Introduction

The 2008 crisis or the "Subprime crisis" has revealed many weaknesses in terms of regulation and supervision, not only for the insurance activity but for all the financial institutions.

Due to the devastating effects of this crisis such as the increase in unemployment rate, record lows interest rates and number of insolvent companies registered, the European supervisors for banks and insurance companies have walked their way to a tighter regulation.

Consequently, the famous "Basel III" and "Solvency II" have emerged, highlighting the importance of the financial solvency through implementing a "Risk-based approach".

After 4 years of application in Europe, the "Solvency II" directive has demonstrated its importance through spreading all over the globe.

As a result, the Tunisian insurance market through its supervising entity the "CGA" have started to create a reglementary framework for the new directive.

In fact, the implementation of the "Risk-Based Solvency" will have a big impact on the local insurance companies due to the tightness of the regulation and the amount of own funds that should be reserved to deal with the risks threatening their business.

Therefore, this will be a good time for the insurance companies to start running some experimentations and establishing scenarios estimating their financial situation under the new directive in order to have enough time to deal with them before the official implementation of "Solvency II".

As an insurance student in the "IFID" and a part of the "MAE" 's staff, we took the decision to make this the objective of our Master Thesis trying to answer this problematic:

"What is the impact of implementation the new directive's Quantitative Requirements on the "MAE" 's solvency using the Standard Formula?"

To sum up, this Master Thesis can be divided into two parts:

- A theoretical part, in which we will be discussing the general context of Solvency II, its structure and impact, followed by an illustration of the whole process of the Standard Formula in order to calculate the company's Solvency Capital Requirement.
- An empirical part, aiming to apply those Quantitative requirements on our company, calculating the SCR and retrieving its Solvency Ratio so we can judge its financial strength under this new regulation compared to its current situation.

Chapter 1: General Context of Solvency II and in brief analysis:

The word solvency is defined as the state of having more assets than liabilities which means the ability of a person or a business to pay their debts and own enough cash to cover their future needs.

However, in the insurance industry, solvency is a set of rules that came in two editions firstly the Solvency I directive that came in a narrow European environment that was followed lately by the Solvency II reform born in the European union we know this days with the aim to unify and harmonize the insurance markets all over Europe.

Nowadays, Solvency II is the #1 trend in our sector because of the big changes in insurance management on both sides quantitatively or capital wise and qualitatively or governance and risk management wise.

So, what are these changes and what's their impact on stakeholders?

That's what we are going to discuss in this chapter starting with Solvency I and the reasons leading us to migrate to a new regime.

In addition, we will present a solvency II in-brief analysis to discover its characteristics and impacts followed by a projection on our country Tunisia relying on a comparable country's experience in implementation this new set of rules.

1. Solvency 1:

1.1. History:

Before 1973, insurance compagnies were following some solvency rules that were set by their countries and those laws differs one to another.

Beginning of the seventies, the European Economic Community wanted to unify the rules in order to open the insurance markets in the different countries which means that an insured can be covered by an insurance company in another country.

The ECC took this step with the aim to guarantee an equal chance to every citizen across all member countries of the union.

1.2. Composition:

Solvency I is a set of 3 directives for life and non-life insurance and was the opening to a highly regulated sector as we can see nowadays.

The European regulators started with the non-life insurance as it was the more dominant type those days like we can see in this table:

Table 1: Solvency I, step by step

Directive	Non-Life	Life
First directive	1973	1979
Second directive	1988	1990
Third directive	1992	1992

Source : Anthony Levy, Exigences quantitatives et impacts comptables sur une société d'assurance mutuelle non-vie

1.3. Content:

The first common European directives came with 3 main principals:

- Enough technical provisions which mean more than future claims.
- Enough assets with a good quality (diversification, stop loss …)
- Enough equity by building a solvency margin to protect the company in cases of emergencies and to guarantee the insured's money.

1.4. Critics:

1.4.1. Quantitative critics:

- Absence of distinction between the different risks, in fact the only risk taken into account while calculating the solvency margin is the underwriting risk.
- Solvency margins can be determined using a flat rate, this ratio is a combination between premiums, claims and provisions.
  This requirement gives result to some overestimated values which will make companies obligated to guarantee more own funds than it really needs.
- These directives are based on a retrospective vision, taking only the past as a reference which means no protection against extreme values and crisis.

- The methods of the technical provision's determination are different from one country to another and that is contradictory even to the objective of this directive which is the unification of norms all over Europe.

1.4.2. Qualitative critics:

- No surveillance over the internal audit
- A complete negligence of the qualitative aspects

Solvency I focused mainly on the quantitative reforms which made it less complete than other solvency systems as the "Swiss solvency Test" or the American "Risk based capital" that inspired the European Union to develop a new model that'll be more reliable to accomplish the unification of norms.

2. Solvency II in brief:

2.1. Conjuncture and conception of Solvency II:

2.1.1. Motivation:

Over the 3 decades following the first generation of non-life reforms or Solvency I -73, the insurance sector has seen many changes.

Companies expanding beyond national borders, the bancassurance has seen the light and new financial markets and instruments are being developed.

These changes have stimulated the need of a new set of regulatory reforms adapted to the new characteristics of the insurance sector.

Stakeholders:

There are many actors who have worked on this project, we can mention:

- The European Commission
- EIOPC: European Insurance and Occupational Pensions Committee
- EIOPA: Committee of European Insurance and Occupational Pensions Supervisors
- The Groupe Consultatif Actuariel Européen
- AMICE: Association of Mutual Insurers and insurance Cooperatives in Europe
- CRO Forum: Chief Risk Officer Forum

2.1.2. Inspiration:

It was clear to everyone that the European insurance sector needs a new directive.

The work on the new reforms has begun by 2001.

The European regulators used many references that helped them build the new solvency directive.

Solvency II has been inspired by some existing models as the Swiss or the US systems but also, we have to mention that Basel II the banking reform was a big inspiration too.

Basel II was prepared since 1998, published in 2004, this reform had 3 pillars form that will be used also in Solvency II.

2.1.3. Lamfalussy Process:

The project of the insurance directive Solvency II has followed a process made of 4 levels.

This process is named after Alexandre Lamfalussy who was the chair of Advisory Committee in the European Union.

These levels are set with the aim that every implementation aspect can take enough time and focus to be discussed properly.

The first level of this process has begun in 2004 after concluding this schedule:

Table 2: Levels of the Lamfalussy Process

Level	Content	In charge	Decider
1-Solvency II directive	Overall framework principles	European Commission	European Parliament and European Council
2-Implementing measures	Detailed implementation measures	European Commission	European Commission but with the consent of EIOPC and the European Parliament
3-Supervisory standards	Guidelines to apply in day to day supervision	EIOPA	EIOPA
4-Evaluation	Monitoring, compliance and enforcement	European Commission	European Commission

Source: David Buckham et al, "Executive's Guide to Solvency II"

2.1.4. The Subprime crisis as an accelerator:

This financial crisis between 2007 and 2010 appeared in the United States, has appeared because of the large decline in home prices which led to mortgage delinquencies so the risk started to spread into different financial institutions.

The Subprime crisis brought to light the need of a new prudential directive for the European insurance sector to guarantee the solvency of the insurance companies and protect the policyholder's interest.

2.1.5. Quantitative Impact Studies:

Simultaneously as they were building the new directive, Solvency II's stockholders decided to conduct a series of QIS to gain sight of the consequences of the new reforms on different types of insurers all across Europe.

1st QIS:

The first quantitative impact studies started in October 2005 and has been completed by the end of the year.

These studies focused on the level of prudence in the calculation of the technical provisions.

As a result, they discovered that the temporary solvency II provision system tend to give small values that are way under Solvency I 's.

2nd QIS:

The second quantitative impact studies took place in spring 2006.

Obviously the second study was more comprehensive and broader compared to QIS 1.

The main conclusion drawn from this QIS is the inconsistent relationship between the calculated SCR and MCR with some cases where the latter exceeded the former.

3rd QIS:

From April to June 2007, EIOPA conducted its third quantitative impact studies.

Compared to the previous QIS the number of participants is the double.

These studies worked on the problems of the QIS 2 as we mentioned the SCR and MCR calibration.

Also, it addressed some new problems to work on as the effect on group insurers but it couldn't be treated well because the low participation of group insurers has not exceeded 5% of the total supplied data.

4th QIS:

Started in April 2008 and published in November of the same year.

The number of participants has reached the third of all the European insurers and over 60% of the premiums.

These studies gave some good results as 90% of the insurer companies were able to meet the SCR and only 17 of them failed to reach the MCR.

5th QIS:

It's the last conducted QIS, starting in August 2010 and being published in March 2011.

68% of all European insurance entities participated.

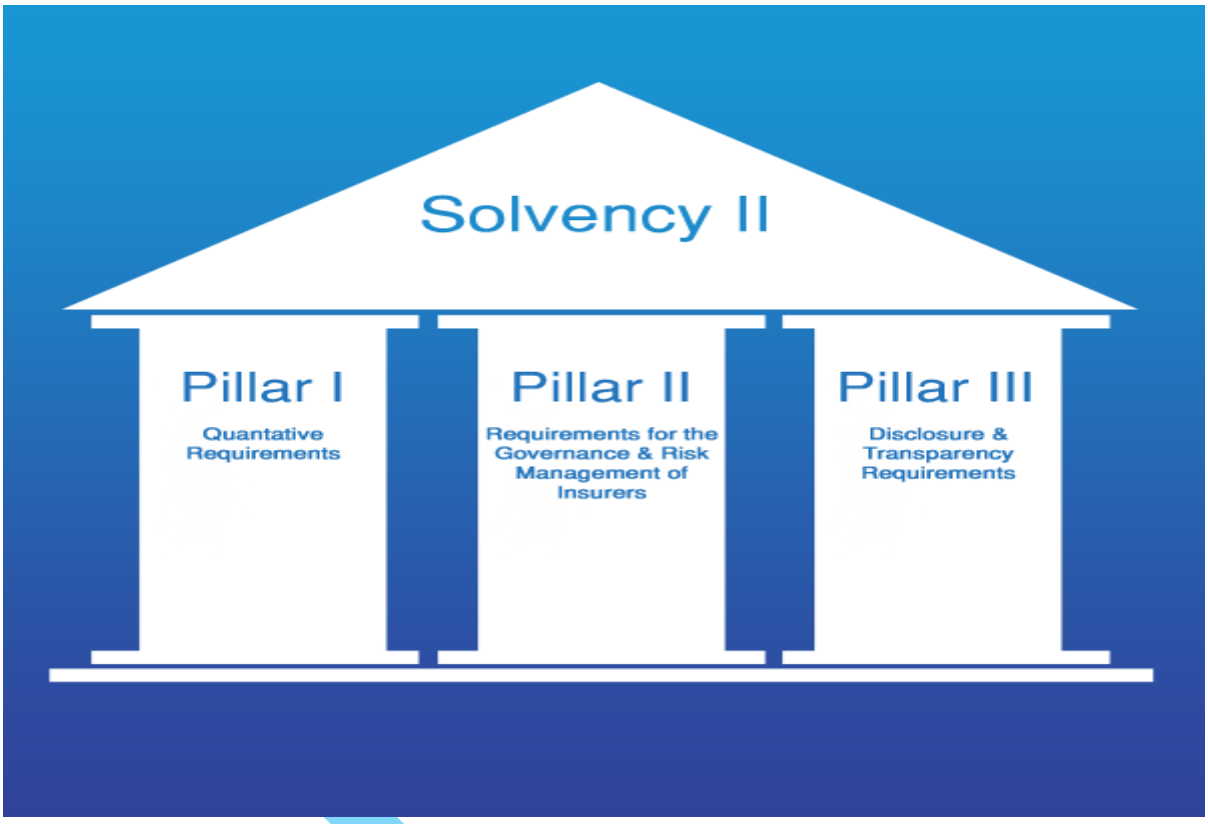
QIS 5 ended up giving the best picture of the insurer's solvency requirement.

These studies have solved most of the problems that it pushed the next QIS more than 9 years and still not to be scheduled for any time soon.

2.2. Structure:

As we already mentioned the structure of the Solvency II has been inspired by Basel II architected in 3 pillars as we can see in the picture below:

Figure 1: The structure of Solvency II



Source Daily fintech, "Solvency II on the blockchain"

2.2.1. Pillar I:

This pillar as we see is reserved for the quantitative requirements on 3 different levels:

- Technical Provisions.
- Capital Requirements (MCR and SCR).
- Eligibility of the capital elements.

As indicated in the first parts the technical provision was calculating using different methods for every country so this new directive will try to harmonize those methods.

2.2.2. Pillar II:

The second pillar is dedicated for the governance and risk management requirements.

Qualitative requirements weren't discussed enough before solvency II and were completely neglected in the first European directive.

(The development of the financial sector globally and especially the different crisis confronted by the financial institution all over the world contributed to the importance of those concepts in our new era of management.

Also, the European commission tried to give more tools and flexibly for the control authorities to detect the companies which are exposed the high risks and to impose a better management.

2.2.3. Pillar III:

The last pillar is related to disclosure and transparency.

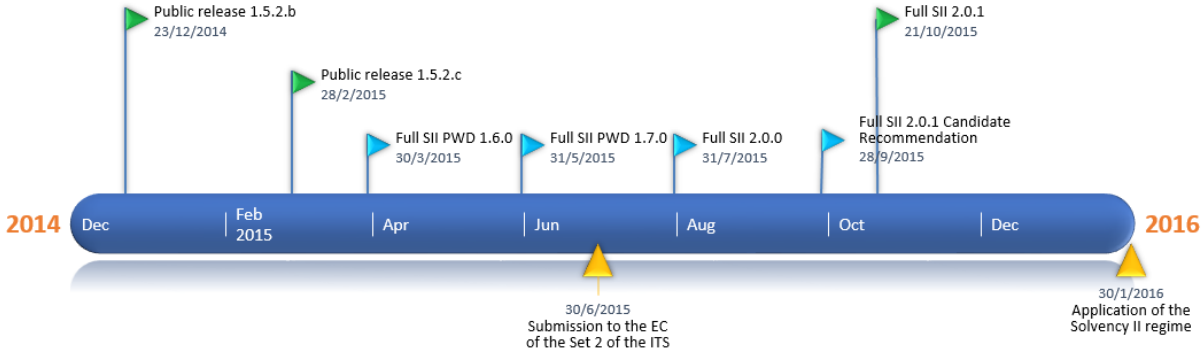
It's mostly about the reporting that insurance companies had to deliver to supervisors, to the stakeholders and also making certain information open to the public bringing in market discipline and more stability.

In this pillar that information will be defined alongside the period of reporting.

2.3. Timeline:

After finishing the 5 QIS, the EIOPS started releasing some different versions of the Solvency II before putting it to vote and here's how the timeline looks like:

Figure 2: The timeline of Solvency II after QIS 5:



Source: Arne Sandström, "Handbook of Solvency for Actuaries and Risk Managers: Theory and Practice"

2.4. Standard formula and internal models:

The Solvency II directive gave insurers an interesting choice to pick either model to calculate their capital requirement.

2.4.1. Standard Formula:

This approach is used by the majority of the European companies, it is based on the calibration of coefficients given to every type of risk and the different levels of stress tests.

This calibration is issued from the 5 quantitative impact studies that assigned the different equations applicable on every company.

The standard formula is mainly the choice for companies that are in the first stages of adaptation to the Solvency II directives and ERM, those who prefer a model with an inferior cost or the insurers who've judged that it's adopted to their management and strategies.

2.4.2. Internal Model:

The internal model is an approach with the same use as the standard formula but it gives insurers more flexibility.

The main advantage of this type of model is giving insurance companies a calculation method that's appropriate and adapted for their business and own management structure.

In certain cases, the company's strategy (investing heavily in real estate as an example) the calibration of the standard formula will end up penalizing those strategies, giving some capital requirements results that aren't adapted to the real state of the company's risk, so that's where the internal model really comes in handy.

Despite the benefit of this approach, it's considered as a really expensive option so most companies think its cost outweighs its benefits.

2.5. Risk based approach:

First of all, we have to say that the whole insurance business is based on risk, concretely insurers are here to protect us from different existing risks transferring them to his side.

This transfer makes an insurer's main function is managing risks.

As a conclusion, managing those risks in the best way will lead to a more efficient business model and execution.

As a matter of comparison, Solvency I was based on a fixed-capital approach in calculating the solvency requirement.

A fixed capital standard is a level established by regulators for all insurance companies of the same size (turnover wise).

The solvency II came with a different approach which is the risk-based capital requirements.

Quantitatively speaking, this approach presented a new term "The risk profile", infusing the different types of risks proper to every company to determine the SCR.

The core of calculation of the Solvency Capital Requirement is the Value at Risk of the probability of ruin.

This probability is based on the exposure to every type of risk for a given company, this is what will build her "risk profile", always with a different coefficient depending on the risk's lethality.

In general, the SCR calculation is literally based on risk exposure and we will show this in more details in the second section "Pillar 1: Quantitative Requirements".

Qualitatively speaking, the side that was missing in solvency I and got a big importance in the new directive.

The second pillar of the Solvency II, show an obligation to implement an adequate risk management system indicate how important it is in this new directive.

The main tool of this second pillar is the ORSA (Own Risk and Solvency assessment) which is a risk management tool acting as process for strategic decision making.

This tool encourages a more developed view of the different risks not only quantitative but also qualitative.

The same goes for this part which will be developed in details in the third section "Pillar 2&3: Qualitative requirement".

2.6. Solvency II: Critics and Side effects:

Solvency II is an important set of rules that is necessary to bring an insurance market to the next level of efficiency and security.

However, like any major change it has some economic side effects on every single actor.

- Starting with the insured, implementing this new directive makes an escalation in insurance prices or premiums very likely as a resulting of facing their real risk with a higher capital so an increase in premiums will help them compensate that.

- The prior point leads us to insurance companies finding themselves in need of a higher level of equity, increase in costs mainly because of the increase in technical provisions and building the new core professions as risk management, actuaries and conformity

with their processes which will provoke a capital increase or a fusion with other companies.

- Also, this new directive, as mentioned previously impose on insurers a capital complement for every type of risk which will bring them to revising their strategies mitigating their risk and taking a safer position.
  Chaining with the previous argument we find ourselves facing one of the major critics to Solvency II which is the effect on the stock market.

- The market risk is one of the main risks that needs a compensation in capital according to the new directive, as a result insurance companies have opted for bond favour of stocks that are a risked financial instrument.
  This consequence was regarded as a big hit for the stock market because insurance companies are considered as a first-row investors.
- Finishing with governments, they had to devote a considerable amount of money for insurance supervisors to implement the Solvency II directive, hiring actuaries and managers for the calibration and for the company's supervision in addition to costs of the different preparations.

2.7. Solvency II: Comparative countries and future in Tunisia

2.7.1. Morocco: a comparative reference for Tunisia:

The closer case of market adopting the new solvency directives is Morocco as it is an African Arabic country, with an economic system which is close enough to our country Tunisia but anticipating the importance of this reform way earlier.

Morocco has started the implementation process of Solvency II under the name "SBR" (Solvabilité basée sur les risques) realising the article 239 of the insurance code putting the country's insurers under the obligation of justifying a solvency margin as a complement for technical provisions in August 2016.

A full project of law is ready by April 2017.

A first quantitative impact study in March 2018 on some old accounts and was followed by a second one in the beginning of 2020 on the 2018 accounts.

In short, Morocco has reached a relatively an advanced stage preparing for the solvency rules to be put into use as they're waiting for the second QIS results to fix the definitive calibration then hold talks and discussions with all the stakeholders before reaching the final step which is the full implementation of the "SBR".

A final mention, despite being a first-row investors, Morocco's minister of finance estimated that they'll still be able to keep the market's dynamic with a well-adapted norm especially with its healthy state.

2.7.2. Solvency II in Tunisia: Progress and Future:

2.7.2.1. Current Situation:

The regulation in Tunisia is still inspired by the Solvency I norms especially for the quantitative requirements with some adaptations to the Solvency II norms in the qualitative area through a project for the revision of the old insurance code.

Quantitative Requirements:

In fact, it stipulates that insurance companies should reserve an amount of own funds named "Minimal Solvency Margin" to tackle the technical provisions and placements volatility.

In accordance to the article 58 of the law 2002-37, the Solvency Margin is calculated using the process listed below:

Figure 3. Solvency Margin Calculation

1) Paid up share Capital or Common funds (+)
2) 50 % of the non-paid up share Capital (+)
3) Statutory, optional and legal reserves (+)
4) Reported profit (+)
5) Revaluation of assets and liabilities (+)
6) Other elements through approval of "CGA" (+)
7) Losses (-)
8) Intangible assets (-)
= Solvency Margin

Source: Established by the author

As for the reglementary minimum it is retrieve through a sum of the life minimum solvency margin and the non-life one.

: $NLMSM = Max\ (N1\ ; N2)$

With: $N1 = 20\% * \ Earned\ premiums\ net\ of\ taxes\ and\ annulation * \frac{Kept\ premiums}{Earned\ premiums\ net\ of\ taxes\ and\ annulation}$ => should be at least 50% or more

And $N2 = 25\% * \ * \ Average\ claims\ cost\ over\ last\ 3\ years\ * \frac{Ceded\ claims}{Claims\ gross\ of\ reinsurance} \geq 50\%$

While:

$$LMSM = Max\ (L1\ ; L2)$$

With $L1 = \ 4\% * \ Mathematical\ provisions * \frac{MP\ net\ of\ reinsurance}{Mp\ gross\ of\ reinsurance} => more\ than\ 85\%$

And $L2 = 3\%\ Capital\ at\ risk * \frac{Capital\ at\ risk\ net\ of\ reinsurance}{Capital\ at\ risk\ gross\ of\ reinsurance} = > 50\%\ or\ more$

Finally, $\boldsymbol{Minimum\ Solvency\ Margin = Max\ (N1\ ; N2\ ) + Sum\ (L1\ ; L2\ )}$

And the **Solvency (or coverage) Ratio will be** $\frac{\boldsymbol{Solvency\ Margin}}{\boldsymbol{Minimum\ Solvency\ Margin}} \geq \mathbf{100\%}$

Qualitative Requirements:

While we have not noticed any changes towards SII in the quantitative requirements, the CGA issued a new set of laws inspired of solvency II directive in the area of governance.

These texts (Appendix 1 law 241) focused on the importance of the 4 eyes mentioned in the Solvency II norms which are:

- Conformity
- Actuarial Services
- Risk management

- Internal audit

Also, they insisted on the separation between the head of the board and the executive management (CEO) in the same project (Appendix 1 law 219) to ensure a better level control over the different entities and avoid any conflict of interest which another point mentioned in the SII directive.

To sum up, these texts are considered to be the first steps in the adaptation of the Solvency II norms but we should also recognise the long way still ahead of us.

2.7.2.2. Prognostics and opinions:

First of all, we would like to confirm the benefits of implementing Solvency II on the insurance companies, management and efficiency wise and on the policyholders giving them more security.

However, I don't think it's the right choice for the current situation of the Tunisian insurance market.

Compared to Morocco, our country has a poor stock market and as we discussed in the side effects of solvency II, insurers will decrease their investment in the risked instruments in favour of bonds and such a strike will have a big impact of the market especially with efforts to develop it.

Another country's experience that was called for as a reference by some insurance professionals is the KSA that took a distinguished route, making sure every single company is listed on the stock exchange before implementing the Solvency II directive.

I think that's a smart move as it will help insurers being ready on both sides:

- Financial side with a more solid capital structure.
- Reporting and transparency side as they'll have to respect the publishing deadlines and rules of the listing on the stock market.

Despite the benefits of this approach, being listed on the stock market is still a strategic move that should be decided by the companies themselves

Coming back to the morocco comparison, our insurance market is too fragmented especially with its small size as we have 22 companies against 19 for morocco with a bigger market which still a bit much.

It's like sharing a small cake between a big number of persons and this will result in companies with a shy part of premiums which will lead to a poor capital structure compared to the risks and the high SCR imposed by solvency II.

According to Hassen Feki CEO of STAR insurance, with the current state of the insurance market at best only 3 or 4 companies of the existent 22 can achieve the Solvency Capital Requirement of Solvency II (Webinar ATUGE).

Otherwise I still share the common opinion saying we should start with something between, something that could be called Solvency 1.5 that is adapted to our Tunisian context and situation and that will increase the Solvency Capital Requirements and improve the governance of the insurance companies.

That's a step that'll prepare us to officially implementing the solvency when we are really ready for it.

Finally, we would like to say that even though my opinion is against the implementation before assuring certain basis first, working on Solvency II as my final thesis is too attractive for me and it will be more than helpful when the right time will come.

2.8. Impact on Mutual insurance companies:

As we are seeing, Solvency II is a directive that pushes the insurance companies to save more in the form of capital in order to deal with the different risks taken into account to calculate the SCR.

Mutual insurance around the world are mostly considered as inferior in size compared the big whales of the sector which are the highly capitalized insurance companies that are private, a directive that'll demand more capital isn't that big of problem for them.

However, for companies such as mutual, their legal statues don't allow to make generate equity as their stockholders are the policyholders themselves so keeping up with the requirements of Solvency II isn't that easy.

Despite the efforts trying to ease up the pressure on them by EIOPA as they allowed them to issue a financial instrument called Mutualist Certificate bought by their policyholders in order to increase their capital, the insurance market has seen many cases of mutual insurance fusions so they can face the new requirements, both quantitative or qualitative as we already said the new governance process and the risk management and conformity units are a big hit to the budgets.

Also, we have to mention the existence of principle in Solvency II called the "Proportionality principle", which exonerates some mutual companies with less than 50M Euros of turnover or contributions.

This principle is not really adapted for the situation of many mutual companies that demand the EIOPA to alleviate some requirements as:

- Decrease the stress test levels on the stocks and on real estate, from 6% to 4.5% and from 25% to 15% respectively (1st pillar).
- The governance requirements shouldn't be an obligation for small mutual insurers, the 4 eyes structures in particular (2nd pillar).
- Reducing the reporting (3rd pillar).

Finally, we have to say that some mutual insurance companies are big enough to handle the Solvency II implementation easily especially without shareholders demanding benefits in the end of every year allowing them to reinvest their benefits and cumulating an important amount of equity.

We can mention some examples like COVEA and GROUPAMA which are two French mutual insurance listed in the Top 20 European insurance companies in 2018 as 8th and 10th respectively.

This companies should be treated exactly like any other insurance company regardless of their legal status with the exception of a few details like own funds classification for the quantitative requirements and some governance specifications for the qualitative requirements.

Starting in the United States then migrating to Europe and Asia, and now it's even getting implemented in Africa.

Solvency II is a subject that got a wide breadth all across the world, it's the result of the importance of this directive that redefined the insurance industry to say the less.

A new governance is born, relying on new roles like the actuaries giving the insurance a more solid basis based on statistics and risk evaluation which opened a new mine of information which will improve the manager's decision making drastically especially with the context of the world we are living, just like they say "Information is power".

Also, the strategies and the priorities of an insurance companies differs after the introduction of this norm because of the risk-based approach which led them to regressing some instruments like the risked stocks and developing others like the Unit Linked insurance contracts that transfers the risk to their policyholders.

In addition, another key factor in the Solvency II set up is the security offered the to the policy holders and the stock by building a more solid financial base for the insurance companies despite a likely decrease in benefits because of the safer approach.

This financial solidity is mainly built on the quantitative requirements the capital reserved to cover every type of risk existing in the insurance business.

So, what are those risk components and how can an insurance company calculate them?

Chapter 2: Quantitative Requirements and the calculation of the SCR based on the standard formula:

As we established in the general context section, the quantitative requirements are about calculating the SCR of the insurance company depending on the calibrations set by the supervising authority.

This calibration is a result of the 5 QIS made on most insurance companies and their data, evaluating the contribution of every risk in a potential insolvency scenario.

These calibrations are reserved to one of the two possible approaches that'll lead insurance companies to implement the Solvency II's capital requirements which are:

- Standard Formula.
- Internal Model.

The first option is the based on a set of calibrations established by the specialised authorities following the 5 QIS while the second is based on an adjustment to the calibrations and calculations methods made by the company's experts to achieve a more adapted model to the characteristics of their company.

This calibration should make a subject to the insurance supervising authority's approval after making sure that those changes are well justified and will not affect the policyholder's interest, which is mainly assuring that the calculated SCR is enough to cover up the given risk.

In this chapter we will discover the full process of implementation the Solvency II quantitative requirements starting with

Our choice in this final thesis is obvious as we can't opt for an Internal model for 3 reasons:

- An internal model is too complicated for a student to work on especially with our training.
- The other reason is that most insurance companies will start with testing the standard formula before establishing an internal model if needed as a reference to compare to.
- As the Solvency II directive is not established yet, an internal model can't be subject to CGA's approval.

1. Total balance sheet approach:

In a Solvency II context, the balance sheet is the most important financial statement because of the need of information reflecting the real situation of the insurance company every year.

To be able to play this role, we need a more coherent vision than the one offered by the accountable balance sheet, something that will reflect the real state of the financial situation, it is the "fair value" or "market value" that will be the key of retreating the balance sheet called also the "Economic

Balance Sheet".

IFRS 13 defines the fair value as "The price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date."

An orderly transaction is a transaction that's not forced by assuming exposure to the market for a period before the date of measurement allowing marketing activities to take place.

Both assets and liabilities should be evaluated by a Fair value approach.

This approach is used to derive the difference between assets and liabilities called the Net asset value that should reflect their real situation.

$$NAV(Net\ Asset\ Value) = Total\ economical\ assets - Total\ economical\ liabilities(mainly\ BE)$$

However, EIOPA has distinguished between 2 different types of liabilities that shouldn't be treated likewise.

The first kind of liabilities is the capital market instruments or the "hedgeable instruments "such as bonds, this type has to be calculated using the market value or the fair value in order to determine their true market value.

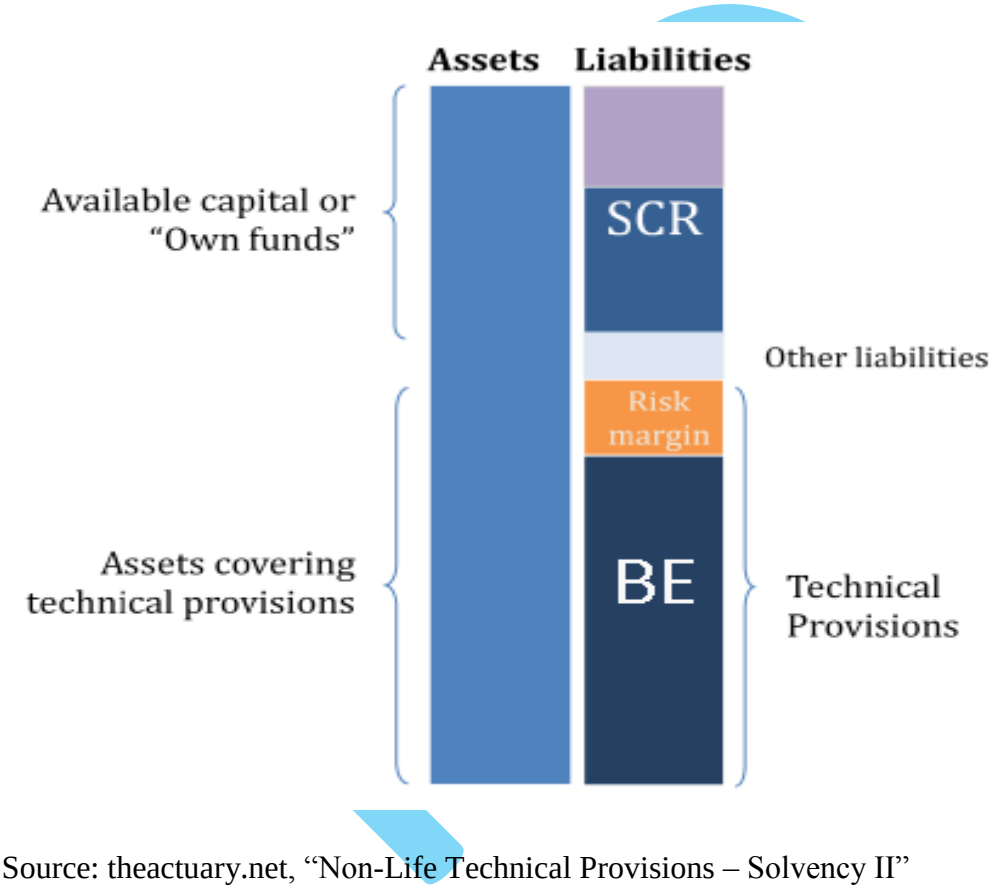
The other type is the insurance liabilities or the "non-hedgeable instruments" that serves to pay out the policyholders like claims and profit sharing.

Defining a fair value for those liabilities is pretty complicated because of the absence of a robust market trading it especially as it presents a large heterogeneity.

In order to apply the same reasoning but using a different approach, EIOPA has defined a linear valuation called “the Best Estimate” to which we add a certain “risk margin”.

EIOPA define the Best estimate as “The probability weighted average of the expected value of discounted cash flows, plus a risk margin, being the cost of capital to a third party of assuming the liabilities in the event of run-off”.

Figure 4: Decomposition of the assets and liabilities under Solvency II



Source: theactuary.net, “Non-Life Technical Provisions – Solvency II”

1.1. Assets valuation:

This valuation is based on the “mark to market” approach which is found on an available market price.

Here is the valuation of certain asset items:

- The Goodwill: Solvency II approach precise that this item has no value.
- Differed acquisition costs: No value under Solvency II.

- Intangible assets out of Goodwill: Mainly a null value except when selling them separately with a present market allowing their tradability or for items with similar features.
- Differed tax asset: That's an item that could be used to reduce future tax base.
- Placement: Should be evaluated based on the market value.

1.2. Valuation of liabilities:

1.2.1. Best Estimate:

The Best estimate is the main tool to revaluate an insurance company's liabilities, which is the discounted cashflows using a risk-free rate.

This method is applied on homogenic risks that's why it demands a treatment for every Line of Business (LoB).

Every type of insurance policy should be affected to a Lob that reflects the best its risk nature.

In fact, this classification is not the one used in the insurance but one that's based on the principle called "Substance over form" dividing insurance contracts into 4 big families:

- Non-life
- Life
- SLT Health: Similar technical basis to a life policy.
- Non SLT Health: Non similar TB to life insurance.

There are 2 types of Best estimate to be calculated:

- BE for outstanding claims: Discounted cashflows for claims dating before or at the date of valuation with unreported claims taken into account.
- BE for premiums: Discounted cashflows for future claims after the valuation date until the expiration date.

1.2.2. Risk Margin

Solvency II defines the RM as “The potential costs of transferring insurance obligations to a third party should an insurer fail.”

This risk margin is calculated using a main formula that could be simplified depending on the available data within every company.

It is calculated depending on the number of years used to determine the Best estimate

Main Formula:

$$RM = CoC \sum_{t=0} \frac{SCRt}{(1 + r_{t+1})^{t+1}}$$

CoC: Cost of Capital estimated at 6% by the EIOPS.

SCR: Solvency Capital Requirement at t.

$r_{t:}$ Risk-free rate at t provided by the EIOPA.

As a matter of example this is one the simplifications:

$$RM = \alpha_{LoB}.BE_{net}$$

α: Line of Business percentage fixed by the EIOPA.

BE: Best Estimate.

1.2.3. Evaluation of technical provision:

Evaluating the technical provisions is an important step in determining the Best Estimate.

Actuaries are equipped with many methods allowing them to evaluate the different types TPs.

Those methods can be classed in 2 types of modelling which are:

- Deterministic models such as Chain ladder and London chain.
- Stochastic models like Bootstrap and Mack

Also, we need to precise that according to the EIOPA, using deterministic methods would be more appropriate (Appendix 2), especially with the fact stochastic approaches are not considered necessary to calculate the BE.

In addition, we have got to bring up that Chain Ladder method is considered by the majority of the specialists as the most stable and precise method and as a must do when it comes to estimating a company's reserves.

As a result, we will be using it to calculate the BE claims in the following chapter.

1.3. Own funds classification:

The solvency II directive has introduced the concept of "Available and Eligible Own Funds" serving as a pillow to absorb the SCR and the MCR representing the probability of ruin.

This notion classifies the own funds into 3 categories:

Tier 1: Basic OF available without restrictions.

Tier 2: Basic and ancillary OF available with some restrictions.

Tier 3: OF out of tier 1 and 2.

To sum up, the 1st tier is eligible to fully absorb the S/M Capital Requirement while the 2nd and 3rd tiers has a reduced loss absorbing capacity which make them eligible to partly cover it.

This classification is based on many factors such as the subordination, availability, duration…

In term of calculation, The MCR uses the T1 and T2 basic OF while the SCR include all types of own funds under this limit:

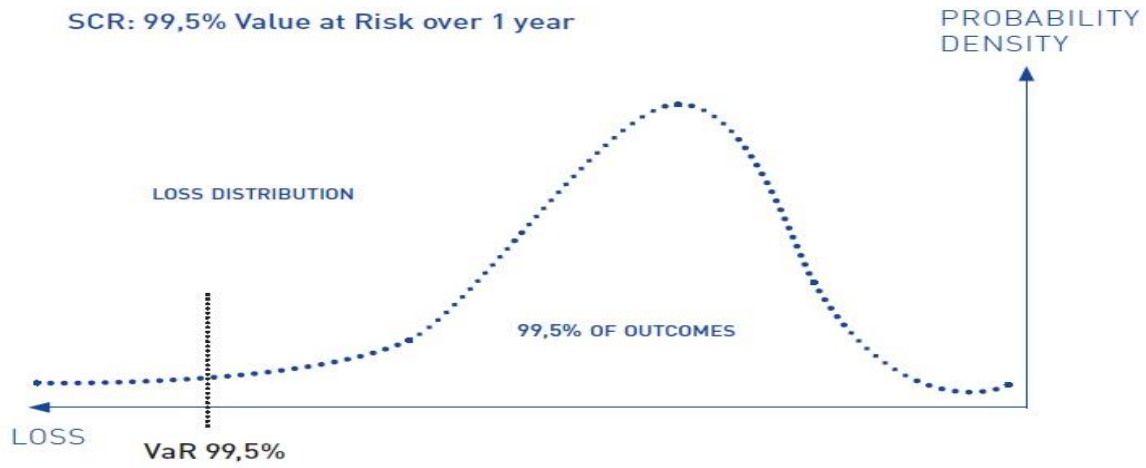
- Tier 1 > 1/3 OF ➔ T1> ½ (T2+T3)
- Tier 3 < ½ (T1+T2)

2. Solvency Capital Requirement:

2.1. Definition:

The Solvency Capital Requirement is a Value at Risk (Var) of the OF at a confidence level of 99.5 over a year representing the probability of ruin (or insolvency) that should be observed on average only once in 200 years.

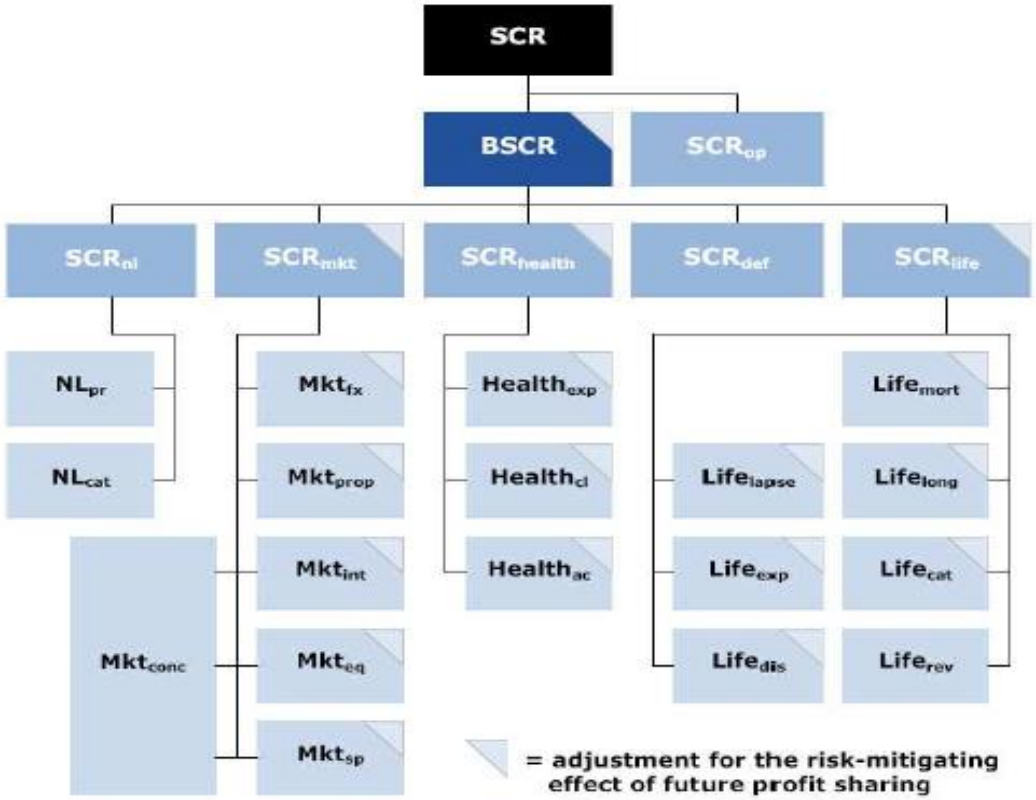
Figure 5:SCR as a Value at Risk



Source: David Hare, "Solvency II: raising the bar on Insurance Technical Expertise"

The Solvency II illustrates the SCR in the form of a diagram as we can see below:

Figure 6: SCR Pedigree



Source: Vincent MEISTER, « Solvabilité II: contexte, valorisation et impacts sur l'exigence en capital »

The table below will define every abbreviation used in the previous SCR diagram clarifying every submodule of SCR that should be calculated in order to get a final SCR.

Adj_{dt}	Adjustment for the risk-absorbing properties of future profit-sharing module
BSCR	Basic SCR module
SCR_{op}	SCR module for operational risk
SCR_{nl}	SCR module for non-life insurance risk
SCR_{mkt}	SCR module for market risk
SCR_{health}	SCR module for health insurance risk
SCR_{def}	SCR module for default risk
SCR_{life}	SCR module for life insurance
NL_{pr}	Premium and reserve risk submodule for non-life risk
NL_{cat}	Catastrophe risk submodule for non-life risk
MKT_{fx}	Foreign exchange risk submodule for market risk
MKT_{prop}	Property risk submodule for market risk
MKT_{ir}	Interest rate risk submodule for market risk
MKT_{eq}	Equity risk submodule for market risk
MKT_{sp}	Spread risk submodule for market risk
MKT_{conc}	Concentration risk submodule for market risk
$Health_{LT}$	Long-term health insurance risk submodule
Accident & $Health_{ST}$	Short-term health insurance risk submodule
$Health_{WC}$	Worker's compensation risk submodule for health insurance
$Life_{mort}$	Mortality risk submodule for life insurance
$Life_{long}$	Longevity risk submodule for life insurance
$Life_{dis}$	Disability risk submodule for life insurance
$Life_{exp}$	Expense risk submodule for life insurance
$Life_{lapse}$	Lapse risk submodule for life insurance
$Life_{cat}$	Catastrophe risk submodule for life insurance
$Life_{rev}$	Revision risk submodule for life insurance

The Formula used to calculate the final SCR is:

$$SCR = BSCR + SCR_{OP} + Adj$$

BSCR: Basic Solvency Capital Requirement

SCR_{op}: SCR aiming to cover the operational risk.

Adj: Adjustment to make for the profit-sharing and the differed tax.

2.2. Operational risk:

The operational risk under Solvency II is defined by EIOPA as "The risk of loss arising from 4 different reasons which are:

- Internal Process.
- Personnel.
- Systems.
- External events."

The OR should be calculated using the formula below:

$$SCR_{op} = \min(30\%\ BSCR) +; \mathrm{OP}) + 25\% \,.\, Exp_{UL}$$

OP: Basic OR charge for all business.

Exp_{UL}: Expenses for Unit Linked insurance.

With $\mathrm{OP} = \mathrm{Max}\ (\mathrm{OP_{PR}};\ \mathrm{OP_{TP}})$

And $\mathrm{OP_{PR}} = 4\%\ (\mathrm{P_{life}} + \mathrm{P_{SLT\ Health}} - \mathrm{P_{life\text{-}UL}}) +$

$3\%\ (\mathrm{P_{non\ life}} + \mathrm{P_{non\ SLT\ Health}}) +$

$\mathrm{Max}\ (0;\ 4\%\ (\Delta \mathrm{P_{life}} - \Delta \mathrm{P_{life\text{-}UL}}) + \mathrm{Max}\ (0; 3\%\ \Delta \mathrm{P_{non\ life}})$

$$\mathrm{OP_{TP}} = 0.45\%\ \mathrm{Max}\ (0;\ \mathrm{TP_{life}} - \mathrm{TP_{life\text{-}UL}}) + 3\%\ \mathrm{Max}\ (0;\ \mathrm{TP_{non\ life}})$$

2.3. Basic Solvency Capital Requirement (BSCR):

The BSCR is the factor that encompasses the different types of SCR calculated separately in order to retrieve the global SCR reflecting the solvency of an insurance company.

We can calculate the Basic Solvency Capital Requirement using this Formula:

$$BSCR = \sqrt{\sum_{i,j} Corr_{i,j} \,.SCR_i \,.SCR_j} + SCR\ Intagibles$$

Corr: Correlation between the different type of risks (i, j).

$SCR_{i,j}$: SCR calculated for the risk modules i, j.

SCR Intangibles: SCR made to cover the intangible assets.

As we mentioned previously the different risks mentioned above are dependent which is pretty natural as any type of insurance risk, taking life risk as an example is affected by many other risks as the default risk.

The existence of a correlation matrix has another objective which is the aim for diversification.

2.3.1. Market Risk:

The market risk is a result of the volatility of the financial instruments owned by a company.

The SCR_{MKT} is calculated using stress test applied on the company's portfolio.

The MR module features 6 sub-modules:

- Foreign exchange risk: The currency risk of going up or down by 25%.
- Property risk: The risk of fall in value of all properties owned by 25%.
- Interest rate risk: The effect of a change on the interest rate term structure.
- Equity risk: Effect on equity values and its volatility.

- Spread risk: risk of capital loss following an investment as a result of the credit spread's volatility
- Concentration risk: Exposure of assets relative to the other market risk submodules to counterparty (excluding assets covered by the default risk)

The formula used to calculate this risk is illustrated below:

$$SCR_{MKT} = \sqrt{\sum_{i,j} Corr_{i,j} \, . SCR_i \, . SCR_j}$$

with SCR $_{i, j}$ stands for the Solvency capital requirements for the 6-market risk sub-modules (property, spread …) and Corr $_{i, j}$ represents the correlation between those SCRs.

2.3.2. Life Underwriting Risk:

The LU risk module is up to put in a capital in reserve to cover the risk related mainly to current life insurance contracts and those of the coming years, more specifically the risk of the life related line of business modules (LoB).

In fact, to retrieve the Solvency Capital Requirement associated to this risk we are going to follow the same approach based on sub-modules and their correlation, illustrated like this:

$$SCR_{life} = \sqrt{\sum_{i,j} Corr_{i,j} \, . SCR_{L\,i} \, . SCR_{L\,j}}$$

With $SCR_{L\ i,\ j}$ are the 7 LU sub-modules defined below and Corr is the correlation between them:

- Mortality risk: The risk of an unexpected increase in mortality rates.
- Longevity risk: The risk that mortality rates decrease unexpectedly.
- Disability risk: Losses due to an unanticipated disability and illness rates.
- Lapse risk: The risk of losses due to unforeseen policy surrender, termination or lapse values payment which makes it impossible to cover acquisition costs using future premiums.

- Expense risk: The risk of a deviation in expenses from what's forecasted.
- Revision risk: Losses due to unexpected adjustment to annuity cash flows
- CAT risk: High claims due to catastrophic events characterized by a high impact and a low frequency.

2.3.3. Non-life underwriting risk:

The NLU risk is the result of an uncertainty related to the non-life portfolio.

Those are uncertainties can be expressed in:

- Pricing.
- Technical provisions.
- Behaviour of the policyholders.
- Catastrophic events.

The capital requirement reserved to cover this type of risk follows the same logic as the other risks already discussed.

$$SCR_{non-life} = \sqrt{\sum_{i,j} Corr_{i,j} . SCR_{NL\,i} . SCR_{NL\,j}}$$

$SCR_{NL\,i,\,j}$: The Solvency Capital Requirements set to cover the non-life risk under 3 sub-modules:

- Premium and reserve risk: Respectively the risk that the forecasted insurance premiums doesn't cover the claims and the risk afferent to the claim's reserves (technical provisions).
- Lapse Risk: The risk of losing or terminating an un expected percentage of contracts.
- CAT risk: The risk of loss due to catastrophes related to non-life business.

2.3.4. Health Underwriting Risk:

The health underwriting risk module aims to build an amount of money as a reserve in the form of a Capital requirements to cover the risk suffered by the insurance companies from their Health business.

Similarly, the calculation of the HUR is based on 3 types of risks giving 3 SCRs which are:

- SCR SLTH: Capital covering the risks related to underwriting Health insurance similar to life, technical basis wise, mainly long-term business.
- SCR NSLTH: Capital set to cover the HUR risk for the contracts non similar to life insurance's technical basis which are the long-term risks.
- SCR CAT_h: The risk of loss as a result of catastrophes in the health business.

Combining them gives us this formula:

$$SCR_{HU} = \sqrt{\sum_{S,N,C} Corr_{S,N,C} . SCR_S . SCR_N . SCR_C}$$

With Corr $_{S, N, C,}$ the correlation between the 3 SCR HU components.

2.3.5. Counterparty Default Risk:

The capital required to cover the risk of loss as a result of irrecoverable debts (or bad debts).

This risk affects both assets and liabilities touching on the reinsurance receivables and on share of the reinsurances in technical provisions.

The counterparty default risk is divided into types of exposition which are:

- Type 1 expositions: Non-diversified counterparties that are likely to be rated elements aiming to mitigate the risk.
  Examples: Special purpose vehicle or bank deposits and reinsurance counterparties.
- Type 2 expositions: Unrated counterparties calculated using a standard approach and applying a simple factor.
  Example: debts owned by policyholders.

The main formula used to retrieve the SCR related to the default is based on the mean of square root of both types giving us:

$$SCR_{def} = \sqrt{SCR^2{}_{def,1} + 1.5\ SCR_{def,1}\ .\ SCR_{def,2} + SCR^2{}_{def,2}}$$

3. Minimum Capital Requirement MCR:

The MCR is the second own funds indicator other than the SCR.

This notion is set to establish the amount of capital needed for the insurance company in order to keep running its business.

In fact, falling under the line of MCR for an insurance company will make it a subject to the intervention of the supervisors that'll end up withdrawing it from business.

The MCR taken into account is called the Combined MCR.

In order to calculate this MCR we need to retrieve 3 components beforehand which are:

- MCR $_{cap}$: It's the ceiling of the MCR corridor representing 45% of the SCR.
- MCR $_{floor}$: The threshold of the corridor expressed as 25% of the SCR.
- MCR $_{linear}$: The linear MCR calculated using this formula:

$$MCR_{linear} = \sum_{s} LoB_{1,s}\ .TP_s + LoB_{2,s}P_s$$

$LoB_{1,s}$: Risk factor applied to technical provisions by segment.

$LoB_{1,s}$: Risk factor applied to the premiums segment.

TP_s: Technical provisions using the Best Estimate.

P_s: Premiums.

In order to calculate the MCR linear, we need to retrieve both the NL MCR and LMCR separately and then we have got to sum them up to determine our final result.

As we already mentioned the MCR to be taken into account is combined MCR calculated as follows:

$$MCR_{combined}: Min\ (\ Max\ (\ MCR_{linear}\ ;\ MCR_{floor}\ )\ ;\ MCR_{cap}\ )$$

This 1st pillar introduced us our sector to many new notions that changed insurance companies to the better.

Starting with the 1st step which is the economic balance sheet, adapting the evaluation the most to reality using the fair value approach that earmarked a real value to the company's assets and the hedgeable liabilities to allow a better understanding of the company's current situation.

The same goes for the non-hedgeable liabilities mainly the technical provisions using the best estimate + the risk following the same vision as the fair value that evaluates the TP based on the discounted cash-flows, taking into account the value of money.

Furthermore, there's also the SCR allocation an amount of capital to cover every type of risk and the MCR which is the final threshold, crossing it means a withdrawing from the market threat after the supervising authority's intervention.

In short, every element of this process was calibrated to make sure that insolvency can only occur once in 200 years.

Chapter 3: Application of Solvency II's standard formula on the MAE

In the first chapter, we discussed the different tools and steps of the Solvency II's Standard Formula.

Proceeding to the empirical study, we will apply this process on our insurance company which is the "MAE".

As known today, the concept of solvency is getting more importance in the insurance markets all over the world making it a matter of time before we are hearing that Tunisia is also going to implement the Risk-Based Solvency approach (or Solvency II) especially with similar countries already halfway through such as Morocco.

We have thought that our master thesis would be a pre-emptive move before the official implementation of the Solvency II directive, testing the impact of such an important process, the difficulties and especially how the results are going to turn.

In fact, these elements mentioned previously can be a foundation to work on in order to diagnose the anomalies and form an estimation of the situation of the company in a Solvency II environment making sure we are ready when the time will come.

In This chapter, we are going to revaluate the assets and liabilities of our company using respectively the fair value and the best estimate in order to establish the economic balance sheet and determine the Net asset value (NAV).

After that we will calculate the different SCR available depending on the lines of business, we are engaged in which will make us retrieve the global SCR essential to figure out the solvency ratio.

Finally, we will compare this solvency ratio under Solvency II with the one calculated based on the current regulation (Solvency II) and interpret our results.

1. Methodology:

Our empirical study in this thesis is mainly a Case study in which we are going to establish a version of the "MAE" under Solvency II's quantitative requirements to check how ready is it for the implementation of this directive , evaluate its financial solvency and whether there's some anomalies to look over and to rectify through some recommendations.

First of all, we have started collecting the different data mentioned in the table below:

Table 3: Data Gathered

Data	Year(s)
Motor Chain Ladder claims triangles (Liability and other coverages.)	2009-2018
Other non-life claims triangles (MR Home, Professional MR and 3rd Party Liability)	2004-2018
Financial investments (Bonds, Stocks, real estate and other investments.)	2018
Annual report (Premiums and Claims per class of insurance or line of business)	2018
Old property valuation made by an expert.	2009

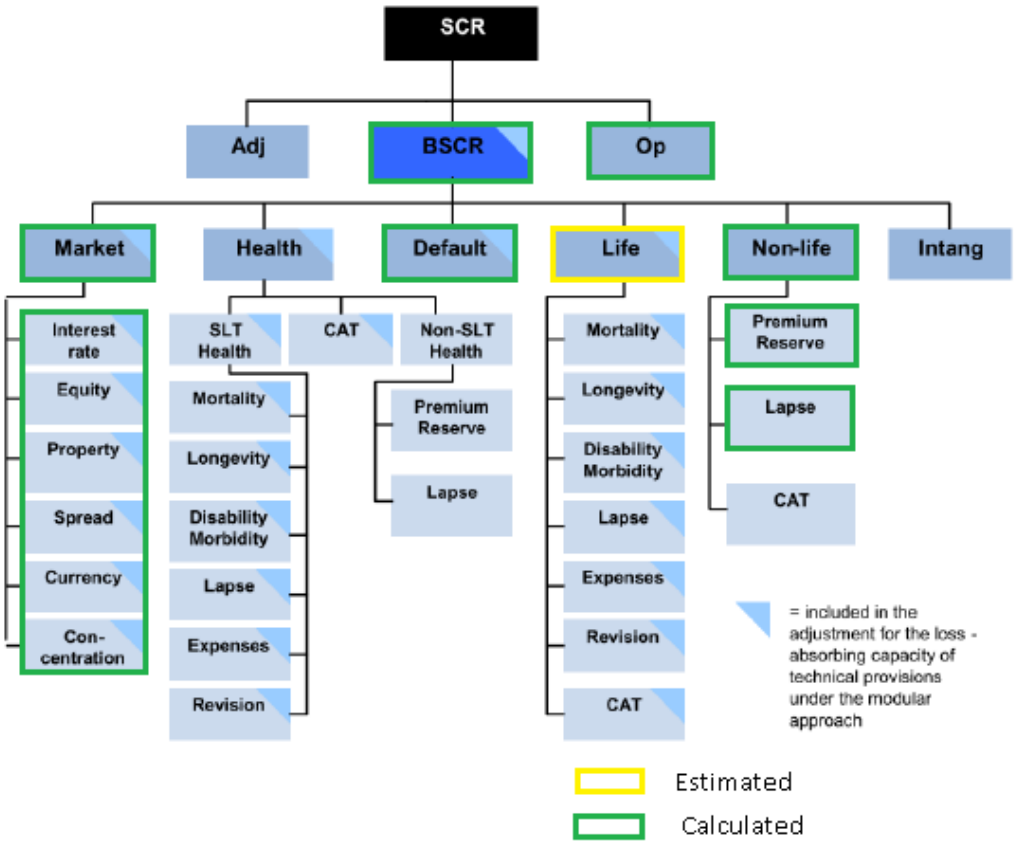
Source: Made by the author

Obviously, when observing these data, we have to choose 2018 as the reference year to establish our balance sheet and calculate our Solvency Capital requirements.

As a matter of fact, we can't execute our work properly with only this set of data unless we can establish some hypotheses that we will be discussing in the parts where they should exist.

Following, based on this set of data we are going to determine the list of SCR modules, submodules and lines of business available to be treated depending on the company's activity.

Figure 7: Concerned SCR modules



Source: Established by the author

SCR and submodules.

We are going to bring our reasons for not working on every item starting from the top to the bottom.

- *Adj*: Which is the adjustment based on the capacity of loss absorption using technical provisions mainly the profit sharing which is registered as a null value in the balance sheet.
- *SCR Health*: We decided to neglect this SCR module because of the low volume of premiums being close to 1% of the company's turnover which will contribute by 0,5% of the SCR.
- *SCR Intangibles*:" Solvency II proposes that intangible assets are assigned a value only when they can be sold separately and a valuation can be derived from a quoted market price in an active market for the same or similar intangible. In practice most intangible

assets of insurers are not traded in active markets and so no value will be assigned under Solvency II." Which will also lead us to not calculating it.

- *SCR CAT:* 97% of written premiums in Non-life insurance in the MAE came from Motor Liability (Lob 1) and Other Motor (Lob 2) that are not concerned by this type of risk so practically it's insignificant.
  - *SCR Life estimation:* First of all, extracting life data from the company's system is too tricky as the latter is managed by an independent company representing 3 companies (MAE, AMI and CTAMA), especially with the transfer of some insurance cover's treatment to the MAE's main system.

    Also, on one hand life premiums represents only 5% which while containing 7 different submodules to work on which is way too much.

    On the other hand, life is a major part in any insurance company with an important impact on the BE in the balance sheet through the mathematical provisions even though the volume of premiums is quite poor.

    For these reasons we decided to make an estimation for the SCR Life and to include the mathematical provision in the BE's value.

Thereafter, we are going to illustrate in this table the list of non-life lines of business that are offered by the MAE.

Table 4 Concerned Lines of Business:

Number	Line of business (Lob)
1	Motor vehicle liability
2	Other Motor
4	Fire
5	3rd party liability

Source: Established by the author

These are the 4 lines of business available to be used in the BE determination as well as the NL SCR.

On the whole, we just defined the general framework depending on the situation of our company and we will be moving on to the steps we followed to reach our final objective which is establishing an estimation of the financial solvency of the MAE under the new directive Solvency II mainly through the calculation of the global SCR.

First, we have to establish the economic balance sheet but in order to achieve objective we need to determine the "Fair Value" of the different asset items and the "Best estimate" of the technical provisions per Lob for the liabilities.

Second, after getting our balance sheet and its fair values ready, we can start applying the different formulas of the SCR modules and submodules as illustrated in the second chapter.

Third, we will retrieve the global SCR and MCR to form a global idea on the company's financial situation under Solvency II.

Finally, we are going to establish the solvency margin using Solvency I norms with the aim to judge the impact of this major change on the financial situation of the "MAE".

2. Solvency II Quantitative requirements.

In this part we will be applying the Standard Formula we detailed in the second chapter using the process and the methodology previously mentioned.

2.1. Economic Balance Sheet.

Before we start the valuation of the different asset and liabilities, we will illustrate the accounting balance sheet to clear up the items we need to work on estimating beforehand.

2.1.1. Accounting Balance Sheet:

Table 5: MAE's accounting Balance Sheet 2018 (in TD)

Assets		**Liabilities**	
Intangible assets	380 169	Own Funds	95 415 788
Equipment and furniture	3 208 089	Provisions for liabilities and charges	4 600 660
Investments	372 755 370	Technical Provisions	294 286 855
Reinsurers share of the technical provisions	16 258 024	Other liabilities	50 266 818
Other Assets	51 968 470	Total liabilities	349 154 333
Total Assets	**444 570 121**	**Total OF and Liabilities**	**444 570 121**

Source: MAE Annual report 2018

This is a simplified version of the company's accounting balance sheet at the end of 2018.

We will be specifying the composition of some items as:

Investments:

- Property.
- Stocks.
- Bonds.
- Saving certificates.
- Monetary and other investments.

Other assets:

- Cash.
- Bank deposits.
- loans.

Other liabilities:

- Cash deposits received from reinsurers.
- Debts.
- Regulation accounts.

We chose this form to show exactly which balance items will be treated and valuated using the FV or the BE.

2.1.2. Solvency II balance sheet:

2.1.2.1. Asset valuation:

Illustrated below we will find the assets valuation using the "Fair value" or "Market value" that we will discuss how we proceeded to achieve those values alongside the hypotheses we took if existed.

Table 6: MAE's Assets: Economic Balance sheet (in TD)

Item	Value
Intangible assets	0
Equipment and furniture	3 208 089
Investments	440 144 199
Reinsurer's share of the technical provisions	16 258 024
Other Assets	51 968 470
Total Assets	**511 578 782**

Source: Established by the author

Intangible Assets:

As there's no market for those assets we can't determine their FV they will be assigned a null value under Solvency II.

Equipment and furniture:

As we don't have enough data on these assets and their acquisition, we can't estimate a FV.

Investments:

This item is most important element of the balance sheet as it represents more than 85% of the total assets, consequently, we will take its components one by one starting by:

Property: In order to estimate its FV, we started by using the Old property valuation made by an expert that dated from 2009.

To sum up, we got the market value of 70% of the real estate owned by the company in 2009 which are mostly completely depreciated alongside 30% new acquisition most of them are bare lands that their market value will not be much superior than their accounting value.

In order to achieve an accurate estimation, we used the INS property price index that illustrates the evolution of real estate and bare lands price from year to year.

While we got no problem estimating the properties valuated in 2009 with a fixed year as a reference, we didn't have an acquisition date for the new ones which pushed us to take this **hypothesis**:

-We will suppose that all new property acquisitions dates from 2014 as a middle year between 2009 and 2018.

Applying the INS index on the final set of data after the different treatments will give us the FV of every property in the portfolio of the "MAE", only a sum is left to get the value on the balance sheet.

Stocks: The fair value of the stocks owned is not that hard to calculate as we only had to multiply the number of shares per company by its price on the 31/12/2018 then summing them up to get our Stocks Fair Value.

Bonds: In order to calculate the Market value of the bonds we had to establish a depreciation schedule for every type of bond with the aim to extract the cashflows per year.
The value of the bond's portfolio would be the present value of those cashflow going from 2018 to 2033.
Other investments: Mainly they are monetary investments.
Lacking the placement rate of those assets we can't proceed to calculate their fair value, consequently we are will suppose that their FV equals their accounting value.

Reinsurers share of technical provisions: We will assume that this item won't be affected by a BE treatment due to not being able to gather any data concerning the reinsurance treaties as a **hypothesis**.

2.1.2.2. Liabilities Valuation:

In this valuation we have to precise that we included the NAV in the balance sheet as they represent the economic Own Funds with aim to retrieve a total OF+ liabilities equal to the total of assets.
Also, the only item of the liabilities that we need to estimate is the technical provisions representing more than 80% of the total liabilities out of Own Funds.

Table 7: MAE's Liabilities: Economic Balance Sheet (in TD)

Item	Solvency II
NAV	238 323 916
Provisions for liabilities and charges	4 600 660
BE+RM	219 160 768
Other liabilities	50 266 818
Total liabilities	269 427 586
Total OF and Liabilities	**511 578 782**

Source: Established by the author

Before We move on to BE and Rm estimation, we have to verify the Own funds classification equations:

- Tier 1 > 1/3 OF ➔ T1> ½ (T2+T3)
- Tier 3 < ½ (T1+T2)

As the company's own funds came from its initial(members) fund, retained earnings and capital related provisions which all belongs to the T1 then both equations are verified.

Best Estimate:

As previously mentioned, the technical provision is non-hedgeable liabilities without a market to trade which means we cannot estimate a FV and this where the BE came into use.
The best estimate we can find in the balance sheet is composed from 3 items:

- BE claims (Non-life).
- BE premiums (Non-life).
- Mathematical provisions and Claims reserves (Life).

We chose this configuration for same reasons that pushed us to estimate the SCR life and not calculate it using the standard formula but we always to take its provisions into account.
Therefore, we will be discussing every item one at a time.

BE Claims: This is the main component of the best estimate.
First of all, we would like to mention the data we gathered which is a set of claims triangles extracted using the chain ladder approach for the list of Lob commercialised by the MAE as follows:

Lob1: Motor vehicle Liabilities

Lob2: Other Moto

Lob4: Fire

Lob5: 3rd person liability.

Furthermore, we will use the payments triangle in order to establish a settlement pattern to help us estimate the sum of money we're going to pay every year in the future related to the existing contracts.

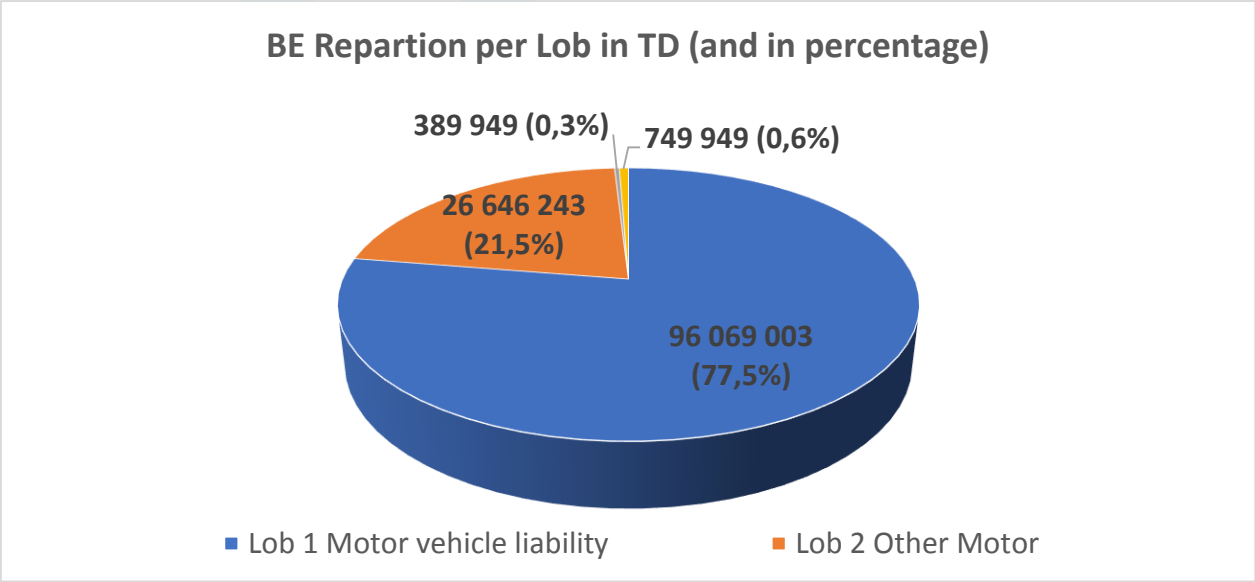
After that, we will estimate the annual claims expenses in terms of claims provisions based on this **hypothesis**:

-Annual claims expenses rate are constant and equal to the average of the $\left(\frac{Claims\ expenses}{Provisions\ for\ claims\ outstanding}\right)$ over the last 5 years (2014-2018) per line of business.

Next, we will apply this rate to the sum we will be paying every year to get the annual cash flows.

By definition, the BE estimate takes into account the time value of money and that's exactly what's left to do using the 2018 (Appendix or fig number :) interest rate curve on the CMF website which will give us actual value of those cashflows, in other words our final BE per Lob broken down as follows:

Figure 8:BE Reparation per Lob in TD (and in percentage)



Source: Established by the author

BE Premiums: While we are always following the same approach of calculating the BE for every Lob we already mentioned, the BE premiums is a formula that we need to apply once we extracted the necessary data.

$$BE\ premiums = CR * UPR + (CR - 1) * PVFP$$

CR: Combined Ratio

UPR: Unearned Premium Reserves

PVFP: Present Value of the Future Premiums

As a result, we got the distribution of BE premiums illustrated in the schedule below:

Table 8:BE premiums per lob (in TD)

Lob	BE premiums
Lob 1 Motor vehicle liability	66 535 846
Lob 2 Other Motor	-16 041 674
Lob 4 Fire	416 435
Lob 4 3rd party liability	773 379
Total	**50 910 607**

Source: Established by the author

Mathematical provisions and claims reserves (life): Always for the same reasons behind not treating the SCR life, we will be just adding these life technical reserves as the impact of not taking them into account will snowball by affecting the NAV which will also impact the SCR and the Solvency Ratio.

Risk Margin

As a result of lacking any previous SCR data we will be using this simplified RM formula:

$$RM = \alpha_{LoB}.BE_{net}$$

2.1.3. Accounting VS Economic balance sheet

With the aim to summarize, we will illustrate in this part a comparison between the accounting and the economic balance of the "MAE", established for the year 2018.

Table 9: Balance sheet comparison under SI and S2(in TD)

Assets				**Liabilities**			
Item	**Solvency II**	**Solvency I**	**Gap**	**Item**	**Solvency II**	**Solvency I**	**Gap**
Intangible assets	0	380 169	-380 169	NAV/OF	238 323 916	95 415 788	-
Equipment and furniture	3 208 089	3 208 089	0	Provisions for liabilities and charges	4 600 660	4 600 660	0
Investments	440 144 199	372 755 370	67 388 829	BE+RM/TP	219 160 768	294 286 855	-75 126 087
Reinsurer's share of the technical provisions	16 258 024	16 258 024	0	Other liabilities	50 266 818	50 266 818	0
Other Assets	51 968 470	51 968 470	0	Total liabilities	269 427 586	344 553 673	-75 126 087
Total Assets	**511 578 782**	**444 570 121**	**51 315 801**	**Total OF and Liabilities**	512 352 162	444 570 121	67 008 661

Source: Established by the author

Obviously, when looking at the gaps between both balance sheets we can notice than the main difference is in the item's investments and technical provision respectively in the assets and liabilities as they are the ones that were treated using the FV and the BE.

For a more in-depth analysis we can compare the ratio (investments / technical provisions) which will indicate how far can the financial investments can cover the technical undertakings.

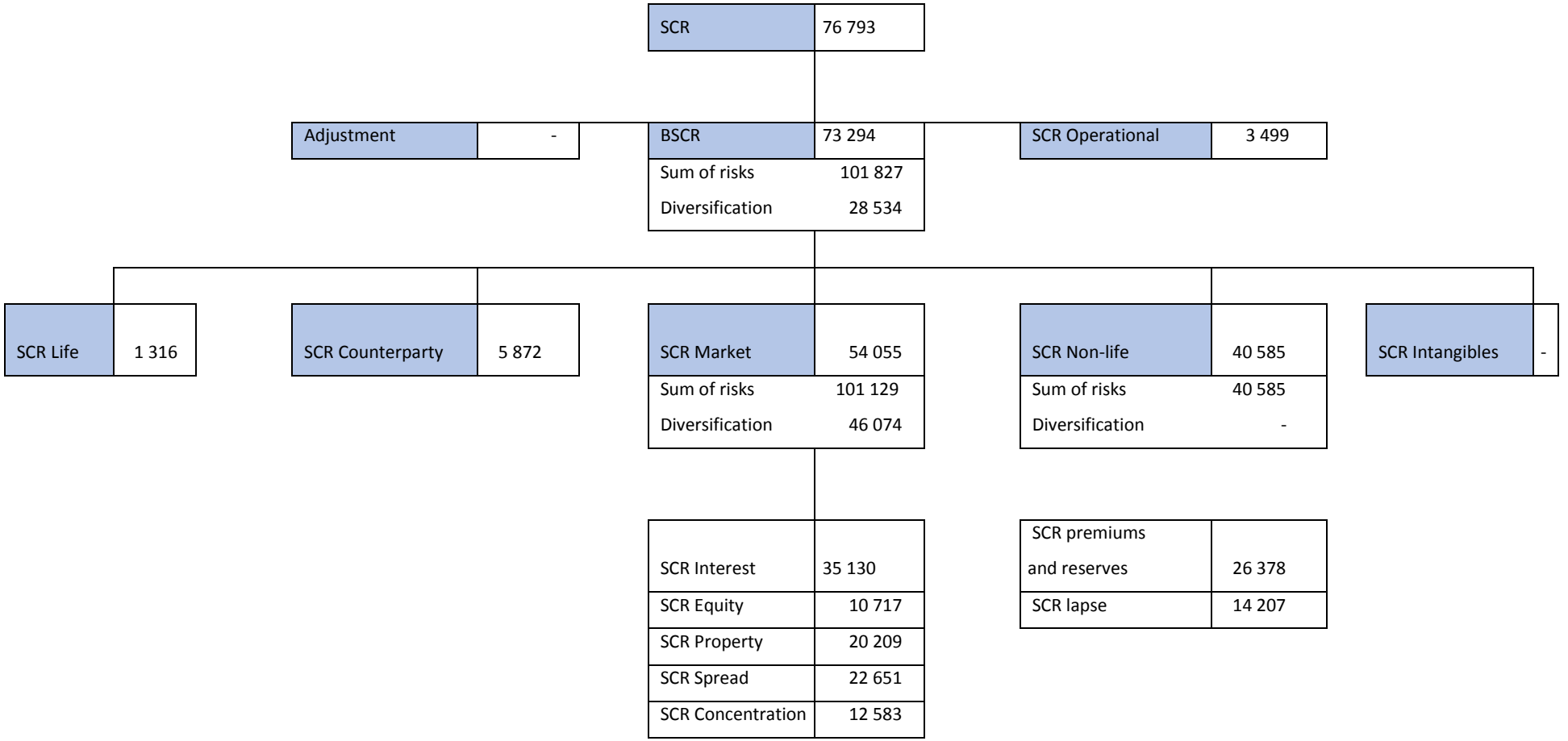
This indicator has increased under Solvency II to 200% from only 126% under Solvency I which already enough.

This rise is explained by the importance of the real estate portfolio that increased the investments value dramatically while the technical provision has been decreased using the BE which can mean that the company's current reserving process is cautious.

2.2. Solvency Capital Requirements:

Starting, we will be illustrating the SCR pedigree then we will be discussing the SCR modules one by one until we reach our global SCR.

Figure 9: MAE's SCR pedigree



Source: Established by the author

2.2.1. SCR Market:

The capital requirement for the market risk is up to **54 054 937 TD** after the diversification.

This SCR is decomposed into 6 submodules including the currency that we will not be treating due to lack of data and the insignificance of the risk with a null value for the currency translation adjustment and the for the investments in foreign currencies

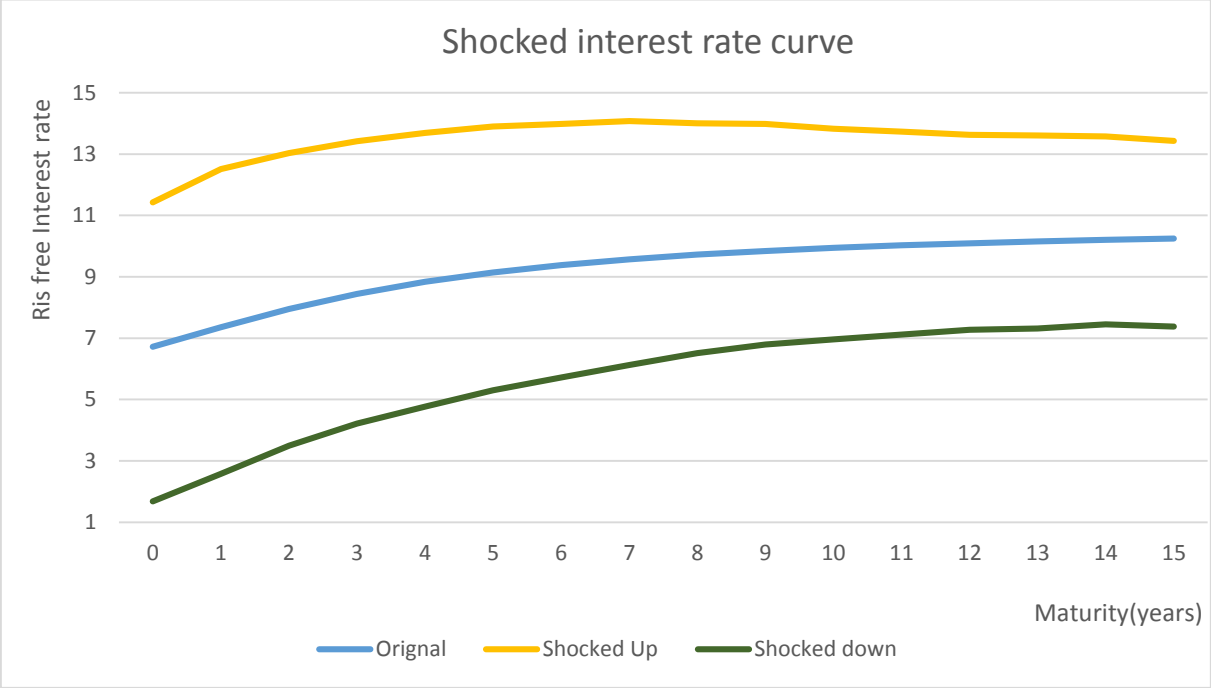
The other 5 market submodules are:

- SCR Interest
- SCR Equity
- SCR Property
- SCR Spread
- SCR Concentration

2.2.1.1. SCR interest Rate:

The SCR IR is calculated through a valuation of the total assets and the BE using a stress test on the interest rate curve shown below:

Figure 10: Shocked interest rate curve



Source: Established by the author

While we can calculate the duration of the BE and the bonds portfolio, we will suppose that the duration of the property and the equity portfolio as the former will be significantly superior and the latter significantly inferior to the bonds duration which will be taken as the total assets duration (**hypothesis**).

After calculating the durations of the BE and the total assets we can proceed to the application of the stress test using both the up curve and the down curve and the more important impact on the NAV will be taken as the SCR IR as we can see in this table:

Table 10: SCR interest rate calculation (in TD)

	VM	Duration	Shock UP	Shock down	Shocked Up	Shocked down
BE	274 028 245	2,13	13,42%	4,22%	310 808 481	262 462 133
Total assets	511 578 781	5,89	13,98%	5,72%	583 101 666	482 297 601
NAV	238 323 916	-			272 293 185	219 835 467
ΔNAV					33 969 268	18 488 448
					SCR IR	**33 969 268**

Source: Established by the author

With the SCR value in hand, now the company knows that it has to save up **33 969 268 TD** of its resources exclusively for this risk to stay safe from insolvency.

2.2.1.2. SCR Equity:

First of all, the SCR equity is a stress test applied on the fair value of stocks after segmenting it to 3 types with each of one of them have a distinct shock rate as illustrated below:

- Listed in the OCDE countries: 39%
- Other shares: 49%
- Strategic participations 22%.

We have to mention that the stress test for both the first and the second type is not final as we have to adjust it using a dampener.

The dampener is calculated based on a weight percentage fixed by the EIOPA for every stock market index.

This Index is determined by an advanced actuarial approach that we can't apply on TUNINDEX which isn't available in the EIOPA list.

In order to deal with this problem, we decided to opt for another **hypothesis** through using the inferior born (-10%) to alleviate the high shock rate of 49% for the investment in stocks out of the OCDE countries.

To sum up, we established this table for the two types the company owns which are the second and the third type:

Table 11: SCR Equity calculation (in TD)

Item	FV	Shock	Shocked FV	SCR
Non-strategic participations	15 358 204	39%	9 368 504	5 989 699
Strategic participations	21 485 892	22%	16 758 996	4 726 896
			SCR Equity	**10 716 596**

Source: Established by the author

Finally, with the knowledge of the SCR equity ‘s value, we can evaluate this risk and how much we need to lay aside from our funds as a protection from the volatility of the stock market.

2.2.1.3. SCR Property:

The SCR property can be obtained through a simple stress test of 25% applied to the fair value of the real estate portfolio.

As a result, we got to save up **20 208 887 TD** ‘s worth of resources to make sure that the company won’t be insolvent more than once in 200 years’ time.

2.2.1.4. SCR Spread:

This submodule aims to absorb the inherent risk of high duration and low rating for the bond portfolio through executing a stress test with a rate increasing in terms of these 2 variables.

This SCR also takes into account the risk of the volatility of the credit derivatives that are nowhere to be found in the company’s investments portfolio leading us to limit our work on the bonds risk.

The shock rate can be calculated by multiplying the duration of the bonds portfolio by the risk factor for the rating which is 3% for the unrated bonds.

Accordingly, we obtained an SCR value equal to **22 651 320 TD** of the economic own funds of the “MAE” to guarantee its solvency under the new directive.

2.2.1.5. SCR concentration:

As its name indicates, this SCR is meant to protect an insurance company from accumulating too much undertaking towards a single entity or group.

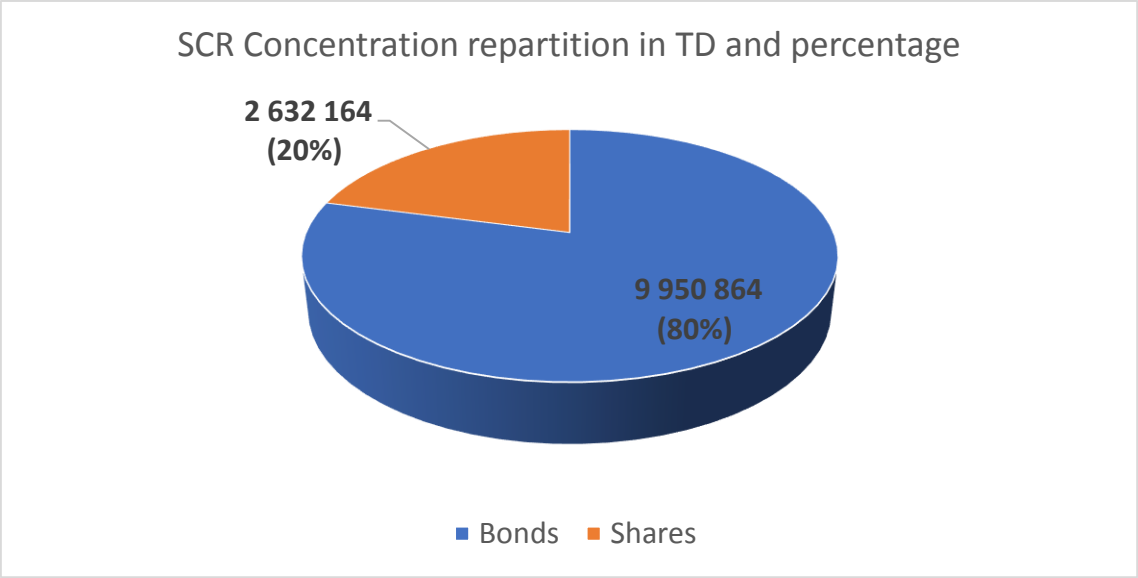
In fact, it takes into account every type asset that can be threatened by this risk.

Due to the data gathered, we can calculate this submodule for 2 types of assets:

- Shares
- Bonds

After choosing the risk factor depending the rating which is 73% in our case for the BB and lower ratings, we have got the repartition shown below:

Figure 11: SCR Concentration repartition in TD and percentage



Source: Established by the author

Consequently, the total SCR Concentration will be evaluated as **12 583 027 TD** 's worth of resources for a 99,5% chance for one case of insolvency over 200 years.

2.2.2. SCR Non-Life:

This SCR module has reached **40 584 929 TD** without diversification because the 2 submodules are not correlated.

As matter of comparison, the SCR NL in our case contributed to more than 50% of the global SCR versus only 16% for the French market.

This important gap is due to huge difference in the repartition of the premiums, as the Non-life activity represents nearly 95% of the "MAE" 's turnover while it has not exceeded the 40% in France.

Also, there's another reason that we have to mention which is poor number of lines of business worked on with a more than clear domination of the NL portfolio by the motor insurance leading

to a low diversification gain through the correlation between Lobs in the calculation of the SCR premiums and reserves.

As previously mentioned, we will be treating 2 submodules in this SCR which are:

- SCR premiums and reserves.
- SCR lapse.

2.2.2.1. SCR premiums and reserves:

This SCR combines both the inherent risks of premiums and reserves.

First of all, we need to calculate the volume which is decomposed into V_p and V_r respectively for net of reinsurance premiums and reserves.

This volume V_{pr} is the sum of the V_p which is retrieved through a simple formula while the V_r is the total of BE reserves per Lob with a possibility of a diversification gain through geographical segmentation that we won't be taking into account due to the lack of data.

Then, we need to calculate the standard deviation per Lob followed by the overall which is a function in terms of the σ premiums, σ reserves which are both fixed in the QIS5 alongside a risk mitigation factor for non-proportional reinsurance, V_{pr} and the Lobs correlation.

Finally, we need to apply this formula in order to obtain our SCR PR:

$$SCR\ PR = 3\ *\ \sigma * V_{pr}$$

As a result, we have got to save up **26 249 365 TD** exclusively for the premiums and reserves risks in order to respect the regulation of the new directive Solvency II.

2.2.2.2. SCR Lapse:

This second component of the SCR NL aim to save an amount of the company's resources equal to **14 207 399 TD** in our case, as a protection for the uncertainty of the underwriting profits due to terminating the contract before its contracting deadline.

It's calculated through a stress test of 40% on the Upcoming Premiums Reserves.

2.2.3. SCR Default:

The SCR default is determined to offer the company a sort of immunization facing the risk of counterparty default for the reinsurance undertakings and policyholders.

As a result of not having enough data for both components we will be using the simplified formula which is:

$$SCR_{Def} = SCR_{NL}\ gross\ of\ reinsurance - SCR_{NL}\ Net\ of\ reinsurance$$

We determined the SCR NL net of reinsurance through 2 adjustments in the calculation of the non- life capital requirement:

- Neglecting the ceded premiums in the V_P calculation.
- Eliminating the risk mitigation factor of the non-proportional reinsurance.

The "MAE" needs to reserve 8% of its NAV (economic own funds), **5 871 836 TD** in terms of money to avoid more than one case of insolvency over a horizon of 200 years due to the risk of counterparty default.

2.2.4. SCR Life:

Before starting the SCR Life treatment, we recommend checking again the methodology part where we listed our reasons for estimating this SCR instead of calculating it using the Standard Formula.

This estimation is based on the decomposition of the Solvency Capital Requirements of the French insurance market.

Because of the disparity in premiums repartition between our company and the French market we will determine the contribution of a unit of premiums to the SCR then multiply it by the life premiums for the MAE.

Even though this estimation might not be precise, the impact on the global SCR will not be important due to the low participation of the life activity in the company's portfolio.

Also, we can assume that it is a prudent estimation as the French market is highly regulated.

The estimated SCR life retrieved through this approach is equal to **1 315 560 TD** that should be reserved as a security to ensure the company's solvency under the new directive.

2.2.5. SCR operational:

To start with, we have got to mention that this SCR is not included in the BSCR but it's on the same level in the pedigree leading directly to the calculation of the global SCR.

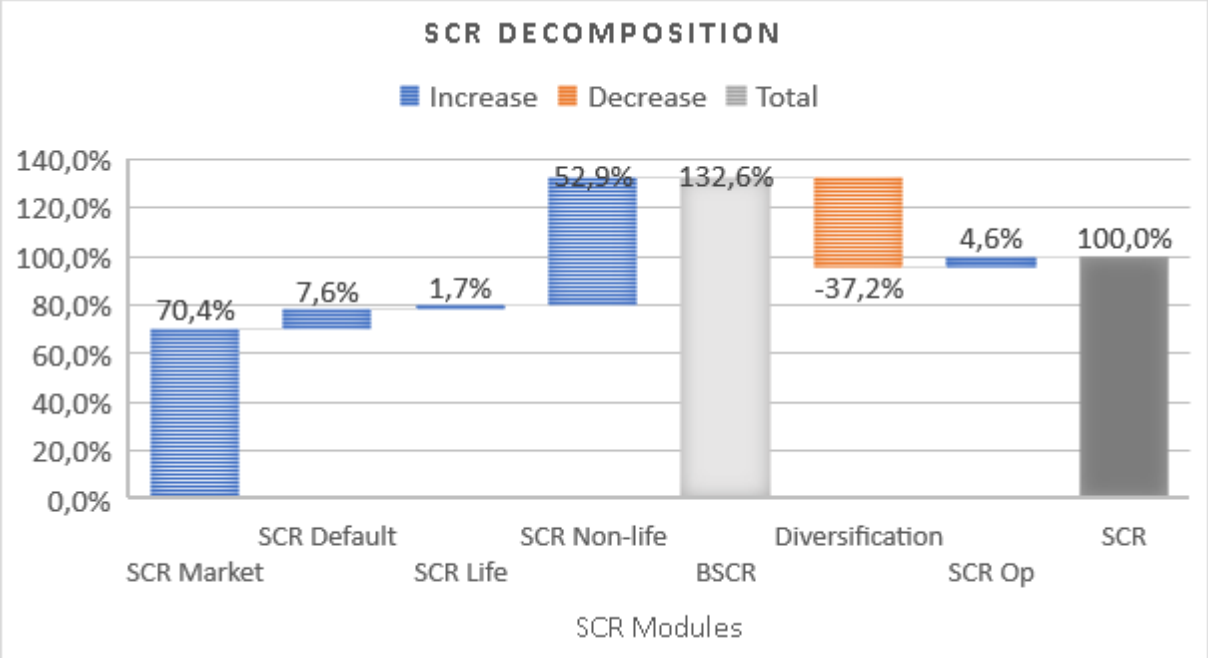
It is conceived to shield the company from the risk of loss due to systems, internal processes, personnel and external events.

We calculated it using both formulas illustrated in the second chapter and the premiums approach ended up giving a more prudential result equal to **3 498 975 TD** to be laid aside from the "MAE" 's own fund to oppose to the risks listed above , to prevent insolvency problems and to follow the new regulation.

2.2.6. Global SCR:

We will start by the SCR decomposition shown below:

Figure 12: MAE's SCR Decomposition



Source: Established by the author

The biggest contribution to the global SCR is registered by the SCR market due to the important asset value especially the property portfolio and its FV valuation.

Also, we need to mention the SCR NL providing 53% of the SCR before diversification (BSCR) because the MAE's activity is based on non-life insurance representing 95% of the total earned premiums.

On the contrary the SCR life contribution is too shy due to the same reason which is the focus on the non-life activity.

Besides, we need to mention the importance of the diversification factor that mitigated a good proportion of the but it still not exploited to the most mainly because of the dispersion between the life and non-life portfolios.

Speaking numbers, the SCR has reached **76 792 560 TD** to be hold on to from the company's own funds in order to ensure that company is exposed only to one case of insolvency over a horizon of 200 years.

While the SCR calculated through the Standard Formula of Solvency II is **76 792 560 TD,** the "MAE" 's prudential own funds exceeds by far that number reaching **242 924 576 TD** which means that the company is still healthy under the new directive and we can judge that it will not be facing solvency problems due to the SII implementation.

2.3. Minimum Capital Requirement:

This notion is given to certain amount of money that an insurer should have as own funds to keep running its business.

Under the MCR limit, the regulator will issue a legal directive to make it withdraw from the insurance market with no means of correction.

The MCR is calculated through the combined MCR formula that uses 3 preliminaries MCR values summarized in the table below:

Table 12: MCR calculation (in TD)

MCR	Value
MCR Linear	24 304 670
MCR floor	19 198 140
MCR CAP	34 556 652

MCR Combined (Min (Max (MCR Floor; MCR linear); MCR Cap))	**24 304 670**

Source: Established by the author

While the "MAE" needs **24 426 106 TD** to hold on to her approval to practice the insurance, its own funds exceeds that amount by far with a ratio $\frac{NAV}{MCR}$ nearly reaching the 1000% which means that the company is in a too good state to be worrying about maintaining its business.

3. Solvency I Capital requirements:

In this part we will be calculating the quantitative requirements according to the current regulation in Tunisia using the Solvency Margin.

The process of the Solvency Margin's determination will be detailed in the table below:

Table 13: Minimum Solvency Margin and Solvency Margin (in TD)

Element	Value
Life Minimum Margin	2 078 626
Non-life Minimum Margin	19 160 471
Minimum Solvency Margin	21 239 097
Solvency Margin	**89 024 772**

Source: Established by the author

As we can see in this table, the "MAE" 's solvency margin is equal to **89 024 772 TD** which quite superior the MSM's value of **21 239 097 TD** meaning that the company's solvency is in a good shape, respecting the current capital requirements and won't be facing any solvency problems at least in the upcoming years.

4. MAE Solvency I VS. MAE Solvency II:

Last but not least, we will be comparing the company's numbers under both regimes in order to highlight the impact of the implementation of the new directive.

A table containing the most important indicators is illustrated below:

Table 14: Indicators: Solvency I Vs. Solvency II (in TD / percentage)

Item	**Solvency I**	**Solvency II**
Coverage of the TP by the investments: (Investments/TP)	126,7%	200,8%
Quantitative requirements	22 789 096	76 792 560
Intervention of the CGA the (Withdrawal from business)	22 789 096	24 304 670
Solvency Ratio (MSM/SM) or (NAV/SCR)	**419,2%**	**316,3%**

Source: Established by the author

- First, the technical undertakings coverage by the investments was **126,7%** under S I, increasing to over **200%** using the S II balance sheet.
  This difference is due to the rise in investments after the FV valuation and the decrease of the technical provision through the BE.
  This ratio means that the company can meet its technical undertakings as long as it is **superior to 100%** which is the case under both directives with a significant improvement under solvency II.
- The quantitative requirements have increased dramatically in a scenario where the solvency II norms are already implemented, moving from **22 789 096 TD** to **76 792 560 TD** because of the increase in the number of risks taken into account, as in the solvency I, only underwriting risks are used to calculate the MSM while we added also the market, default and operational risk to retrieve the SCR.
- After going under a certain threshold of own funds, the insurance regulators will intervene to make a company withdraw from the market, this limit represent the MSM in the current regulation which is equal to **22 789 096 TD** versus the MCR for the new directive reaching **24 304 670 TD**.
  The gap between the two values is insignificant because both notions uses almost the inputs with the difference that the MCR is calculated per Lob and using the BE instead of the technical provision before valuation.
- Finally, and most importantly, the Solvency ratio which the objective of this thesis and the main factor to judge a company's solvency.

This indicator should **exceed 100%** to make the assumption that the company won't be facing any problems meeting its obligations in the short term.

In fact, using the current regulation, the SR has reached nearly **420%** meaning that the company is really strong financially with no forecast of solvency problems.

However, this ratio has declined significantly under the new directive hitting only **316%** losing a fourth of its percentage under Solvency I.

Although, a decrease in the solvency ratio is always a bad sign but it is more than expected because of the impact of taking into account a large set of risks leading to a tighter regulation compared to the old directive.

Out of comparison, **316%** SR under Solvency II is more than a good result, such a number indicates that the MAE is in a good shape financially with the economic own funds weighting 3 times more than the Solvency Capital Requirement which is a really good sign for the future of the company.

5. Limits and recommendations:

Following our work on the impact of Solvency II on the MAE and after treating the different risks threatening the company, we would like to suggest some recommendations in order to smooth the process and the results of implementing the new directive.

First, we will start with the recommendations related to the process illustrated below:

- In our study, we used the Standard Formula with the coefficients established by the EIOPA, we noticed all along this thesis that those factors are not adapted to the company or even to the Tunisian market especially in the SCR market and more precisely the rating of the bonds issuers and the high stress test rate for the non OCDE shares , also the calculation of the SCR operational that does not reflect the lethality of this risk.

  In order to deal with those problems, we would like to suggest:

  The use of an internal model or the USP (Undertakings Specific parameters) which is an actuarial tool that will allow the company to change some of the coefficients to achieve a more a realistic judgement.

  According to PWC, 71% of the insurers questioned in a S II survey added a set of a complementary operational risks and 30% for the emerging risks which we recommend highly especially for the OR.

- Also, we would like to highlight the importance of the ORSA (Own risk and Solvency adjustment) which is the heart of the second pillar (qualitative requirements) that will put into use the work we have done integrating it in the decision making by establishing a new version of the Business Plan including the Solvency II indicators, a set of scenarios after fixing the threshold of SR to make sure that the new development strategy won't affect its solvency on the medium term.

Second, we will move to the recommendations that will affect the calculations we have done and that will improve the significance of those numbers and their repartition:

- To start with, we wish to point up the lack of diversification on two levels:

  Life and non-life repartition: The dispersion between both activities is just huge which is reflected on the underwriting SCR registering **1 316 KTD** and **40 585 KTD** respectively for the life and non-life.

  This gap illustrates that the company is putting her eggs in one basket and missing the opportunity to develop the most important line of insurance worldwide.

  Developing the life business will have many impacts on the quantitative requirements under Solvency II, on one hand, an increase in the SCR life and the BE will be expected which will lead to decreasing the overall Solvency Ratio but on the other hand, there will a compensation because of the diversification effect (correlation) and the decrease of the SCR operational due to the Units Linked expenses.

  To sum up, even though we are not sure that the final impact on the SR will be disadvantageous, we are almost sure that the company will register a big benefit due to the low risk of the life business.

  Non-life Lobs: the diversification problem extends to the non-life activity itself as the 2 Motor insurance Lobs (Motor Liabilities and other Motor) contribute to **98%** of the SCR Non-life which will result in a deficiency by missing a chance to improve the SR through the diversification from the correlation factors.

  In addition, we would like to recommend a new valuation for the property portfolio as we calculated the FV using a rapport dating from 2009 using the INS real estate price index, which is not that precise and will not take into account the availability of some properties as they are aging more than 50 years old.

Finally, we would like mention that some of the those recommendations are only valid before officially implementing the new directive by the Tunisian regulators mainly the USP and internal model one as prior to this, there will be a set of a Quantitative Impact Studies (QIS) on the Tunisian market in order to establish an adequate calibration.

Despite the decrease in the Solvency Ratio comparing to the Solvency I, we want to highlight again the financial strength of the "MAE" reaching more than 300% meaning it will be facing less than one case of insolvency over a horizon of 200 years with a confidence level of 99,5%.

Also, we would like to say that if Mr Hassen Feki 's quote that only 3 Tunisian companies might remain solvent after the implementation of Solvency II then the "MAE" is definitely going to be one of them.

Conclusion

After the implementation of the Solvency II directive, insurance companies have been complaining about the tighter regulation and the difficulties to keep up with the new Solvency Capital Requirements.

In this thesis, we tried to answer this problematic: "What is the impact of implementation the new directive's Quantitative Requirements on the "MAE" 's solvency using the Standard Formula?"

Following our study on this subject, we definitely confirm the eligibility of these complaints as the Solvency ratio of the "MAE" has decreased significantly from nearly **420%** using the current regulation to **316%** under Solvency II.

Even though we registered a drop in the Solvency ratio moving to the new directive, the "MAE" 's Net Asset Value calculated through the economic balance sheet has reached **238 323 916 TD** which exceeds by far the Solvency Capital Requirement that has not surpassed **76 793 000 TD.**

As a result, we can judge that the company is in a really good shape financially with no forecast of any solvency problems on the medium term and guaranteeing less than one case of insolvency over the next 200 years with confidential rate of 99,5.

Consequently, with those numbers, the "MAE" should not even keep in mind the possibility of the intervention of the "CGA" to make them withdraw from insurance market as we found out that the Minimum Capital Requirement represents only **10%** of its NAV.

Last but not least, we would like to mention that there were some limits to our study that should be solved by the time the "CGA" start running a Tunisian version of the QIS to extract our own calibration, also we have got to mention that the registered numbers could be even better if the company's portfolio was more diversified which is already being worked on using the new development strategy.

Finally, we have got to recognise that our Master Thesis have only focused on the Quantitative Requirements which represents only one pillar of the Solvency II ‘s structure so what will be the impact of the qualitative requirements on our company, and how ready it is to deal with them?

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Appendices

Appendix 1: Solvency II governance texts applied in Tunisia (in French)

Chapitre 241 (nouveau):

Les sociétés d'assurance et les sociétés de réassurance doivent mettre en place au sein de sa structure organisationnelle des fonctions indépendantes du reste des structures d'exploitation, et d'appui chargées de l'audit interne, de la gestion des risques, de l'actuariat et du contrôle de la conformité.

La structure d'audit interne et la structure de gestion des risques de la société d'assurance et de la société de réassurance assurent les travaux de secrétariat des comités d'audit et des comités des risques.

Un règlement du Comité fixera les missions dévolues aux fonctions d'audit interne, de gestion des risques, d'actuariat et de contrôle de la conformité.

Article 219 (nouveau):

Les sociétés d'assurance et les sociétés de réassurance dirigées par un conseil d'administration doivent distinguer les fonctions de Président du Conseil d'Administration et celles de Directeur Général.

Le Directeur Général ou le Directeur Général Adjoint d'une société d'assurance et d'une société de réassurance ne peut pas être membre du conseil d'administration de cette société,

Une société d'assurance ou une société de réassurance peut, à titre exceptionnel, combiner les fonctions de Président du conseil d'administration et de Directeur Général, après approbation du Comité.

Cette approbation est accordée en tenant compte la nature de l'activité et la taille de la société.

Appendix: 2 Deterministic models:

"For the estimation of non-life best estimate liabilities as well as life insurance liabilities that not need simulation techniques, deterministic and analytical techniques can be more

appropriate. At the current point in time, stochastic reserving techniques, especially in non-life insurance, are not considered as necessary valuation techniques to calculate best estimate values. The application of deterministic techniques and judgement can be far more important than the mechanical application of simulation methods." QIS5

Appendix 3: SCR Market

Property Risk

$$Mkt_{Prp} = Max\left(\Delta NAV|Property\ shock\ of\ 25\%\,;0\right)$$

Interest Rate Risk:

$$Mkt_{int}^{UP} = \Delta NAV\,|up$$

$$Mkt_{int}^{Down} = \Delta NAV\,|down$$

Two results which are the changes in the NAV, afferent from two stress test scenarios the first upward and the second downward based on the changes illustrated by the EIOPA below:

Maturity(year)	Changes Up	Changes Down
0	70%	75%
1	70%	65%
2	64%	56%
3	59%	50%
4	55%	46%
5	52%	42%
6	49%	39%
7	47%	36%
8	44%	33%
9	42%	31%
10	39%	30%
11	37%	29%
12	35%	28%
13	34%	28%
14	33%	27%

15	31%	28%

The selected SCR will be the highest capital requirement from the two scenarios up and down shocks.

Equity Risk:

$$Mkt_{eq} = \sqrt{\left(Mkt_{eq,1}\right)^2 + \left(Mkt_{eq,2}\right)^2 + 2.75\% \,.\, Mkt_{eq,1} \,.\, Mkt_{eq,2}}$$

With :

$$Mkt_{eq,i} = NAV - \Delta NAV_{shoch}$$

$Mkt_{eq,1}$: SCR afferent to type 1 equity.

$Mkt_{eq,2}$: SCR relative to type 2 equity.

The level of shock is judged depending on the equity type, the investment strategy and the calculation method as illustrated below:

Type 1	Nature	Shock
Shock 1	Strategic Investment type 1	-22%
Shock 2	Non-strategic type 1	-39% + Dampener
Shock 3	Type 1 whose calculation is based on the duration	-22%

Type 2	Nature	Shock
Shock 1	Strategic Investment type 2	-22%
Shock 2	Non-strategic type 2	-39% + Dampener
Shock 3	Type 2 whose calculation is based on the duration	-22%

The dampener's calculation is based on a Symmetrical Adjustment (SA) in order to vary the shock according to the stock's value and evolution calculated like this:

$$SA = \frac{1}{2}\left(\frac{CI - AI}{AI} - 8\%\right)$$

CI: Current Index of the stock.

AI: Average stock index based on a 36 months history.

$$Dampener = Max\left(Min\left(SA;\ 10\%\right);\ -10\%\right)$$

Spread Risk:

$$Mkt_{Spread} = Mkt_{Bonds} + Mkt_{securitisation} + Mkt_{Credit\ Derivatives}$$

As the only type available to be calculate in our case is the bonds here's the calculation formula for it:

Risks correlation matrix:

	Interest	Equity	Prop	Spread	Concentration
Interest	1	0	0	0	0
Equity		1	0,75	0,75	0
Prop			1	0,5	0
Spread				1	0
Concentration					1

Appendix: 2 SCR Non-life underwriting:

Starting the premiums volume:

$V_{p,\ lob}$= Max ($PW_{lob;}$ PE_{lob}) + $PVNP_{lob}$

With: $PW_{lob:}$ Premiums written per lob
PE_{lob}: Premiums earned per lob
$PVNP_{lob:}$ Present value of net premiums per lob

Reserves volume:

$V_{r,\ lob}$= BE per lob

Standard deviation per lob:

$$\sigma_{(lob)} = \frac{\sqrt{\left(\sigma_{(prem,lob)} V_{(prem,lob)}\right)^2 + 2\alpha\sigma_{(prem,lob)}\sigma_{(res,lob)}V_{(prem,lob)}V_{(res,lob)} + \left(\sigma_{(res,lob)}V_{(res,lob)}\right)^2}}{V_{(prem,lob)} + V_{(res,lob)}}$$

Overall Standard deviation:

$$\sigma = \sqrt{\frac{1}{V^2} \cdot \sum_{r,c} CorrLob_{r,c} \cdot \sigma_r \cdot \sigma_c \cdot V_r \cdot V_c}$$

And Finally:

SCR_{NL}= V . 3. (σ)