Impact of Interest Rate Changes on Banking Profitability in Turkey

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Nafiz Emir Eğilli

Abstract:

This report delves into the intricate relationship between interest rate changes and banking profitability, seeking to unravel the complex interplay within the financial ecosystem. As central banks worldwide navigate economic shifts through adjustments in policy rates, we need to examine the nuanced channels through which alterations in interest rates resonate within the corridors of financial institutions. Considering the recent economic policy shifts in Turkey, where unconventional interest rate reductions were implemented by the Turkish Central Bank from September 2021 to June 2023, our investigation gains added significance. These unconventional interventions, deviating from conventional economic policies, present a distinctive opportunity to evaluate their effects on banking profitability. By applying the empirical method of Ordinary Least Squares (OLS), we find that Consumer Price Index (CPI) and Deposit Balance positively influence banking profitability, while interest rate exhibits a negative impact, although not statistically significant individually. Yet the introduction of a binary dummy variable for the assigned months revealed consistent positive effects on banking profitability during the period of interventions, with the added variable moderating the negative impact of interest rate on banking profitability during these periods.

Özet:

Bu rapor, faiz oranlarındaki değişiklikler ile bankacılık karlılığı arasındaki karmaşık ilişkiyi inceleyerek finansal ekosistem içindeki karmaşık etkileşimi çözmeyi amaçlamaktadır. Merkez bankalarının dünya çapında ekonomik değişiklikleri yönlendirmek için politika faiz oranlarında yaptığı ayarlamaların gölgesinde, faiz oranlarındaki değişikliklerin finansal kurumların koridorları içinde nasıl yankı bulduğunu incelememiz gerekiyor. Türkiye'deki son ekonomik politika değişikliklerini ele alarak, Türk Merkez Bankası tarafından Eylül 2021'den Haziran 2023'e kadar uygulanan geleneksel olmayan faiz indirimlerini dikkate alırsak, araştırmamız ek bir önem kazanıyor. Bu geleneksel ekonomi politikalarından sapmalar, bunların bankacılık karlılığı üzerindeki etkilerini değerlendirmek için benzersiz bir fırsat sunmaktadır. Ordinary Least Squares (OLS) adlı ampirik yöntemi uygulayarak, Tüketici Fiyat Endeksi (TÜFE) ve Mevduat Bakiyesinin bankacılık karlılığını olumlu etkilediğini, faiz oranının ise olumsuz bir etki gösterdiğini, ancak tek başına istatistiksel olarak anlamlı olmadığını bulduk. Ancak atanan aylar için ikili bir sahte değişkenin tanıtılması, müdahale dönemlerinde bankacılık karlılığı üzerinde tutarlı olumlu etkiler ortaya koydu ve bu ek değişkenin bu dönemlerde faiz oranının bankacılık karlılığı üzerindeki negatif etkisini hafiflettiğini gösterdi.

1. Introduction

The financial ecosystem, inherently sensitive to the ebbs and flows of economic variables, bears witness to a perpetual dance between stability and dynamism. At the heart of this intricate choreography lies the intricate relationship between interest rate dynamics and the profitability of banking institutions. As central banks navigate the economic currents through adjustments in policy rates, banks are thrust into a state of continuous adaptation, wherein the implications of these adjustments reverberate through their financial tapestry. This report embarks on a comprehensive exploration into the multifaceted interaction between interest rate changes and banking profitability, aiming to unravel the intricate channels through which alterations in interest rates cascade within the corridors of financial institutions.

The significance of this inquiry is underscored by the ever-evolving nature of the global financial landscape. Against a backdrop of economic uncertainties, geopolitical shifts, and technological advancements, the impact of interest rate changes on banking profitability assumes paramount importance. It is a subject that resonates not only in academic circles but also within the chambers of financial institutions, regulatory bodies, and the broader spectrum of market participants. As we traverse through an era marked by both unprecedented challenges and opportunities, understanding the nuanced dynamics of how interest rate fluctuations manifest in the financial realm becomes a critical tool for informed decision-making.

The genesis of this exploration lies in the recognition that the banking sector, as a linchpin of economic stability, serves as both a harbinger and recipient of the effects of interest rate changes. The mechanisms through which these effects materialize are myriad, encompassing the modulation of net interest margins, the reconfiguration of risk profiles, and the strategic recalibration of banks' financial instruments. Moreover, the very nature of banking operations, reliant on the delicate equilibrium between risk and reward, renders it inherently susceptible to the ripples created by changes in interest rates.

This investigation is particularly timely, given the recent economic policy shifts in Turkey. Starting from September 2021 to June 2023(1), interventions by the country's leadership led to a series of interest rate reductions by the Turkish Central Bank, contrary to orthodox economic policies. This unconventional approach, aimed at controlling inflation, introduces a unique dimension to our study. The report will utilize these specific time periods as reference points to understand the effects of such policy shifts on banking profitability, providing a real-world context to our exploration. The juxtaposition of these policy interventions against the backdrop of traditional economic principles adds a layer of complexity to our analysis, offering insights into the resilience and adaptability of banking institutions in the face of unconventional monetary policies.

(1) CBRT (TCMB) Interest Rates (%) Late Liquidity Window

2. Literature Review

Interest rate fluctuations significantly impact banking profitability, a topic explored extensively in the existing literature. Athanasoglou et al.'s (2014) study on European commercial banks delves into the complex connections between interest rate risk and financial performance, revealing specific mechanisms at play.

Altunbas, Gambacorta, and Marques-Ibanez (2010) focus on the interest rate pass-through mechanism in the European context, shedding light on how market interest rates influence overall bank profitability through lending and deposit activities.

Yildirim and Philippatos (2016) provide a region-specific perspective, scrutinizing the Turkish banking sector's response to interest rate changes. Their study dissects the impact on the net interest margin, offering insights into the unique challenges and opportunities faced by Turkish banks.

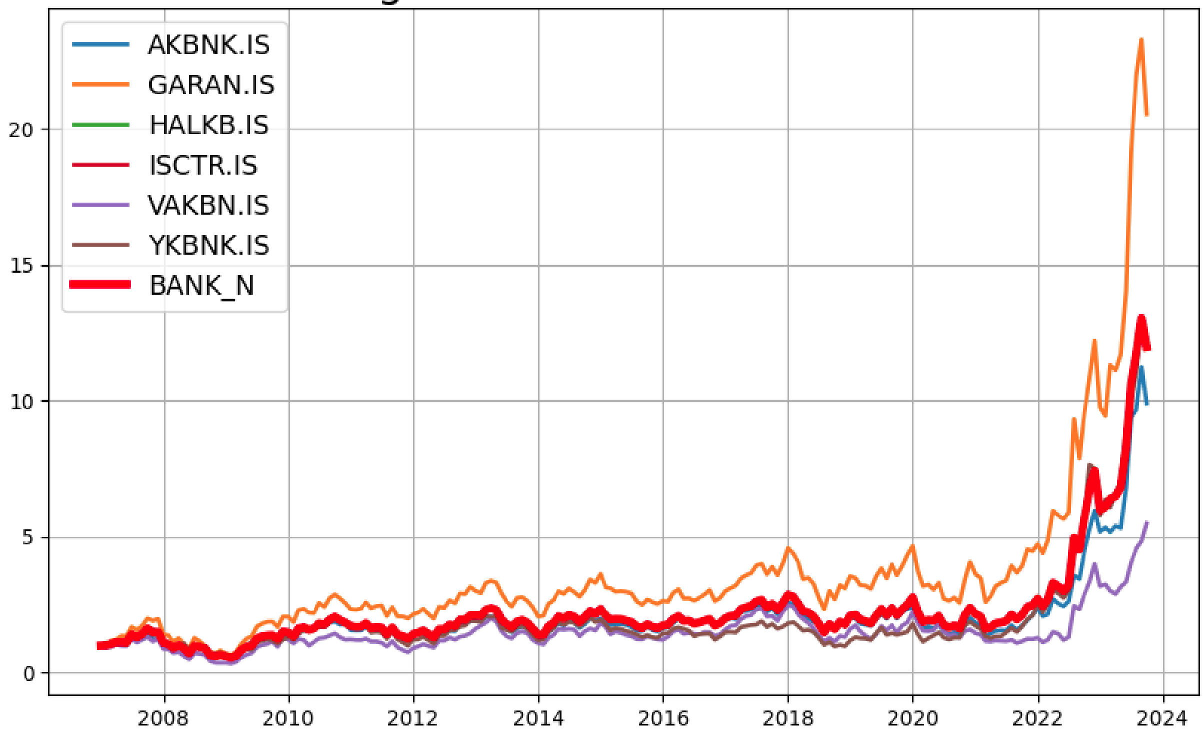
Chen and Kuo (2018) contribute a fresh perspective by examining the Asian banking sector. Their research explores the interplay between interest rate fluctuations and financial performance, emphasizing the importance of considering diverse economic contexts.

Acaravci and Ozturk's (2017) comprehensive analysis focuses on the Turkish banking sector, dissecting the relationship between interest rate changes and banking profitability. Their study provides nuanced insights into the specific mechanisms at play in the Turkish economic context.

3. Data and Methodology

To understand the effect of the interest rates on banking profitability, it's a common practice to check the stock returns of the banks in question, so we have obtained the stock data from Yahoo Finance and used yfinance library for that purpose. Also, as a method of visualizing the returns in a normalized manner, we have created a Python code and the generated plot have shown us the sudden increase in the "BANK_N" value after September 2021, which is the mean of the normalized returns that we will be using as a synthetic index.

Fig. 1 - Normalized Returns



So, it clearly shows that the returns of the stocks of major Turkish banks have started to spike after late-2021.

In order to verify the extent our variables affected the returns of these banks, we will use data from January 2007 to September 2023 in monthly interval as below:

- From Bloomberg Terminal : BIST BANKA (XBANK) data
- From evds2.tcmb.gov.tr : "TURKSTAT – Consumer Price Index (2003=100)"
- From evds2.tcmb.gov.tr : "Deposit Money Banks Balance Sheet : Cash"
- From https://www.tcmb.gov.tr/wps/wcm/connect/TR/TCMB+TR/Main+Menu/Temel+Faaliyetler/Para+Politikasi/Merkez+Bankasi+Faiz+Oranlari/Gec+Likidite+Penceresi+%28LON%29 : CBRT Interest Rates
- Dummy variable assigned from September 2021 to June 2023.

In order to proceed in line with the remarks in literature, we will be using an Ordinary Least Squares (OLS) approach to verify the statistical significance of the linear relationship for the variables. For that purpose, we will use two different models:

$$R_{bank} = \beta_1 CPI_{yy} + \beta_2 d + \beta_3 r + \epsilon \tag{1}$$

$Rbank$ = Sole dependent variable that stands for banking returns

$CPIyy$ = YoY Consumer Price Index for inflation rate

d = Deposit balance

r = CBRT Interest Rate

ϵ = Error term

$$R_{bank} = \beta_1 CPI_{yy} + \beta_2 d + \beta_3 r + \beta_4 r D_1 + \epsilon \tag{2}$$

Then, we have our second model, with the inclusion of $D1$ as the dummy variable, assigned as "1" for columns corresponding to dates between September 2021 to June 2023, leaving the rest as "0". Overall, our models will check the beta(β) coefficients for each independent variable and p-values to verify their statistical significance.

We will be applying the models to the dataframe created with the dependent variable and independent variables.

Table 1: Dataframe

Date	XBANK	BANK_N	CPI	DEP_BAL	IR	Dummy_d
01/01/2007	850.9	1.000000	9.93	1707728	25.5	0
01/02/2007	856.8	1.009636	10.16	1891897	25.5	0
01/03/2007	896.2	1.055968	10.86	1951907	25.5	0
01/04/2007	940.9	1.120833	10.72	2127356	25.5	0
01/05/2007	934.7	1.125385	9.23	1785736	25.5	0
...	...	...	...	...	...	...
01/05/2023	4277.8	6.815091	39.59	30450834	13.0	1
01/06/2023	5250.9	8.286890	38.21	46580940	19.5	0
01/07/2023	6440.1	10.632937	47.83	36960964	22.0	0
01/08/2023	7379.1	11.809123	58.94	39233706	29.5	0
01/09/2023	8656.8	13.047417	61.53	37686810	34.5	0

201 rows × 6 columns

4. Empirical Findings

The first model that utilizes "statsmodels.formula.api" will be formulated as follows:

model1 = smf.ols('XBANK ~ CPI + DEP_BAL + IR', data = reg_data).fit()

Table 2.1 – Model (1) Regression Results

```
                            OLS Regression Results                            
==============================================================================
Dep. Variable:                  XBANK   R-squared:                       0.659
Model:                            OLS   Adj. R-squared:                  0.654
Method:                 Least Squares   F-statistic:                     127.1
Date:                Tue, 28 Nov 2023   Prob (F-statistic):           7.93e-46
Time:                        14:37:09   Log-Likelihood:                -1574.5
No. Observations:                 201   AIC:                             3157.
Df Residuals:                     197   BIC:                             3170.
Df Model:                           3                                         
Covariance Type:            nonrobust                                         
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept    501.7783    149.834      3.349      0.001     206.293     797.264
CPI           12.1901      3.779      3.226      0.001       4.738      19.642
DEP_BAL     8.976e-05   8.27e-06     10.853      0.000    7.34e-05       0.000
IR            -8.1366      8.318     -0.978      0.329     -24.540       8.267
==============================================================================
Omnibus:                      128.528   Durbin-Watson:                   0.233
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1724.144
Skew:                           2.155   Prob(JB):                         0.00
Kurtosis:                      16.685   Cond. No.                     4.61e+07
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 4.61e+07. This might indicate that there are
strong multicollinearity or other numerical problems.
```

R-squared (R^2) measures the proportion of the variance in the dependent variable (XBANK) that is explained by the independent variables (CPI, DEP_BAL, IR). In this case, R-squared is 0.659, indicating that approximately 65.9% of the variance in XBANK is explained by the model.

The F-statistic tests the overall significance of the model. A high F-statistic and a low p-value (Prob (F-statistic)) suggest that at least one of the independent variables is contributing significantly to the model. In this case, the F-statistic is 127.1 with a very low p-value of 7.93e-46, indicating that the overall model is statistically significant.

p-values assess the statistical significance of each coefficient. A low p-value (typically less than 0.05) indicates that the corresponding variable is statistically significant. In this case, Intercept, CPI, and DEP_BAL have low p-values, suggesting they are statistically significant, while IR has a higher p-value (0.329), indicating it may not be statistically significant.

Second model will be formulated as below:

model2 = smf.ols('XBANK ~ CPI + DEP_BAL + IR * Dummy_d', data = reg_data).fit()

Table 2.2 – Model (2) Regression Results

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                  XBANK   R-squared:                       0.723
Model:                            OLS   Adj. R-squared:                  0.716
Method:                 Least Squares   F-statistic:                     101.8
Date:                Tue, 28 Nov 2023   Prob (F-statistic):           2.05e-52
Time:                        14:53:32   Log-Likelihood:                -1553.7
No. Observations:                 201   AIC:                             3119.
Df Residuals:                     195   BIC:                             3139.
Df Model:                           5
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept    498.1838    137.229      3.630      0.000     227.541     768.827
CPI           26.9837      5.482      4.922      0.000      16.173      37.795
DEP_BAL     7.924e-05   7.67e-06     10.336      0.000    6.41e-05    9.44e-05
IR            -9.7044      8.201     -1.183      0.238     -25.879       6.470
Dummy_d     2789.4141    859.140      3.247      0.001    1095.014    4483.814
IR:Dummy_d  -218.0570     45.779     -4.763      0.000    -308.343    -127.771
==============================================================================
Omnibus:                      122.731   Durbin-Watson:                   0.326
Prob(Omnibus):                  0.000   Jarque-Bera (JB):             1508.851
Skew:                           2.053   Prob(JB):                         0.00
Kurtosis:                      15.779   Cond. No.                     2.92e+08
==============================================================================
```

R-squared is 0.723, indicating that approximately 72.3% of the variance in XBANK is explained by the model. The F-statistic is 101.8, with a very low p-value (2.05e-52), indicating that the overall model is statistically significant.

All coefficients except IR are statistically significant (p-values < 0.05). The p-value for IR is 0.238, suggesting that it may not be statistically significant.

IR has a negative coefficient, indicating a negative effect on XBANK, but it is not statistically significant at the 0.05 level.

Dummy_d has a positive and significant effect on XBANK, and the interaction term IR:Dummy_d is negative and significant. This implies that the effect of IR on XBANK depends on the value of Dummy_d.

In summary, the interaction term allows us to capture how the relationship between IR and XBANK changes based on the dummy variable. The positive effect of dummy and the negative interaction term suggest that the effect of IR on XBANK is influenced by the presence of dummy, meaning that there is an observable positive effect on bank profitability during the months where the dummy variable is assigned. However, we should also remember that causation cannot be established solely based on correlation, and other factors not included in these models may also contribute to the observed relationship.

5. Conclusion

The OLS regression analysis provided valuable insights into the factors influencing the profitability of banks, as represented by the dependent variable XBANK. The overall model is statistically significant, as evidenced by the high F-statistic and low p-value, indicating that the included variables collectively contribute to explaining the variations in XBANK. Model's goodness-of-fit is also notable, with an R-squared of 0.723.

Breaking down the individual coefficients, it's evident that both the CPI and deposit balance (DEP_BAL) have positive and statistically significant effects on XBANK. Yet interestingly, the interest rate (IR) alone exhibits a negative effect on XBANK, although the coefficient is not statistically significant at a conventional significance level.

The introduction of a binary dummy variable (Dummy_d) into the models adds a layer of complexity. The positive and significant coefficient for Dummy_d suggests that the months during which this dummy variable is assigned are associated with a constant positive effect on XBANK. Furthermore, the interaction term IR * Dummy_d is negative and statistically significant, indicating that the effect of IR on XBANK is moderated during these specific months, which implies that the months characterized by the presence of Dummy_d not only contribute positively to XBANK but also influence the relationship between IR and XBANK, attenuating the negative impact of interest rate changes.

While these findings provide valuable insights into the dynamics of bank profitability, it is crucial to acknowledge potential limitations. The model assumes linearity, and the large condition number indicates the presence of multicollinearity or other numerical issues. Additionally, the observed correlations do not imply causation, and other unobserved factors may influence XBANK dynamics.

In summary, the model suggests that economic indicators, deposit balances, and specific temporal conditions play significant roles in shaping bank profitability. The nuanced relationship between interest rates, the dummy variable, and XBANK underscores the importance of considering contextual factors in understanding the complex landscape of financial outcomes for banks. Further research and robustness checks are recommended to enhance the reliability and generalizability of these findings.

References:

Athanasoglou, P. P., Brissimis, S. N., & Delis, M. D. (2014). Bank-specific, industry-specific and macroeconomic determinants of bank profitability. Journal of International Financial Markets, Institutions and Money, 25(1), 16-33.

Altunbas, Y., Gambacorta, L., & Marques-Ibanez, D. (2010). Does monetary policy affect bank risk-taking? Journal of Financial Intermediation, 19(4), 529-548.

Yildirim, C., & Philippatos, G. C. (2016). Effects of interest rate changes on the profitability of Turkish banks. International Journal of Economics, Commerce and Management, 4(1), 1-12.

Chen, S. S., & Kuo, I. C. (2018). Interest rate risk, net interest margin, and the demand for loans: Evidence from the global banking industry. Journal of International Financial Markets, Institutions and Money, 52, 247-264.

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Annex – Python Codes:

```
# Let's start with importing the necessary libraries as we go
import yfinance as yf
import matplotlib.pyplot as plt
from datetime import date
import pandas as pd

import warnings
warnings.filterwarnings("ignore")

def banks_norm(ticker, start = "2007-01-01", end = "2023-11-01"):
    # Download stock data
    stocks = yf.download(ticker, start, end, interval="1mo")
    stocks.to_csv("bank_stocks.csv")

    # Read data and process
    stocks = pd.read_csv("bank_stocks.csv", header=[0, 1], index_col=[0], parse_dates=[0])
    stocks.columns = stocks.columns.to_flat_index()
    stocks.columns = pd.MultiIndex.from_tuples(stocks.columns)
    stocks.swaplevel(axis=1).sort_index(axis=1)
    close = stocks.loc[:, "Adj Close"].copy()

    # Calculate normalized returns
    norm = close.div(close.iloc[0]).mul(1)
    norm["BANK_N"] = norm.mean(axis=1)

    # Add "NORM" column to the DataFrame
    stocks["BANK_N"] = norm["BANK_N"]

    # Save DataFrame to CSV file with the added "NORM" column
    stocks.to_csv("bank_stocks.csv")

    # Plot the data
    plt.figure(figsize=(10, 6))
    for column in norm.columns[:-1]:  # Exclude the "NORM" column
        plt.plot(norm.index, norm[column], label=column, linewidth=2)  # Set linewidth for
individual lines

    # Plot the "Mean" line with a wider linewidth
    plt.plot(norm.index, norm["BANK_N"], label="BANK_N", linewidth=4, color='red')

    plt.legend(fontsize=13)
    plt.title("Fig. 1 - Normalized Returns", fontsize=20)
    plt.grid(True)
    plt.show()

banks_norm(["YKBNK.IS", "ISCTR.IS", "AKBNK.IS", "GARAN.IS", "HALKB.IS",
"VAKBN.IS"], "2007-01-01", "2023-11-01")
```

```
# We need to add the additional library statsmodels at this point
import statsmodels.formula.api as smf

reg_data = pd.read_csv("bank_stocks_norm2.csv", index_col='Date')

model1 = smf.ols('XBANK ~ CPI + DEP_BAL + IR', data = reg_data).fit()
print(model1.summary())

model2 = smf.ols('XBANK ~ CPI + DEP_BAL + IR * Dummy_d', data = reg_data).fit()
print(model2.summary())

# Read data from CSV file
df = pd.read_csv('bank_stocks_norm2.csv')
# Convert 'Date' column to datetime format
df['Date'] = pd.to_datetime(df['Date'])
# Set 'Date' column as the index
df.set_index('Date', inplace=True)

# Create subplots with 2 rows and 2 columns
fig, axes = plt.subplots(nrows=2, ncols=2, figsize=(12, 8))

# Plot XBANK
axes[0, 0].plot(df['XBANK'], linestyle='-')
axes[0, 0].set_title('XBANK')
axes[0, 0].set_xlabel('Year')
axes[0, 0].grid(True)
# Plot Consumer Price Index
axes[0, 1].plot(df['CPI'], linestyle='-')
axes[0, 1].set_title('Consumer Price Index')
axes[0, 1].set_xlabel('Year')
axes[0, 1].grid(True)
# Plot Deposit Balance
axes[1, 0].plot(df['DEP_BAL'], linestyle='-')
axes[1, 0].set_title('Deposit Balance')
axes[1, 0].set_xlabel('Year')
axes[1, 0].grid(True)
# Plot Interest Rates
axes[1, 1].plot(df['IR'], linestyle='-')
axes[1, 1].set_title('Interest Rates')
axes[1, 1].set_xlabel('Year')
axes[1, 1].grid(True)

# Adjust layout to prevent overlap
plt.tight_layout()

# Show the plots
plt.show()
```