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An Analytical Framework for the Introduction of Overnight Index Swaps to Transform Risk Management in Morocco's Financial Market: Volatility or Stability

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Abstract: This study explores the introduction of Overnight Index Swaps (OIS) to the Moroccan financial market. OIS are financial derivatives that involve the exchange of fixed interest rate payments for floating payments linked to an overnight index, and they are widely used for interest rate risk management. The primary goal of this research is to assess the feasibility and potential impact of OIS in Morocco through a thorough analysis of their characteristics, benefits, and the regulatory environment. A detailed examination of OIS reveals their potential advantages for Moroccan businesses and financial institutions, including improved interest rate risk management and increased liquidity. The study also evaluates the current regulatory framework in Morocco, assessing its readiness to support the introduction of OIS, and identifies key market participants and their needs for such financial instruments. To provide insights into market dynamics and future trends, the study employs quantitative models such as ARIMA (Auto Regressive Integrated Moving Average), SARIMA (Seasonal ARIMA), and the Simple Moving Average (SMA) method. These models are used to analyze historical interest rate data, identify patterns, and forecast future movements, thereby aiding in understanding the potential impact of OIS on the Moroccan market. The findings suggest that OIS could significantly enhance risk management practices and contribute to market stability in Morocco. By providing effective hedging against interest rate volatility, OIS can reduce financial uncertainty for institutions and corporations. Additionally, the introduction of OIS could attract more foreign investment and stimulate the growth of Morocco's financial derivatives market.

Keywords: Overnight Index Swaps (OIS), Moroccan Financial Market, Moroccan Overnight Index Average, ARIMA, SARIMA, Risk Management, Financial Derivatives, Market Stability

Introduction

Interest rate derivatives have become essential instruments in the global financial landscape, offering companies and financial institutions effective tools for risk management and investment strategy optimization. Among these products, Overnight Index Swaps (OIS) stand out for their ability to provide reliable and transparent benchmark rates, which are crucial for the stability and smooth functioning of financial markets (Adedeji & Baker, 2002).

The interest rate derivatives market has experienced exponential growth over the past few decades, driven by financial innovations and increased regulation aimed at enhancing transparency and resilience in financial systems. These derivatives have played a pivotal role in helping financial institutions manage interest rate risk, hedge against unfavorable rate movements, and improve overall financial planning. They have also contributed to greater market liquidity and efficiency, which are vital for the health of the global economy (Hull & Basu, 2016).

However, in Morocco, the development of the interest rate derivatives market remains in its infancy (Hull & Basu, 2016). Despite significant reforms and initiatives by the Moroccan government and financial authorities to modernize the financial sector and attract more foreign investment, the adoption and utilization of sophisticated financial instruments like OIS have been limited. This underdevelopment can be attributed to various factors, including a lack of awareness and understanding of these products among market participants, regulatory challenges, and the relatively nascent state of the Moroccan financial markets.

The introduction of OIS in the Moroccan market represents a strategic opportunity to bridge this gap and equip local financial actors with effective tools for managing interest rate risks. OIS can provide Moroccan financial institutions with a robust mechanism to hedge against short-term interest rate fluctuations, thereby enhancing their risk management capabilities. Additionally, by offering a reliable reference rate, OIS can improve the transparency and predictability of interest rate movements, which is essential for making informed investment and financing decisions.

Moreover, the successful implementation of OIS in Morocco could lead to broader market benefits. It could stimulate further financial innovation and development, attracting more domestic and international investors. By enabling better liquidity management and offering more sophisticated hedging instruments, OIS could help enhance the competitiveness and stability of the Moroccan financial market. In the long term, this could contribute to a more resilient and dynamic financial sector, capable of supporting sustained economic growth and development.

Literature Review

Currently, one of the most prominent trends in financial markets is the considerable rise of derivative products. Since the 1980s, these financial instruments have experienced a dramatic increase in transactions, to the point where they now constitute a significant portion of financial activity. For example, interest rate futures increased from 91 million contracts in 1986 to 234.5 million in 1991. Interest rate options also saw impressive growth, rising from 22.2 million contracts in 1986 to 50.8 million in 1991. This growth far exceeds that of traditional financial operations, which were already outpacing the growth of production or trade in goods (Hull, 2017).

Derivatives are not merely speculative instruments; they have become essential for financial risk management (Reinhart & Rogoff, 2009). The growing demand from investors and the ingenuity of financial institutions has led to a proliferation in the number and variety of these products, as well as associated leveraged instruments. This constant diversification has profoundly transformed how companies manage their finances (Hull & Basu, 2016). As a result, the knowledge and effective use of derivatives have become crucial skills in the field of finance. It is therefore essential to deeply understand these instruments and their impact on financial markets and companies. Interest rate derivatives are financial instruments whose value depends directly or indirectly on interest rates associated with an underlying financial asset, such as a bond, stock, exchange rate, or interest rate index (Adedeji & Baker, 2002). These derivatives are designed to allow investors to protect themselves against the risk of interest rate fluctuations or to speculate on these variations (Hull & Basu, 2016).

Interest rate derivatives have a long history, dating back to commodity futures and stock options in the 17th century (Hull, 2017). However, it was in the 20th century that interest rate derivatives began to develop significantly. They were first used by banks and financial institutions to manage risks related to interest rate fluctuations and later by investors to speculate on these movements (Reinhart & Rogoff, 2009). Interest rate derivatives played an important role in risk management during past financial crises, such as the 2008 crisis, where they allowed market participants to manage and limit their risks related to interest rate variations and to hedge against interest rate risks on their mortgage and bond portfolios (Adedeji & Baker, 2002). These interest rate derivatives are bought and sold in derivatives markets. Derivatives markets are divided into two main categories: over-the-counter (OTC) markets and organized or regulated markets.

Over-the-counter (OTC) market: In the over-the-counter market, transactions take place bilaterally, meaning they are concluded directly between sellers and buyers. The products offered in this market are "tailor-made" to meet investors' expectations, often offering less standardized and normalized operations or in a more flexible regulatory framework. Trading volumes far exceed those recorded on structured markets.

Organized market: Unlike the over-the-counter market, in the organized market, contracts are standardized, and transactions are not negotiated bilaterally. A clearinghouse acts as a counterparty between the buyer and seller. These markets are characterized by high transparency, higher transaction fees, and the absence of counterparty risk (Lloyd, 2018).

Currently, derivative instruments can be used within one of the following three frameworks:

***Hedging*:** Hedging is a strategy employed in the derivatives market to protect against interest rate fluctuations. It is a risk management technique that involves taking opposite positions in the market. This strategy is essential for investors and companies exposed to the inherent risks of interest rate movements in financial markets (Hull & Basu, 2016).

Hedging strategies in interest rate derivatives are diverse and can include the use of interest rate futures, interest rate swaps (Fang, Taylor, & Uddin, 2022), interest rate options, or other similar financial instruments. For example, an investor or company holding long-term bonds can use an interest rate swap to exchange fixed interest payments for variable interest payments, or vice versa, to reduce their exposure to interest rate fluctuations (Adedeji & Baker, 2002).

The advantages of hedging in interest rate derivatives are numerous. First, it allows investment portfolios or cash flows to be protected from adverse interest rate movements. By hedging against interest rate risks, investors can better control their exposure and minimize potential losses (Reinhart & Rogoff, 2009). Additionally, hedging can help stabilize cash flows and reduce uncertainty, which can be particularly beneficial for companies planning long-term investments or business activities sensitive to interest rates (Hull & Basu, 2016). However, hedging in interest rate derivatives also has drawbacks and limitations to consider. First, it can be costly due to fees, margins, and premiums associated with using derivative instruments. These costs can reduce potential profits or increase losses if interest rate movements do not align with forecasts. Furthermore, hedging does not guarantee complete protection against interest rate risks, as market movements can sometimes be unpredictable or occur unexpectedly, rendering the hedging strategy ineffective (Lloyd, 2018).

***Speculation*:** Speculation is a strategy that involves taking risky financial positions to profit from anticipated interest rate fluctuations. This practice relies on predictions and anticipations regarding the direction and magnitude of interest rate movements, differing from hedging, which aims to reduce risks rather than exploit them (Adedeji & Baker, 2002).

The nature of speculation in interest rate derivatives is intrinsically linked to interest rate volatility. Speculative investors seek to interpret market signals, economic data, and central bank decisions to formulate hypotheses about future interest rate movements. Based on these anticipations, they take positions through various derivative financial instruments such as interest rate futures (Hull, 2017), interest rate swaps, or interest rate options (Fang, Taylor, & Uddin, 2022).

Speculation strategies in interest rate derivatives are diverse and can vary depending on investors' perspectives and market conditions. Some speculators adopt a directional approach by betting on an increase or decrease in interest rates, while others prefer more complex strategies such as options trading or using leveraged derivative products to amplify potential gains (Hull & Basu, 2016).

However, speculation carries significant risks. Market movements can be unpredictable, and investors' anticipations may prove incorrect. In case of incorrect forecasts, speculators risk incurring substantial losses, especially if they use leveraged derivative products. Additionally, speculation can be exacerbated by external factors such as changes in monetary policy, geopolitical events, or economic shocks, making the practice even riskier.

Despite these risks, speculation also offers opportunities for substantial profits for investors who successfully anticipate market movements. By capitalizing on interest rate

fluctuations, speculators can achieve significant gains in a short period, making it an attractive strategy for many investors (Adedeji & Baker, 2002).

***Arbitrage*:** Arbitrage refers to the simultaneous buying and selling of a financial asset or derivative instrument in different markets to exploit price variations. Investors can exploit price differences between different financial instruments related to interest rates. For example, if there is a gap between the price of an interest rate futures contract and the price of a bond, investors can buy the futures contracts and sell the bonds to make a risk-free profit (Hull, 2017). In the financial landscape, there are two categories of derivative products: firm products and optional products (Lloyd, 2018).

The distinction between firm and optional products lies in their nature and function. Firm products, such as standardized forward contracts and over-the-counter contracts, involve binding commitments between parties, with an obligation to buy or sell an underlying asset at a specified price and date. In contrast, optional products, such as options, provide the right but not the obligation to buy or sell an underlying asset at a specified price. Thus, firm products require parties to execute the agreed transaction, while optional products offer flexibility, allowing the buyer to decide whether or not to exercise their right to buy or sell (Lloyd, 2018).

Types of Derivative Products

Among firm derivatives, we primarily find:

***Forward Contracts*:** A forward contract is a financial agreement between two parties to exchange cash flows at specified future dates, based on a predetermined interest rate. These contracts allow parties to lock in or speculate on future interest rates (Ooka, Nagano, & Baba, 2006).

A forward contract may involve the exchange of cash flows based on fixed or variable interest rates. For example, a company might enter into a forward contract to exchange fixed interest payments for variable interest payments, or vice versa, at a predetermined future date.

These contracts are used to hedge against interest rate fluctuations or to capitalize on expectations of future rate movements. For instance, a company might enter into a forward contract to lock in a fixed interest rate to secure the future cost of its financing, or an investor might speculate on a future decline in interest rates by entering into a forward contract to receive fixed interest payments (Ooka, Nagano, & Baba, 2006).

***Futures Contracts*:** The development of over-the-counter transactions led to the creation of organized futures markets, aimed at ensuring the security of settlements and deliveries.

A futures contract is essentially similar to a forward contract, being a transaction on a financial asset or product at an agreed price and a future date. The primary difference is that in a forward contract, the transaction is directly concluded between two parties, whether physical or legal entities, whereas in the case of a futures contract, the transaction takes place on a regulated market that sets the terms of the contract (Hull, 2017).

Futures contracts offer a symmetric profit profile, but credit risk can be completely eliminated through two specific mechanisms:

***Margin Deposit and Margin Calls*:** The margin deposit, or initial margin, is an initial cash payment that each party must deposit with the regulated market when entering into the transaction. Its amount is based on the volatility of the contract's price. Due to daily price fluctuations of futures, the regulated market adjusts each party's accounts by debiting one account and crediting the other, depending on price variations. If the margin account balance falls below a minimum level, known as the maintenance margin, a margin call is made to the account holder. Unlike forward contracts, where payment occurs only at maturity, futures contracts are settled daily based on price fluctuations, making them "mark-to-market" (Hull, 2017).

***Clearing House and Contract Standardization*:** In the case of futures contracts, the clearinghouse acts as a counterparty to both the buyer and the seller, thus guaranteeing participants against the risk of default on the contract. Contracts are not concluded directly between the contracting parties, but between each party and the clearinghouse, which reduces the risk to zero and acts as a form of insurance.

FORWARD	**FUTURES**
• Contract adapted to the client in terms of format and delivery date.	• Standard contract in terms of format and delivery date.
• Private contract between two parties.	• Standard contract between the client and the clearinghouse.
• The contract cannot be reversed.	• Possibility to freely negotiate the contract on the market.
• The profit or loss on a position is only realized at the delivery date.	• Contracts are all marked to market, with profits and losses recognized and settled immediately.
• The margin is set once and for all.	• The margin must be maintained to reflect price movements.

***Swap Contracts*:** Originally, a swap referred to the exchange of services or products between two parties over a specified period. However, following the first financial swap, the term has come to specifically denote an exchange of financial flows. These flows are generally fixed or variable interest rates or currency exchange rates (Fang, Taylor, & Uddin, 2022). There are various types of swaps, with the most common being interest rate swaps, currency swaps, and credit swaps (Fang, Taylor, & Uddin, 2022).

An interest rate swap is a financial instrument where two parties, often referred to as the "fixed" and "floating" parties, agree to periodically exchange interest payments, typically on a regular basis such as every six months or annually (Sadr, 2009). These payments are calculated based on an agreed notional amount, which is generally used as a reference for calculating interest payments but is not typically exchanged between the parties. For example, in an interest rate swap, one party may agree to pay a fixed interest rate in exchange for payments based on a floating interest rate such as the LIBOR (Fang, Taylor, & Uddin, 2022).

***Derivative Products with Options*:** Options are an integral part of the range of financial derivatives. Unlike forward, futures, or swap contracts (Fang, Taylor, & Uddin, 2022), an option grants its holder the right, but not the obligation, to buy or sell an underlying asset at a predetermined price on a specific expiration date (for European options) or during a period up until expiration (for American options), with a specified settlement method in advance (either by delivering the underlying asset or by cash payment equivalent to the asset).

The main types of traded options are calls and puts. A call option gives the right to buy, and a put option gives the right to sell. Each type of option involves a buyer and a seller, allowing an investor to buy or sell a call or put. In all cases, the seller of the option is subject to the buyer's decision, who will exercise the option only if it is beneficial. This subordination is compensated by the premium paid by the buyer at the time of the contract's conclusion (Ooka, Nagano, & Baba, 2006). A "call option" : represents a contract between a buyer and a seller, where the buyer has the right, but not the obligation, to purchase an underlying asset at a previously agreed-upon price (the strike price) within a specified period or on a predetermined date. A "put option": is a contract between a buyer and a seller, where the buyer has the right, but not the obligation, to sell an underlying asset at a pre-established price

(the strike price) within a specified period or on a predetermined date. Exercising this option incurs a certain cost, called the premium.

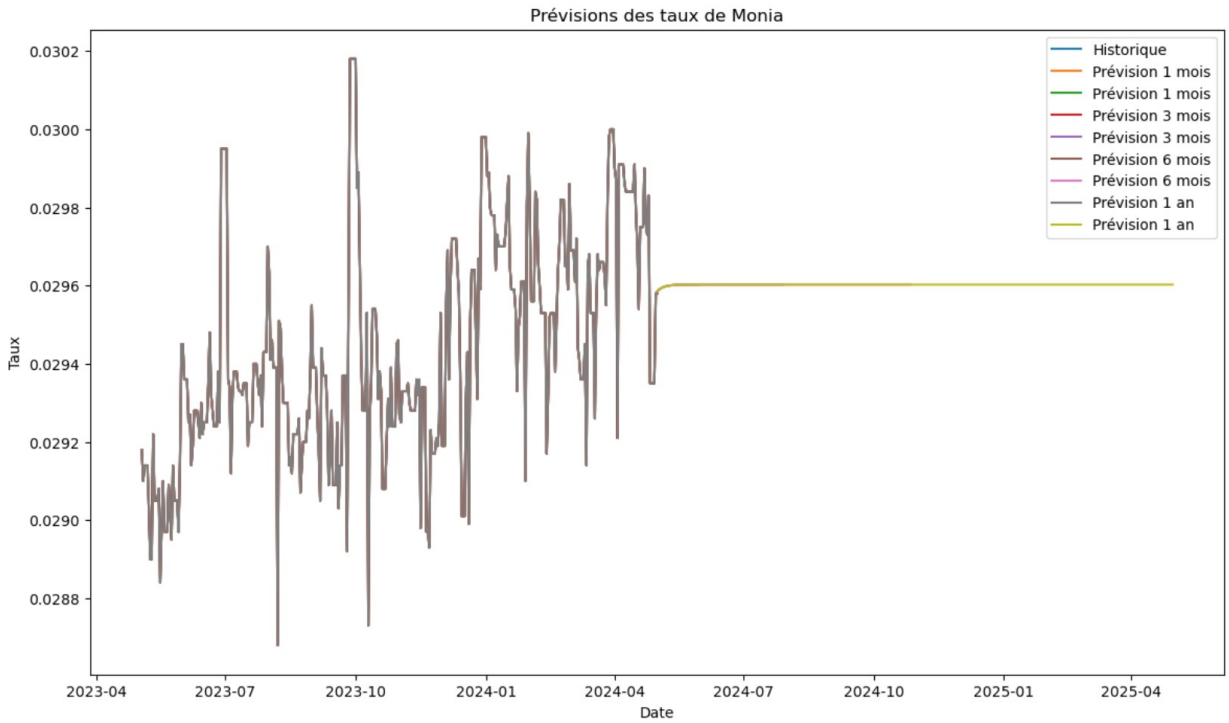
When considering the purchase of an option, it is essential to evaluate whether the premium required to exercise the option provides a significant probability of being able to exercise the right to buy or sell (Smith, 2013). Generally, the more likely the option is to be exercised, the higher the premium. The theoretical value of the option depends on several factors, including the strike price, the time remaining until expiration, and the volatility of the underlying asset (Ooka, Nagano, & Baba, 2006).

Methodology

In our research, we have adopted a quantitative methodology to forecast future rates of the MONIA (Moroccan Overnight Index Average). This approach involves using several statistical models to predict future interest rates based on historical data. Specifically, we have employed ARIMA (Auto Regressive Integrated Moving Average), SARIMA (Seasonal Auto Regressive Integrated Moving Average), and the Simple Moving Average (SMA) method.

- ARIMA **Model**: The ARIMA model is used to capture and model the underlying patterns in the time series data of the MONIA rates. This model combines autoregressive (AR) components, integrated (I) components, and moving average (MA) components to model the temporal dependencies in the data. The ARIMA model is particularly useful for non-seasonal time series data and helps in forecasting future values based on historical observations.
- SARIMA **Model**: The SARIMA model extends the ARIMA model by incorporating seasonal effects. It is designed to handle time series data that exhibit seasonal patterns. By including seasonal autoregressive, seasonal integrated, and seasonal moving average components, the SARIMA model accounts for periodic fluctuations in the MONIA rates, providing more accurate forecasts for periods that exhibit strong seasonal trends.
- Simple **Moving Average (SMA)**: The SMA method is employed to smooth out short-term fluctuations and highlight longer-term trends in the MONIA rates. This method calculates the average of the data points over a specified number of periods, providing a straightforward approach to predicting future rates based on recent historical data.

Results

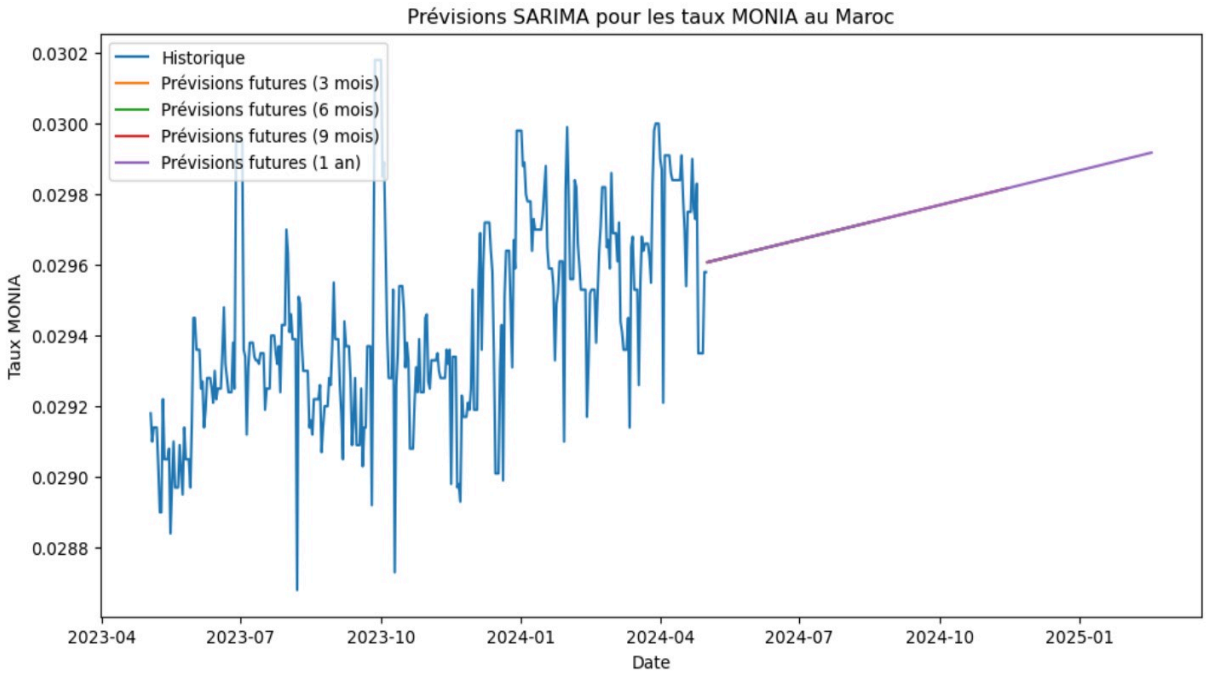


The results obtained through the application of the ARIMA model reveal a challenge in predicting interest rate fluctuations for the studied period. The stability observed, where rates remained constant without significant changes throughout the duration of the analysis, raises questions about the model's effectiveness in capturing market variations in this specific context.

The ARIMA model, which is designed to account for temporal dependencies and trends in time series data, struggled to identify and predict the dynamic changes in interest rates due to the lack of significant fluctuations during the period under review. This stability in the data suggests that the ARIMA model may not be fully equipped to handle scenarios where interest rates exhibit minimal variation.

These results underscore the need to explore alternative methods or models to achieve a more accurate assessment of future interest rate trends. Given the limitations encountered with the ARIMA model, investigating other analytical approaches, such as SARIMA or different forecasting techniques, could provide better insights into potential future rate movements and enhance the precision of interest rate predictions.

In summary, while the ARIMA model provided valuable insights, its performance in this specific scenario highlights the importance of considering a broader range of forecasting models to effectively capture and predict interest rate variations.



Despite employing the SARIMA (Seasonal Auto Regressive Integrated Moving Average) model for our forecasts, the results obtained were not satisfactory. As illustrated by the graph, the forecasts for interest rates across various periods—namely 1 month, 3 months, 6 months, 9 months, and 1 year—showed nearly identical values. This uniformity in the forecasted rates indicates a stability in the interest rates throughout the studied period.

The SARIMA model, which incorporates seasonal components to account for periodic fluctuations in time series data, also struggled to identify significant variations in interest rates due to the observed stability. The model's inability to capture distinct rate changes during the analysis period suggests that the SARIMA approach was not well suited for this particular dataset, which exhibited minimal variability.

These results highlight the limitations of using SARIMA in a context where interest rates remained stable and did not display seasonal or significant fluctuations. As a result, there is a clear need to explore other forecasting models or methods to achieve a more accurate

assessment of future interest rate trends and better handle scenarios with minimal rate variability.

After using both the ARIMA and SARIMA models, which proved to be ineffective, we explored an alternative approach: the Simple Moving Average (SMA) method. The results obtained with the SMA method were effective and well-suited to our research.

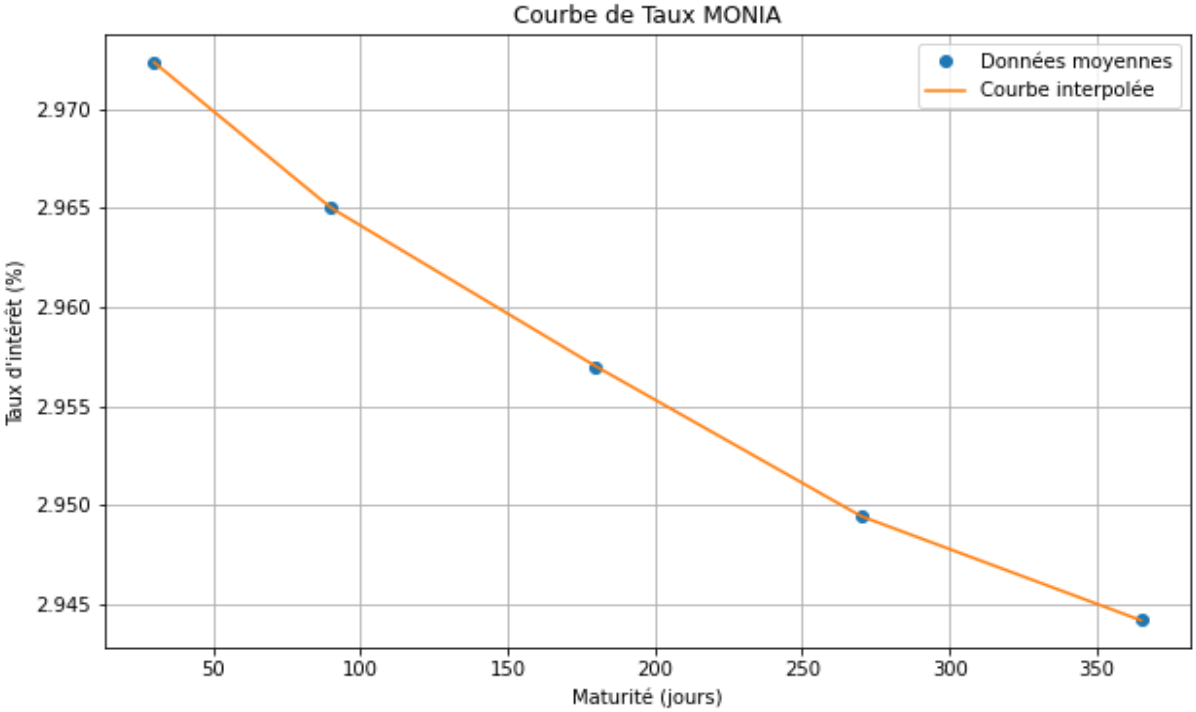
We used historical MONIA rate data to calculate moving averages over different periods. The objective was to analyze the trend of the MONIA interest rate over rolling periods ranging from 1 month to 1 year. We selected the following periods for the moving averages: 1 month, 3 months, 6 months, 9 months, and 1 year.

Here are the results obtained:

Period	**Rate**
1 month	2.97233%
3 months	2.965%
6 months	2.957%
9 months	2.949444%
1 year	2.944192%

After calculating the moving averages of MONIA rates for different periods (1 month, 3 months, 6 months, 9 months, and 1 year), we proceeded to use the linear interpolation method. This method allows us to estimate interest rates for intermediate maturities that are not directly observed in our data.

We utilized the rates obtained with the Simple Moving Average method to program a linear interpolation function, consisting of linear segments connecting adjacent data points.



The resulting yield curve features a straight line connecting the known data points, providing a continuous estimate of interest rates for intermediate maturities.

Conclusion

Through this graduation project, we were able to conduct an in-depth analysis of the interest rate derivatives market, focusing on the products themselves as well as the risks and opportunities they present. The theoretical part allowed us to understand the different types of interest rate derivative products and the regulatory framework surrounding them. We also identified the risks associated with using these products and the protections they can offer. By studying Overnight Index Swaps (OIS), we discovered their essential role in interest rate risk management. We analyzed their potential in the Moroccan market by evaluating market demand and maturity, current regulations, and the needs of key financial players in the country.

For OIS pricing, we explored the use of ARIMA and SARIMA models. These statistical models added a quantitative dimension to our analysis, highlighting the importance of data-driven forecasts to anticipate market trends. The application of these models demonstrated their relevance in the context of derivative products, although they require high-quality data and a thorough understanding of market dynamics.

This project underscored the importance of derivative products in financial risk management and the opportunities they offer to businesses and financial institutions. The Moroccan market presents significant potential for the adoption of these instruments, provided that appropriate regulations are implemented, and market participants are well-trained and informed.

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