unable to provide us with other types of property and casualty insurance. However, she did mention that life insurance constitutes 12% of auto insurance.

Liability Duration = Life Duration + Auto Duration

Risk premium of MAE= RP of government (as mentioned by Mr lassaed)

E. Net Duration

This net duration will give an idea of the overall interest rate risk.

When the **net duration** of a firm is positive, it signifies that the firm's assets are more sensitive to interest rate changes than its liabilities. This is known as **interest rate risk**. If interest rates rise, the value of the firm's assets would decrease more than the value of its liabilities due to the higher sensitivity (or duration), potentially leading to a decrease in the firm's net worth.

Conversely, if interest rates fall, the value of the firm's assets would increase more than the value of its liabilities, potentially leading to an increase in the firm's net worth. Therefore, a positive net duration can have both positive and negative impacts on a firm's financial position, depending on the direction of interest rate changes.

IV. Banks Research

1. *Analysis of their Characteristics*

As the research that was made on insurance companies, we also conducted a comprehensive analysis of the **23 banks available in Tunisia.** We have gathered useful information that will help us to determine the best bank to collaborate with: *operations, experience with derivative products, reachability, etc.* Then, we classified them according to priorities criterias.

2. *Contacting Phase*

The contacting of the insurance companies was between the **3rd and 4th of June**. The methods of communication used include phone calls, emails, and LinkedIn messages.

During this phase, 5 banks were responsive (AMen Bank, QNB-Tunis, UBCI, BTL, and STB) and 1 of them proceeded to have a physical meeting with them (Amen Bank).

❖ Amen Bank Contacting

Amen Bank is the bank that we will be collaborating with in this project.

A. Timeline

Jun 3, 2024 : The contact was initiated through phone with Msr Hedia Jellouli, the Director of Financial Markets, and a meeting was booked.

Jun 4, 2024 A physical meeting was held in which the Director showed her interest to collaborate with us in this project.

V. Swap Contract

1. Swap Agreement

Preamble:

This Swap Agreement is made and entered into as of June 6, 2024, between MAE Assurances, an insurance company with its headquarters at Avenue Ouled Haffouz, Tunis, and Amen Bank, a bank with its headquarters at Avenue Mohamed 5, Tunis.

Article 1: Incorporation of the ISDA Master Agreement

The parties agree that this Agreement is subject to the terms of the 2002 ISDA Master Agreement, which is incorporated by reference as if fully set forth herein, except as modified by this Agreement. In the event of any inconsistency between the terms of this Agreement and those of the ISDA Master Agreement, the terms of this Agreement shall prevail.

Article 2: General Conditions

Payments under this Agreement must be made on the due date for value on that date at the account specified in the relevant Confirmation or otherwise in accordance with this Agreement and the ISDA Master Agreement, in freely transferable funds and in a manner customary for timely payments in the required currency. Where settlement is to be made by delivery, such delivery must be made for receipt on the due date in a manner customary for the relevant obligation, unless otherwise specified in the relevant Confirmation or elsewhere in this Agreement.

Article 3: Definitions of Terms

In addition to the terms defined elsewhere in this Agreement, the definitions and provisions contained in the 2006 ISDA Definitions are incorporated into this Agreement. Terms used but not defined herein shall have the meanings assigned to them in the ISDA Master Agreement.

a. *Confirmation:* Also called a swap confirmation. It is a document used by the parties to a derivatives transaction to specify the commercial terms of the transaction, including pricing terms such as spreads.

b. *Event of Default:* Any event specified in the contract that constitutes a breach of contractual obligations by either party, potentially triggering remedies or termination rights.

c. *Payment or Delivery Default:* The failure of a party to make a payment or delivery by the due date as stipulated in the terms of the contract or a Confirmation.

d. *Breach of Agreement:* Any violation or non-performance of the terms and conditions specified in this Agreement or any Confirmation, other than a Payment or Delivery Default.

e. *Collateral Default:* The failure to provide or maintain collateral or other credit support as required by the terms of the contract, or a breach related to collateral or any other credit support document.

f. *Misrepresentation:* Any false statement or omission of a material fact made by a party in connection with the contract, including statements and warranties that prove to be inaccurate or misleading.

g. *Default in a Designated Transaction:* The occurrence of a breach, event of default, or other similar condition under the terms of any other agreement or transaction between the parties that is designated as a designated transaction in this Agreement.

h. *Cross Default:* A clause that triggers a default under this Agreement due to a default or event of default under another agreement or obligation of a party, as specified in this Agreement.

i. *Bankruptcy:* The occurrence of any of the following events with respect to a party: insolvency, inability to pay its debts when due, filing for bankruptcy, appointment of a trustee or receiver, or any other similar proceeding or action indicating financial distress or insolvency.

j. *Non-Assumed Merger:* The consolidation, amalgamation, or merger with or into another entity, or the transfer of all or substantially all assets to another entity without the consent of the other party, where the resulting or transferee entity fails to assume the obligations of this Agreement.

k. *Party A:* MAE Assurances

l. *Party B:* AMEN Bank

m. *Termination Event:* Termination events include, but are not limited to, the following:

(1) Failure of either party to perform its material obligations under this Agreement; (2) Insolvency or bankruptcy of either party; (3) Merger or acquisition resulting in a change of control; (4) Any other event agreed upon in writing by the parties.

Article 4: Payments and Settlements

Payments under this Agreement must be made on the due date for value on that date at the account specified in the corresponding Confirmation or otherwise in accordance with this Agreement, in freely transferable funds and in the manner customary for timely payments in the required currency.

Article 5: Legal Obligations

The obligation of each party is subject to: (1) the condition precedent that no Event of Default or Potential Event of Default with respect to the other party has occurred and is continuing, (2) the condition precedent that no Early Termination Date relating to the relevant transaction has occurred or been effectively designated, and (3) any mutually applicable condition precedent specified in this Agreement.

Article 6: Conditions in the Event of Default

The following events of default apply to the parties under the specified conditions:

- Article 2(c) (Payment or Delivery Default) applies to Party A and Party B.
- Article 2(d) (Breach of Agreement) does not apply to either Party A or Party B.
- Article 2(e) (Collateral Default) does not apply to either Party A or Party B.
- Article 2(f) (Misrepresentation) does not apply to either Party A or Party B.
- Article 2(g) (Default in a Designated Transaction) does not apply to either Party A or Party B.
- Article 2(h) (Cross Default) does not apply to either Party A or Party B.
- Article 2(i) (Bankruptcy) applies to Party A and Party B.
- Article 2(j) (Non-Assumed Merger) applies to Party A and does not apply to Party B.

Article 7: Termination Events

In the event of a Termination Event under Article 5(m), the non-defaulting party must send a written notice to the defaulting party, specifying the nature of the breach and granting a cure period of [insert number] days from the date of such notice.

Article 8: Governing Law

This Agreement is governed by and construed in accordance with the law of the State of Tunisia, without regard to conflict of law provisions.

2. Confirmation

By entering into an interest rate swap, both parties can effectively hedge their risks. The insurance company can offset the risk of rising interest rates by receiving a floating interest rate from the bank. On the other hand, the bank can offset the risk of falling interest rates by receiving a fixed interest rate from the insurance company.

Swap Details

-Currency: Tunisian Dinars

-Applicable Law: Tunisian Law
-Swap Type: plain vanilla
-Principal Amount: X
-Fixed Rate: 10.19%
-Floating Rate: tmm+2.25%
-Term: 3 years from today
-Frequency: annually
-Initial Swap Value: Zero

3. A model of Confirmation of and IRS Operation

From: MAE Assurances

To: Amen Bank

We hereby confirm the terms of the swap transaction between Amen Bank and MAE Assurances under the agreement established between the two institutions.

The statements made at the conclusion of the master agreement are renewed by each party as of the date of the interest rate swap transaction.

Commencement Date: 06/06/2024
Final Maturity Date: 06/06/2027

- **Variable Amount Payer: Amen Bank**

-Notional Amount: TND X

-Variable Rate: TMM + 2.25 percent

-Frequency: Annual

-Calculation Basis for Variable Amounts: Actual/360

-Variable Rate Determination Date: 2 business days preceding the first business day of each application period.

-Variable Amounts: An amount equal to the product of the notional amount, the variable rate, and the calculation basis for variable amounts.

-Variable Amounts Application Period: Annually, every June 6, starting on June 6, 2024, and ending on the final maturity date.

-Variable Rate for the First Calculation Period: 9.15 percent

-Variable Amounts Payment Date: The last business day of each variable amounts application period.

-Capitalization: None

- **Fixed Amount Payer: MAE Assurances**

-Notional Amount: TND X

-Fixed Rate: 10.19 percent

-Frequency: Annual

-Calculation Basis for Fixed Amounts: Actual/360

-Fixed Amount: An amount equal to the product of the notional amount, the fixed rate, and the calculation basis for fixed amounts.

-Fixed Amounts Application Period: Annually, every June 6, starting on June 6, 2024, and ending on the final maturity date.

-Fixed Rate for the First Calculation Period: 9.15 percent

-Fixed Amounts Payment Date: The last business day of each fixed amount's application period.

Payment Instruments:

- **Payment to MAE Assurances:** Account for payment in TND
- **Payment to Amen Bank:** Account for payment in TND

Notification:

Notification to be sent to Amen Bank:

Amen Bank
Avenue Mohamed 5
1002 Tunis
Tel: 71 148 888

Notification to be sent to MAE Assurances:

MAE Assurances
Avenue Ouled Hafouz
1075 Tunis
Tel: 70 020 300

In light of these risks, each party declares and attests that it possesses the necessary investment knowledge and experience to evaluate the characteristics and risks involved in this transaction.

Each party declares and attests that it has identified its needs with respect to this transaction relative to its business and financial situation and has conducted its own analysis of the financial, legal, tax, accounting, and regulatory aspects of the transaction, without relying on the other party for this purpose.

Sincerely,

MAE Assurances

Amen Bank

Name : Myriam Ben Abdennebi

Title : Financial Director

Date : Thursday, June 6th, 2024

Amen Bank

BY :

BY : MAE Assurances

Name : Hedia Jellouli

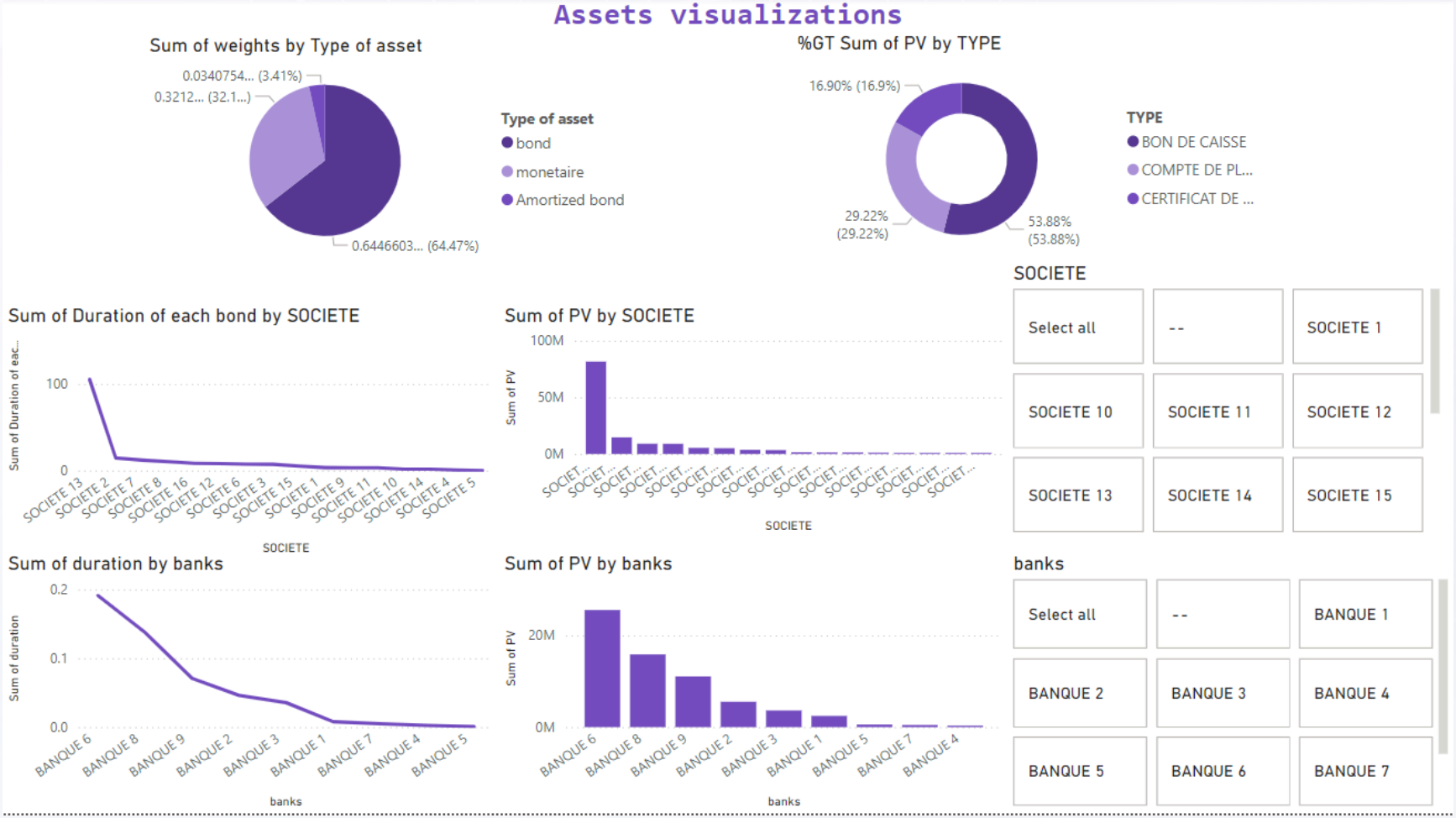
Title : Director of Financial Markets

Date : Thursday, June 6th, 2024

VI. PowerBi Dashboard

The Dashboard created provides a visual summary about the insurance company's assets, liabilities and the Swap contract created. It contains 3 pages:

A. Assets' Visualization



This page describes the following:

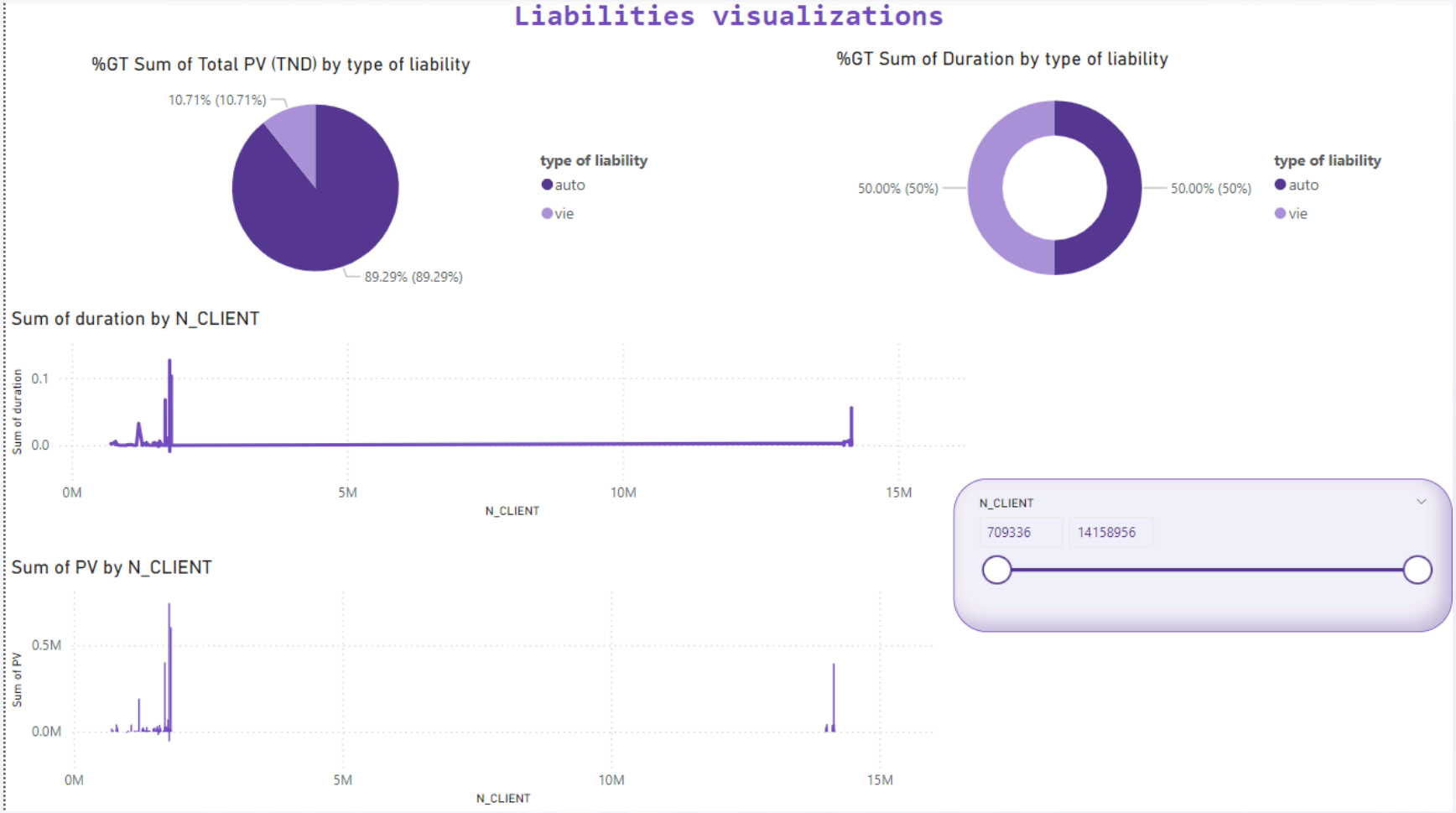
- **Sum of weights by Type of asset**: This is a pie chart that shows the total weight for each type of asset. The two types of assets in this example are “bond” and “monétaire”.
- **Sum of PV by TYPE**: This is a donut chart that shows the percentage of the total present value (PV) for each type of asset.
- **Sum of Duration of each bond by SOCIETE**: This table shows the sum of the duration of each bond by issuer (SOCIETE).
- **Sum of PV by SOCIETE**: This table shows the sum of the present value (PV) for each issuer (SOCIETE).

Note: There is also a slicer to select a specific society.

- **Sum of duration by banks**: This table shows the sum of the duration of bonds by bank.
- **Sum of PV by banks**: This table shows the sum of the present value (PV) for each bank.

Note: There is also a slicer to select a specific bank.

B. Liabilities' Visualization



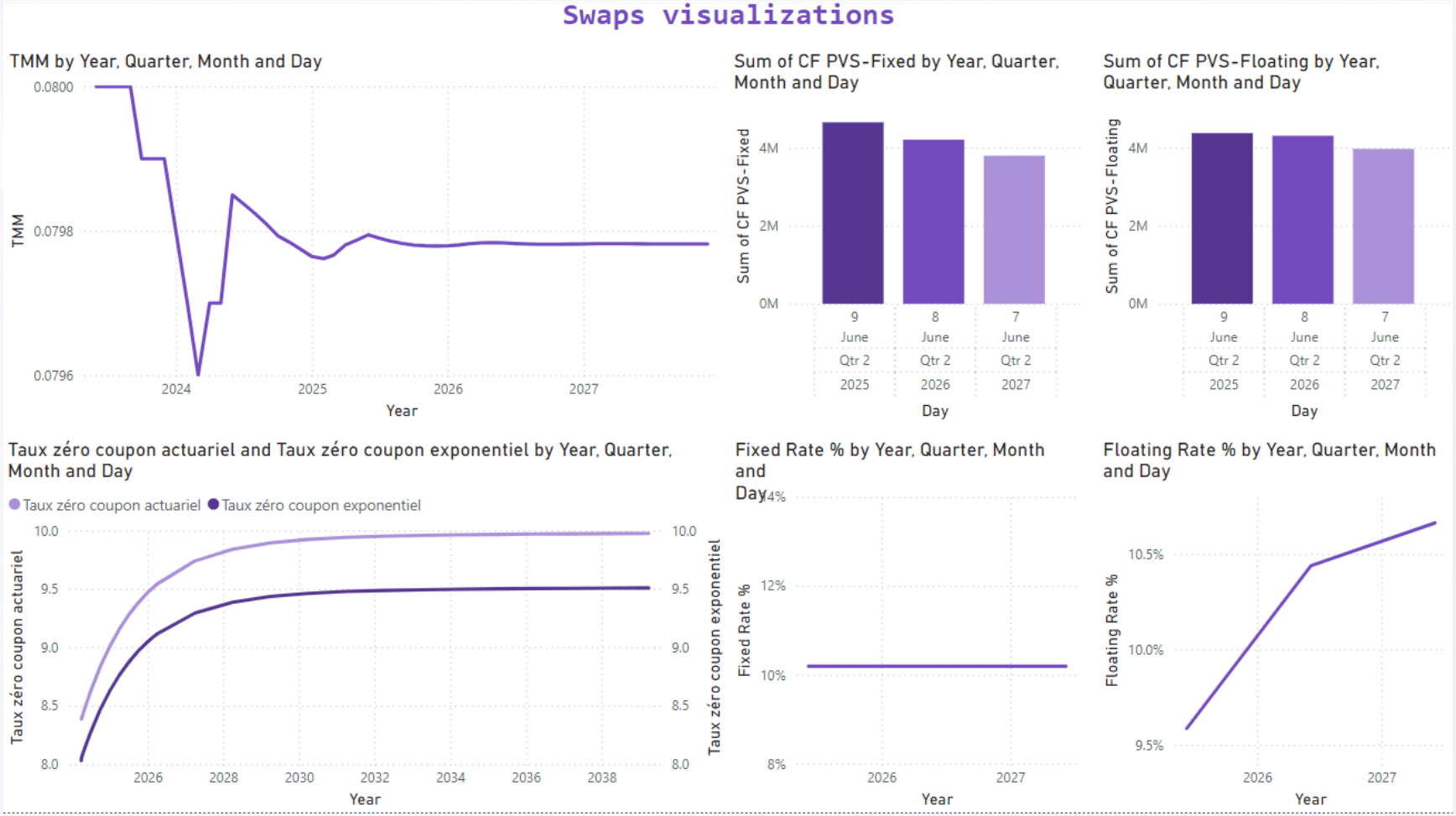
This page describes the following:

- **Sum of Duration by type of liability**: This is a pie chart that shows the total duration for each type of liability. The two types of liabilities in this example are “auto” and “vie”.
- **Sum of Total PV (TND) by type of liability**: This is a donut chart that shows the percentage of the total present value (TND) for each type of liability.
- **Sum of duration by N_CLIENT**: This table shows the sum of the duration of liabilities by client.
- **Sum of Total PV (TND) by N_CLIENT**: This table shows the sum of the total present value (TND) for each client.

Note: There is also a slicer to select a specific client.

- **Sum of PV by N_CLIENT**: This table shows the sum of the present value (PV) for each client.

C. Swaps' Visualization



This page describes the following:

- **TMM by Year, Quarter, Month and Day**: This is a line chart that shows the Term Market Rate (TMM) over time. You can view the data by year, quarter, month, and day.
- **Sum of CF PVS-Fixed by Year, Quarter, Month and Day**: This is a clustered column chart that shows the Present Value of the Cash Flow(CF PVS) for fixed rate instruments over time. You can view the data by year, quarter, month, and day.
- **Sum of CF PVS-Floating by Year, Quarter, Month and Day**: This is a clustered column chart that shows the Present Value of the Cash Flow (CF PVS) for floating rate instruments over time. You can view the data by year, quarter, month, and day.
- **Taux zéro coupon actuariel and Taux zéro coupon exponentiel by Year, Quarter**: This is a line chart that shows the Zero Coupon Forward Rate (Taux zéro coupon actuariel) and Zero Coupon Discount Rate (Taux zéro coupon exponentiel) over time. You can view the data by year and quarter.
- **% Fixed Rate by Year, Quarter, Month and Day**: This is a line chart that shows the fixed rate over time. You can view the data by year, quarter, month, and day.
- **% Floating Rate by Year, Quarter, Month and Day**: This is a line chart that shows the floating rate over time. You can view the data by year, quarter, month, and day.

VII. Conclusion

In conclusion, this project represents a thorough exploration of the insurance companies in Tunisia and their strategies to hedge the interest rate risks they are facing.

Indeed, mastering duration calculation and swap contract crafting equips us with essential risk management tools. Understanding how changes in interest rates impact financial instruments' values empowers us to make informed decisions. Moreover, crafting tailored swap contracts enhances our ability to navigate the derivatives market effectively.

In essence, this endeavor has bridged theoretical concepts with real-world data, fostering a nuanced and practical understanding of the derivatives market. The project not only contributes to academic inquiry but also equips us with applicable knowledge essential for navigating the complexities of the evolving financial landscape.