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Impact of Interest Rate Fluctuation on Tunisian Bank Profitability

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Abstract:

The threats to financial stability have significantly increased. the tightening of monetary policy has had to be accelerated by central banks by raising interest rates in order to stop inflationary pressures from taking hold. In this situation of marked financial vulnerability, this study examines the effects of interest rate changes on the profitability of a sample of Tunisian banks from 2010 to 2021, and calculates the adjustment speeds of revenues and costs in response to a change in interest rates. An instantaneous adjustment of both sides of the balance sheet reflects a perfect immunization of the bank. Our findings demonstrate that banks in our sample have a duration gap between their assets and liabilities. The average maturity of their asset portfolio is greater than that of their liabilities. Changes in market conditions will have a negative impact on the results of these banks, and their profitability is negatively correlated with interest rates variation.

Key words: bank interest margin, bank profitability, interest rate risk, Seemingly Unrelated Regression (SUR).

Classification JEL :E43, G21, G32, C32

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I. Introduction.

Banks have noticed substantial changes since the start of financial globalization. Deregulation and disintermediation have landed banks in a precarious situation. Major changes are being made to their conventional roles of credit-granting, intermediation, and deposit-taking. They have lost some loyal customers as a result of direct market financing. Moreover, household funds have been redirected to other investments due to the advent of new, more profitable investment structures (Arestis and Singh, 2010). Banks are required to rearrange their activities (profitability and risk control) and examine the new environment of the banking system due to the increased competition from market financing and the abolition of the separation of the banking business from other financial motives.

These changes have thus increased the inherent risks of banking, made profitability more erratic than before, and caused a shift in concentration at the level of national banking systems. Also, the frequency of crises and bank collapses is rising. The cost of these crises has been considerable, and the danger that banking problems will spread to the whole financial system has increased. The risk of bankruptcy may be the main issue for a bank, but it is also true that there is another, similarly significant danger that was not yet considered in the researches. This is the interest rate risk related to a bank's primary function of maturity transformation.

One of the risks that has significantly increased in relevance in recent years is interest rate risk. This risk relates to the ability for a bank's performance to decline or the value of its assets and obligations to depreciate in the event of a negative shift in interest rates. Interest rate volatility and the challenge in predicting their future levels are to blame for this risk. Interest rate risk was historically thought to be less important than credit and liquidity risks, regarded as the top focus of credit institutions. The stability of interest rates and the difficulty to evaluate this risk were the factors that contributed to the marginalization of interest rate risk. Yet, interest rate volatility has exacerbated over the past 20 years, and interest rate risk has evolved into a significant financial risk. One of the main hazards associated with the banks' transformation effort is interest rate risk. The financial equilibrium of credit institutions as well as overall financial stability may be threatened by excessive or poorly regulated taking of this risk or by a failure to anticipate changes in the environment.

This interest is becoming more acute today because specific institutions may be more sensitive to this risk as a result of changes in the financial, regulatory, and accounting environments. And measures are being taken to fix the problem of exposure to interest rate risk and its management, which is at the core of the issues of the different actors in terms of financial stability.

II. Literature Review

Several strategies are suggested in the literature to answer how interest rate changes affect bank profitability. The correlation between monetary policy, deposits, and bank profitability has gained attention out of several researchers.Using a sample of Brazilian banks between September 1999 and June 2018, Caetité et al. (2022) test the hypothesis that monetary policy changes affect bank deposits in a high interest rate environment. The findings demonstrate that Brazilian banks raise their deposit spreads in reaction to changes in monetary policy, which decreases their financing due to a decline in deposits. They consequently provide fewer loans and tighten credit requirements.Altavilla, Boucinha, and Peydro (2018) examined whether monetary policy affected bank profitability. They made use of spot prices and balance sheet information from individual euro area banks switching back to 2007. Their findings demonstrate that monetary policy moderation, which results in lower short-term interest rates or a flattening of the yield curve, is not associated with lower bank profits.So, keeping interest rates low for an extended duration can have a negative impact on bank profitability.

The correlation between the interest rate and liquidity is investigated by other researchers. For instance, Ysmailov (2021) reveals that due to the potential cost of holding of liquidity high (or low) interest rates are related with high (or low) short-term investment and low (high) liquidity.

Beutler et al. (2020) examined how interest rate risk affects bank lending. They used regulatory data on the net interest rate risk exposure of Swiss banks. Realized interest rate risk explains around one-eighth, or 30 basis points, of the expected total decline in cumulative loan growth one year following a one percentage point upward shock to nominal rates through reducing banks' economic capital. According to the study, the impact of an interest rate shock on a bank's loans increases proportionally to the bank's exposure to interest rate risk.

Lopez-Penabad et al (2022) examined the effect of a negative interest rate policy (NIRP) on profitability and risk taking in the European banking sector. Using a dataset of 2596 banks from 29 European countries over the period 2011-2019 and applying a static modeling approach, they find that the implementation of NIRP decreases the net interest margin and return on assets of a representative bank by 14.5 basis points and 18.5 basis points, respectively. Also, when interest rates are already negative, a decrease in the short-term interest rate reduces the net interest margin.

By taking into account the level of bank security as a mediating variable, Al-Slehat (2021) aims to determine the impact of interest rate risk on financial performance. 13 Jordanian commercial banks from 2011 to 2018 are part of the study sample. It was concluded that the relationship between interest rate risk and financial performance is partially influenced by the level of bank security. Also, the banking industry should strengthen its monetary and financial policy to reflect positive interest rate levels and reach an equilibrium between interest rate risks, performance, and bank security level.

Khan and Sattar (2014) examined whether changes in interest rates between 2008 and 2012 affected the profitability of four important Pakistani commercial banks. They argue that interest rates have a significant impact on the bank's interest income, that there is a strong and positive relationship between interest rates and the profitability of commercial banks. The Pearson

correlation method is used to support these findings. These authors showed how the profitability of the bank is dependent on the monetary policy instrument, known as the interest rate.

Using the return on assets (ROA) and return on equity (ROE) ratios as proxies for bank profitability, Khan et al. (2014) test and investigate the impact of market interest rate on bank profitability in Pakistan's both the public and private sectors. The results of the regression proved that interest rates had a significant impact on both the public and private sectors' return on assets (ROA) and return on equity (ROE). Moreover, compared to public sector banks, private banks' ROA and ROE proxies are more sensitive to changes in interest rates.

In a similar vein, Montes and Pérez (2018) investigated a group of Spanish banks from 2000 to 2016 to find out how sensitive bank profitability and balance sheet structure were to changes in interest rate levels. The estimation of autoregressive distributed lag models (ardl) for the time series of the main asset and liability classes (credit, financial securities, time deposits, etc.) and profit components (returns on assets and liabilities, provision charges, etc.) revealed the existence of a nonlinear relationship between the level of interest rates, profitability, and the structure of the banks' balance sheet items, that varied with the level of interest rates.Changes in interest rates have an impact on both the maximum volume of transactions that the banking industry may provide in a specific period as well as the return on funds, through their effect on the average interest rates corresponding to bank assets and liabilities.

Using panel data, Musah et al. (2018) investigated the impact of the interest rate spread on the profitability of a sample of 24 commercial banks in Ghana over a ten-year period.Net interest income (IntSp) and net interest margin (NIM) are used to calculate the interest rate spread. While return on assets (ROA) and return on equity (ROE) are used to measure bank profitability. The results of this investigation revealed a positive and statistically significant correlation between bank profitability and interest rate spread in Ghana.

Although variations in short-term interest rates seem to provide an obvious risk to banks. In reality, they keep their balance sheets managed to reduce their vulnerability to this risk. Even when banks are inherently exposed to risk related to interest rates, recent studies show that banks cannot totally absorb such risk (Paul and Zhu, 2020).

Another way to assess banks' exposure to interest rate risk is to examine the response of their stock prices to changes in interest rates (English, van den Heuvel, and Zakrajšek (2018)). Stock returns decrease when expected short-term interest rates rise, indicating that banks are much more exposed to interest rate risk.

Furthermore, according to Paul (2020), banks are "original" such that their stock price responses are more robust than those of non-bank equities. For banks that are more strongly involved in maturity transformation, these effects are also accentuated.

Overall, due to various interest rate risk, banks are not immune from it, according to research findings. Interest rate fluctuations have a significant impact on banks' profit margins, stock prices, deposits. As a result, bank actively manage their risks by transferring interest rate risk to their creditors and borrowers. But this risk transfer still not perfect.

III. Methodology and Data

The threats to financial stability have significantly escalated in this plainly unstable global situation. Inflation, which is reaching levels not seen in many decades, is one of the primary issues that financial institutions are currently dealing with. As central banks continue to boost interest rates, financial conditions are tightening. These variations in interest rates may be correlated with greater yields, but they will often be correlated with lower bank balances, which would result in welfare losses for bank borrowers and possibly lower levels of bank profits. Yet in light of the changes in banking results seen in recent years, the argument that it is important to comprehend the effects of interest rate changes on financial intermediaries' results has come back into the spotlight.

The increased volatility of interest rates exposes banks to a higher rate risk. In this context, we are interested in empirically testing the impact of market rate fluctuations on the profitability of a sample of Tunisian banks and in calculating the adjustment speeds of revenues and costs, individually and across banks, in response to a change in interest rates. An instantaneous adjustment of both sides of the balance sheet reflects a perfect immunization of the bank. In contrast, longer effective periods for assets and liabilities would result from slower adjustments.

1. Research Model and Theory

Banks are able to accept some risk associated with interest rate changes because of their intermediation activities, which causes them to keep deposits with a longer maturity than their liabilities. Similar to how things may appear concerning in the face of the wave of deregulation and the explosion of off-balance sheet operations, regulators are now primarily concerned with evaluating and controlling the interest rate risk that banks confront.

This worry is all the more justified, that interest rate risk is one of the few that is not expressly accounted for in the prudential or regulatory solvency ratios. Additionally, because this is a hedging-eligible non-diversified risk, its assessment can reveal the degree of risk that the bank is willing to accept in order to reconcile that risk with their anticipated return.

The market value of a firm is the sum of the present value of all potential dividends. This value is expressed equivalently as a function of anticipated future income and expenses:

$$V = \sum_{t=1}^{\infty} \frac{R_t - C_t}{(1 + i_t)^t} \qquad (1)$$

where V current market valuation of the bank, R_t revenue in period t (excluding capital gains or losses), C_t costs in period t, i_t market's current discount rate int.

Based on the assumption that costs C_t, revenues R_t, and the discount rate i_t are likely to be impacted by market interest rate circumstances, the market value of the bank V is ultimately determined by the net influence on these three variables (C_t, R_t, i_t). A change in interest rates' impact may also be indirectly assessed through the bank's results. The time required to adapt

revenues and expenses to changes in market conditions serves as an illustration of the implied maturities of the asset and liability portfolios. A bank has a perfect interest rate risk hedge if, in response to a change in interest rates, revenues, and expenses, C_t and R_t instantaneously adjust to reflect the new market conditions. In contrast, larger maturities result from later adjustments.

However, Flannery (1981–1983) explains the issue as follows in order to estimate these adjustment times: If the bank chooses how to invest its money without being constrained by previous portfolio decisions, the best asset selections would provide the revenue stream based on current conditions:

$$R^* = f(r, \sigma^2, TA) \qquad (2)$$

where TA Total asset, r market interest rate, σ^2 market interest rate volatility

But, in practice, banks may only reallocate a fraction of their interest-bearing assets (the maturing component) in the short term, thus revenues will adjust to new market conditions with some delay. Hence, revenues in t may be divided into two categories: revenues from net new assets that represent the current market rate, and revenues from the portfolio of old assets that only reflect the current rate to the degree of those assets that have matured and been reinvested.

According to econometric theory, the structure of this lag is specified as a partial adjustment including dependent variables that are lagged by the explanatory factors. Hence, using the following models, we may econometrically estimate the adjustment times:

$$\frac{NIM_t}{TA_t} = \alpha_0 + \alpha_1 \left(\frac{NIM}{TA}\right)_{t-1} + \alpha_2 r_t + \alpha_3 \sigma_t^2 + \alpha_4 \left[\left(\frac{TA_t - TA_{t-1}}{TA_{t-1}}\right)\right] + \varepsilon_t \qquad (3)$$

where NIMt Net interest margin in t, TA_t Total asset in t, $r_t$market interest rate in t, σ_t^2 market interest rate volatility in t, ε_t Error term, α_i estimated coefficient (with i ranging from 0 to 4)

The expected signs for the estimated coefficients are:

$\alpha_0, \alpha_2, \alpha_4 > 0$

$0 \leq \alpha_1 \leq 1$

α_3 any

The adjustment speed is estimated by$\gamma = 1 - \alpha_1$

If α_1 is zero then the adjustment is instantaneous, as the revenue in t is independent of the revenue in (t - 1) and thus the speed is equal to 1.

As for, the implied maturity of the asset portfolio is measured by:

$$\frac{1-\gamma}{\gamma} = \frac{\alpha_1}{1-\alpha_1} \qquad (4)$$

The total operational expenses gradually change to reflect market rates. Total operating costs adjust slowly to the market rate. The estimated regression for the costs has a similar shape, so we

obtain the same specifications for the bank's commitment portfolio. The operating costs are modeled as follows:

$$\frac{CO_t}{TA_t} = \beta_0 + \beta_1\left(\frac{CO}{TA}\right)_{t-1} + \beta_2 r_t + \beta_3\sigma_t^2 + \beta_4\left[\left(\frac{TA_t - TA_{t-1}}{TA_{t-1}}\right)\right] + \mu_t \qquad (5)$$

whereCO_tTotal operating costs in t, $\beta_i$estimated coefficient (with i ranging from 0 to 4), μ_tError term.

Finally, gross operating income (GOI) is modeled analogously by the following equation:

$$\frac{GOI_t}{TA_t} = \delta_0 + \delta_1\left(\frac{GOI}{TA}\right)_{t-1} + \delta_2 r_t + \alpha_3\sigma_t^2 + \delta_4\left[\left(\frac{TA_t - TA_{t-1}}{TA_{t-1}}\right)\right] + \omega_t \quad (6)$$

where RBEt gross operating income in t, $\delta_i$estimated coefficient (with i ranging from 0 to 4), ω_t Error term.

The expected signs and interpretation of the coefficients of these two equations are similar to those of regression (3).

Although, extraordinary profits and losses as well as taxes can hide the influence of market rates, we accept gross operating income as a more appropriate measure of the bank's revenue than net income.

2. Sampling and Data Set

The approach used in this empirical validation to investigate the effect of market rate changes on the profitability of commercial banks is that of Flannery (1981-1983). After an interest rate change, it is important to measure the speed of adjustment of revenues and costs. An immediate adjustment of assets and liabilities results in perfectly immune positions. Longer periods on both sides of the balance sheet may be possible since these modifications are made more slowly.

a. Data:

The financial statements from annual reports of banks, publications from the Tunis Stock Exchange, and publications from the Central Bank of Tunisia provided the data utilized to conduct the empirical study. Ten Tunisian commercial banks are involved. The period covered by our study is from 2010 to 2021.

b. Variables:

The following variables are included in our model:

- Net interest margin (NIM_t), includes interest income plus other revenue (commissions and income from the securities portfolio) minus interest paid (financial expenses).

- The total operating expenses (CO_t) include the operating expenses plus the other losses.

- Gross operating income (GOI_t) is the difference between net interest margin and total operating expenses.

- r_t et σ_t^2 represent the annual money market rate and its variance.

c. Estimation methodology:

Equations (3), (5) and (6) omitted some explanatory variables, which cause an autocorrelation of the disturbances. The application of the ordinary least squares method approach leads to an unbiased but inefficient estimation. The three regressions, MIN, CO, and RBE, are then estimated jointly for each bank and for all banks in the sample using the Zellner approach for seemingly unrelated regressions (SUR). It removes the bias while enabling simultaneous estimation of several equations. The traditional Durbin Watson test underestimates the probability of autocorrelation and has lower power since this is a dynamic model with an endogenous and lagged variable as an explanatory variable. Then, a new test called Durbin -h must be applied.

IV. Empirical findings and interpretations

This section provides empirical evidence on the impact of interest rate fluctuations on the profitability of financial institutions. The empirical findings of the SUR (Zellner) estimated regressions are shown in Tables (1) through (3). These tables show the findings from the SUR method's estimation of net interest margin, total operating expenses, and gross operating income for all banks (table 1), bank adjustment lags in years (table 2), and adjustment lags in years for all banks in the sample (table 3). The SUR estimation yields findings are more effective than OLS. The h-findings test's show that there is no autocorrelation. The estimated coefficients are therefore not biased.

Table n° (01): Gross operational income, total operating costs, and estimated net interest margin for all banks using the SUR technique

	Constant term	*Delayed dependent variable*	*Interest rate r_t*	*interest rate volatility σ_t^2*	*Returns on new assets*	*R^2 (adjusted)*
NIM	0.007804 (2.7635)***	0.823184 (16.3461)$^+$	-0.002196 (-3.5326)***	-0.00432 (-2.1124)**	-0.012182 (-0.4582)	0.8123
CO	0.006862 (2.0031)**	0.550346 (12.2197)$^+$	-0.586410 (-10.4016)$^+$	-0.006527 (-2.8055)**	0.365001 (10.4717)$^+$	0.5733
GOI	0.00344 (2.1828)**	0.800161 (11.3062)$^+$	-0.050332 (-2.3492)**	0.000822 (0.1267)	0.009136 (0.7863)	0.6248

Notes:( )$^+$ Totally significant, *** Sgnificant at 1%, ** Sgnificant at 5% , * Sgnificant at 10%, Student tests are in parenthesis

The signs of the different coefficients are generally in accordance with expectations, With the exception of the interest rate variable's coefficient, which is negative in 68% of cases. At the 95% and/or 99% level, the delayed dependent variable is statistically significant (for 18 of 30 estimated regressions).The adjustments were perfect with no autocorrelation for most cases.Student's t test is significant for the variables r_t andσ_t^2. From the estimated coefficients, α_1 and β_1, of the delayed revenue and cost variables for each bank, we computed (1- α_1) that represents the speed of asset adjustment and (1-β_1) that represents the speed of liability adjustment,as well as the average maturities of the assets and liabilities determined by formula (4), which are shown in table (2) below:

Table n° (02):Bank adjustment times in years

	$\boldsymbol{\alpha_1}$	$\boldsymbol{\beta_1}$	$\boldsymbol{1-\alpha_1}$	$\boldsymbol{1-\beta_1}$	*Asset Maturity* $\frac{\alpha_1}{1-\alpha_1}$	*Liability Maturity* $\frac{\beta_1}{1-\beta_1}$
STB	0.797856	0.587317	0.20214	0.41268	3.947	1.423
BNA	0.815231	0.66342	0.18477	0.33658	4.412	1.971
BIAT	0.778967	0.129341	0.22103	0.87066	3.524	0.149
UIB	0.230141	0.587905	0.76986	0.41210	0.299	1.427
UBCI	0.794824	0.476891	0.20518	0.52311	3.874	0.912
AttijB	0.698695	0.61024	0.30131	0.38976	2.319	1.566
BT	0.878674	0.778954	0.12133	0.22105	7.242	3.524
BH	0.800142	0.895765	0.19986	0.10424	4.004	8.594
ATB	0.522472	0.699878	0.47753	0.30012	1.094	2.332
AmenB	0.67418	0.34368	0.32582	0.65632	2.069	0.524

For all the banks in the sample, the adjustment speeds found are as follows:

Table n° (03): Adjustment time of all banks in number of years

	$\boldsymbol{\alpha_1}$	$\boldsymbol{\beta_1}$	$\boldsymbol{1-\alpha_1}$	$\boldsymbol{1-\beta_1}$	*Asset Maturity*	*Liability Maturity*
all banks	0.823184	0.550346	0.176816	0.449654	4.655	1.224

For all the banks in the study, the average speed of adjustment of assets is 0.176816, corresponding to an average delay of 4.655 years. That of liabilities is 0.449654, indicating a 1.224-year average maturity. As a result, these estimations show that Tunisian commercial banks are in a short position. According to what is generally accepted, they tend to borrow short and lend long. This is clearly manifested by an average maturity of their asset portfolio higher than

that of the liabilities. A variation in interest rates is negatively connected with these banks' profitability, and changes in market condition may have a negative effect on their performance.

These findings disagree with what Flannery found (1981-1983).However, this is not the case for U.S. banks, because they are required to borrow long-term and lend short-term in order to be able to protect themselves against rate changes(the asset maturity is lower than the liabilities maturity, the balance sheet is fairly well protected).

Moreover, we found that for three banks in our sample, the maturity of assets is shorter than the maturity of liabilities. This is for the case of BH (M_a =4.004 < M_l =8.594) et UIB (M_a=0.299 < M_l=1.427) et ATB (M_a=1.094 < M_l=2.332).These banks effectively manage the maturity of their assets and liabilities.Contrary to what is often known, they lend short-term and borrow long-term.So, it is clear that these institutions' balance sheets are moderately immune to interest rate fluctuations.

However, the rate variable and its variance, which are significant in most regressions and have a negative sign, indicate that an increase in the interest rate will have a negative effect and reduce bank profitability.

Relatively, for the model's constant term, which is often considerable,this term refers to commissions and fixed operating costs, which are the fixed parts of each bank's costs and revenues.So, it is important to note that gross operating income is net banking income less total operating expenses, and that net banking income is mainly composed of interest margin and commissions. This distinction is both required and significant, because commissions are unrelated to interest rates. Thus, the sensitivity of this revenue to changes in interest rates decreases as the proportion of commissions in the gross operating income increases.
In this regard, banks must increase their revenue from the portfolio of securities and commissions in order to mitigate any negative effects of interest rate risk on their performance. They need to operate in the financial market more frequently and increase their profitability by charging higher fees. They will therefore be moderately exposed to interest rate risk.

V. Conclusion

This study examined the impact of market rate changes on the profitability of a sample of Tunisian commercial banks over an 11-year period. For each bank in the sample and for all banks, the estimate of the three regressions using the SUR technique, let us to analyze the response of certain performance measures, such as interest margin, operational expenses, and gross operating income to lagged explained factors, the current market rate, and rate volatility.We found that Tunisian commercial banks exhibit a significant duration gap between assets and liabilities. The average maturity of their asset portfolio is larger as compared to their liabilities, which appears to confirm this.The results of these institutions might be negatively affected by fluctuations in

market conditions, considering that the profitability of these institutions and interest rate volatility are inversely correlated.

Financial institutions are confronted with additional challenges as a result of the financial liberalization, consisting of high competition, a gradual relaxation of interest rate restrictions (on loans and borrowing), and a rise in bank failures, that has characterized the financial sector. Furthermore, in this competitive and dynamic environment, interest rate risk should constantly be considered. The Tunisian commercial banks have then incentive to become aware of this danger to be able to immunize themselves against an increase or a decrease of the rates.

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