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BACHELOR'S GRADUATE QUAILIFICATION WORK

BACHELOR GRADUATION PAPER

УПРАВЛЕНИЕ ЛИКВИДНОСТЬЮ И КРАТКОСРОЧНЫМИ ФИНАНСОВЫМИ РИСКАМИ В КОРПОРАТИВНОЙ СРЕДЕ

FIRMS' CASH MANAGEMENT AND CURRENCY RISKS

Field of study: 38.03.01 «Economics»

Degree programme:

INTERNATIONAL PROGRAMME IN ECONOMICS AND FINANCE

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Moscow 2024

Аннотация

Это исследование рассматривает влияние экономических и политических факторов на доходность депозитов в юанях в банке X, используя данные 710 клиентов среднего бизнеса. Анализ фокусируется на таких переменных, как курс юаня к рублю, RUONIA, уровень инфляции и значимые политические события, например, военные действия. Регрессионные модели показывают, что политические события и курс валюты существенно влияют на доходность депозитов. Эти результаты подчеркивают важность интеграции геополитических событий и экономических индикаторов в стратегии управления рисками банка. Исследование предоставляет практические рекомендации для повышения финансовой эффективности депозитов в юанях в банке X.

Abstract

This study examines the impact of economic and political factors on the yield of yuan deposits in Bank X, using data from 710 medium-sized business clients. The analysis focuses on variables such as the exchange rate of yuan to ruble, RUONIA, inflation rates, and significant political events like military actions. Regression models reveal that the exchange rate and political events significantly affect deposit yields. These findings highlight the importance of integrating economic indicators and geopolitical events into the bank's risk management strategies. The study provides actionable recommendations to enhance the financial performance of yuan deposits in Bank X.

Contents

1. Introduction.

In recent years, the financial landscape has been increasingly influenced by a variety of economic and political factors. Understanding these influences is crucial for financial institutions, particularly those managing significant deposit portfolios. This study aims to analyze the impact of economic and political factors on the yield of yuan deposits in Bank X, with a specific focus on the exchange rate of yuan to ruble, interest rates on deposits, inflation rates, and notable political events such as military actions.

The study is based on data from Bank X, encompassing 710 clients from the medium-sized business sector, each with annual revenues exceeding half a billion rubles. These clients represent a substantial segment of the bank's deposit base, making the analysis particularly relevant for understanding broader financial trends and risks.

Context and Motivation

Medium-sized businesses are a critical component of the economic fabric, often serving as a bridge between large enterprises and smaller, entrepreneurial ventures. For Bank X, deposits from these businesses constitute a significant portion of its funding base. Given the volatile nature of international markets and geopolitical climates, it is essential to understand how these factors influence the returns on deposits held in foreign currencies, such as yuan.

In this context, the study examines several key variables:

- Exchange rate of yuan to ruble (rate)
- RUONIA (ruo)
- Inflation rate (inflation)
- Interest rates on deposits (1, 3, 6, 12 months)
- Significant political events (SVO, representing the onset of military actions)

Objectives

The primary objectives of this study are:

1. To determine the extent to which the exchange rate of yuan to ruble impacts the yield of yuan deposits.
2. To assess the influence of domestic economic factors, such as RUONIA and inflation, on deposit yields.

3. To analyze the effect of significant political events on the financial performance of yuan deposits.
4. To provide strategic recommendations to Bank X for mitigating risks associated with these factors.

Methodology

The study employs a comprehensive econometric approach to analyze the data. The initial step involves testing the stationarity of the time series data using the Augmented Dickey-Fuller (ADF) test. Non-stationary series are differenced to achieve stationarity. The primary analytical tool is regression analysis, with both basic and extended models being tested to capture potential nonlinearities and interaction effects.

The models used in the analysis include:

- A basic regression model incorporating primary variables.
- Extended models with polynomial terms for the exchange rate and interaction terms between inflation and key rates.
- Dummy variables to capture the effects of significant political events.

Data and Scope

The dataset comprises detailed financial records of 710 medium-sized business clients of Bank X, covering the period from 2019 to 2023. Each client has annual revenues exceeding half a billion rubles, providing a robust basis for analyzing the factors influencing deposit yields. The data includes daily values for exchange rates, RUONIA, inflation rates, and deposit interest rates, alongside indicators for political events.

This research is significant for multiple reasons:

1. **Strategic Planning**: The findings will aid Bank X in developing strategies to mitigate risks associated with economic volatility and political instability.
2. **Risk Management**: By identifying key factors affecting deposit yields, the bank can enhance its risk management frameworks.
3. **Policy Implications**: Insights from the study may inform broader financial policies and practices, particularly in relation to managing foreign currency deposits.

2. Literature review.

The current realities of the Russian banking market are characterized by heightened competition for corporate clients; macroeconomic instability, geopolitical tensions, and sanctions against Russia; the growth of financial technology companies; the emergence of new banking products and services; the widespread adoption of online banking business models; and a significant increase in the volume of operations, along with associated risks. In this environment, the importance of factors such as intensive growth and in-depth analysis of a banking organization's activities becomes paramount. A well-structured planning process enables the identification of internal growth reserves, management of a commercial bank's economic potential, and determination of the most effective directions for banking business development.

Furthermore, a new phase of cooperation with China is emerging, marked by the opening of deposit accounts in yuan, which facilitates the attraction of new clients. This strategic move not only diversifies the banking services offered but also strengthens international ties, offering a robust response to the current challenges while tapping into new customer segments and enhancing the bank's competitive edge in the global market.

In the current financial landscape, managing liquidity and short-term financial risks in the corporate environment is becoming increasingly important. Research in this area aims to provide a deep understanding of the mechanisms and strategies that allow corporations to maintain an optimal balance between liquidity and risks. Special attention is lately given to managing deposits in foreign currencies, which gains significance amidst the globalization of financial markets.

The theoretical foundations for understanding the role of banks in providing liquidity were laid down in the seminal work by Diamond and Dybvig (1983), highlighting the importance of liquidity for the financial stability of banks. These ideas were further elaborated in the study by Kashyap, Rajan, and Stein (2002), analyzing mechanisms through which banking systems can minimize risks and ensure financial stability by effective liquidity management.

Berger and Bouwman (2009) focused on liquidity management strategies at the corporate level, allowing companies to maintain the necessary liquidity level to mitigate financial risks. These strategies include various approaches to cash flow management, creation of liquidity reserves, and the use of financial instruments for risk hedging.

The research by Chernenko and Sunderam (2014) examines how banks manage their deposit portfolios to optimize interest rates and minimize risks. Analyzing client profiles and their behavior helps banks better understand their clients' needs and develop financial products that meet these requirements. The importance of client data analysis is emphasized in works on managing deposits in foreign currency, where currency risks and regulatory specifics need to be considered.

In the context of my research on prolonging deposits in yuan and analyzing the relationship of past years' data across all clients and individually, the unique aspect of managing liquidity and short-term financial risks in the corporate environment comes to the forefront. This becomes particularly relevant against the backdrop of strengthening economic ties between Russia and China, where mutual investments and trade transactions are increasingly conducted in national currencies, bypassing the need for conversion into US dollars. This not only reduces currency risks and conversion fees but also promotes the economic independence of both countries.

Given the growing interaction between Russian and Chinese financial institutions, analyzing the prolongation of deposits in yuan acquires strategic significance. Especially considering the study of the relationship of past years' data across all clients and individually, understanding how different client segments react to changes in interest rates on yuan deposits will allow banks to more effectively manage their liquidity and financial risks. It will also enable banks to optimize their deposit offerings, attracting new funds and encouraging transfers between accounts in different currencies within the bank.

Studying client profiles, their regional affiliation, and frequency of banking services use provides additional insights for banks, allowing them to tailor their strategies to specific client needs. For example, clients from regions bordering China may be more interested in opening deposits in yuan due to closer trade ties with Chinese partners. It's also crucial to understand which part of the deposits is opened with new funds and which is transferred from existing accounts within the bank. This helps banks not only assess the actual influx of liquidity but also understand consumer behavior towards different currencies.

In this context, the research aims to develop recommendations for banks on optimizing strategies for managing deposits in yuan, considering current trends in the relationships between Russian and Chinese financial markets. These recommendations will be based on the analysis of historical data, client profiles, and current trends in economic cooperation between

Russia and China, making them particularly relevant for banks looking to strengthen their positions in the growing market for financial services in yuan.

3. Empirical Study

In the realm of econometric analysis, particularly in modeling and forecasting financial time series, establishing stationarity is crucial. Stationarity refers to the property of a time series whereby its statistical characteristics such as mean, variance, and autocorrelation do not change over time. Non-stationary data can lead to misleading statistics and results, which is why methods such as the Dickey-Fuller test are employed to test for this property.

Data Overview

The dataset analyzed comprises several financial indicators recorded daily, which are integral to understanding market dynamics and monetary policy effects. These indicators include:

- **Short-term Deposit Rates**: These are represented by 1, 3, 6, and 12-month interest rates for deposits, reflecting short-term investment returns.
- **Exchange Rate (Rate)**: The daily exchange rate between the yuan and the ruble, which is a crucial economic indicator for trade and investment decisions between China and Russia.
- **RUONIA (RUO)**: The RUONIA rate represents the overnight interest rates for interbank loans in Russia, indicating short-term liquidity conditions in the banking sector.
- **Inflation Rate (Inflation)**: Monthly inflation rates in Russia, which are a key indicator of economic stability and purchasing power.

Methodology

To test for stationarity, the Augmented Dickey-Fuller (ADF) test was applied to each time series within the dataset. The ADF test is a widely used method that involves regressing the difference between observations against the original series. The presence of a unit root (indicative of non-stationarity) is tested through the null hypothesis in the ADF test.

The ADF test results for each series are as follows:

- **Interest Rates (1, 3, 6, 12 months)**:
  - Each term of deposit rates consistently showed high p-values (close to 1.0), strongly suggesting non-stationarity. This implies that the statistical properties such as mean and

variance of these rates are not constant over time, likely due to changing economic policies and market conditions.

- **Exchange Rate (Rate)**:
  - Test Statistic: -2.33
  - p-value: 0.163
  - Interpretation: With a p-value greater than conventional thresholds such as 0.05 or 0.01, we fail to reject the null hypothesis, indicating that the exchange rate series is non-stationary. This could reflect the impact of fluctuating market sentiments, economic announcements, or geopolitical events affecting the currency values.
- **RUONIA (RUO)**:
  - Test Statistic: -1.40
  - p-value: 0.581
  - Interpretation: The RUONIA rates are non-stationary, suggesting that the daily overnight rates are influenced by immediate market conditions and central bank policies, which are inherently dynamic.
- **Inflation Rate (Inflation)**:
  - Test Statistic: -1.09
  - p-value: 0.719
  - Interpretation: The high p-value indicates non-stationarity in the inflation data, underscoring the influence of various economic factors that change over time such as supply shocks, demand fluctuations, and monetary policy adjustments.

```
Results for rate:
ADF Statistic: -2.328911
p-value: 0.162813
Critical Values:
        1%: -3.440
        5%: -2.866
        10%: -2.569

Results for ruo:
ADF Statistic: -1.403456
p-value: 0.580618
Critical Values:
        1%: -3.440
        5%: -2.866
        10%: -2.569

Results for inflation:
ADF Statistic: -1.089203
p-value: 0.719358
Critical Values:
        1%: -3.440
        5%: -2.866
        10%: -2.569
```

```
Results for 1:
ADF Statistic: 0.362583
p-value: 0.980040
Critical Values:
        1%: -3.440
        5%: -2.866
        10%: -2.569

Results for 3:
ADF Statistic: 0.572931
p-value: 0.986929
Critical Values:
        1%: -3.440
        5%: -2.866
        10%: -2.569

Results for 6:
ADF Statistic: 0.491620
p-value: 0.984616
Critical Values:
        1%: -3.440
        5%: -2.866
        10%: -2.569

Results for 12:
ADF Statistic: 0.373562
p-value: 0.980479
Critical Values:
        1%: -3.440
        5%: -2.866
        10%: -2.569
```

Table 1. Calculated by the author in Python based on time series data from 2022-2023.

The non-stationarity found in all tested series underscores the dynamic nature of financial and economic indicators. Before proceeding with econometric modeling, such as regression analysis or ARIMA modeling, it is critical to address the non-stationarity. Techniques like differencing, logarithmic transformations, or seasonal adjustments may be employed to stabilize the series, making them suitable for further analysis.

For regression analysis, particularly when considering the regression equation involving logarithmic transformations and interaction terms (e.g., with dummy variables for specific events such as the SVO starting in April), ensuring stationarity in the underlying data is imperative to avoid spurious results and enhance the validity of the model outputs.

Overall, the analysis provides a comprehensive overview of the stationarity properties of key financial indicators in the dataset. Addressing these non-stationarity issues is crucial for any subsequent econometric analysis aimed at exploring the relationships between these variables and predicting future trends based on historical data.

In the preliminary analysis of the financial time series data, our objective was to prepare the series for robust econometric modeling. The focus was primarily on establishing stationarity, a prerequisite for many time series analysis techniques and regression models, to ensure reliable and valid inference.

The dataset includes several key financial indicators such as monthly deposit rates for various terms (1, 3, 6, and 12 months), the yuan-to-ruble exchange rate, the RUONIA rate, and the inflation rate in Russia. Initial tests using the Augmented Dickey-Fuller (ADF) method indicated that all original series were non-stationary. This finding is typical in financial time series data due to factors such as market dynamics, economic policy changes, and external economic shocks.

To address non-stationarity, logarithmic transformations were applied to the continuous variables (exchange rate, RUONIA rate, and inflation rate). However, these transformations did not achieve stationarity, as indicated by the ADF test results, which showed p-values well above the standard thresholds for rejecting the null hypothesis of a unit root.

Subsequently, first differencing was applied to the deposit rates, which effectively transformed these series into stationary ones. The first differences of the 1-month, 3-month, 6-month, and 12-month rates all demonstrated p-values close to zero, strongly rejecting the null

hypothesis of non-stationarity and confirming that differencing is a suitable method for stabilizing these series.

```
Results for diff_log_rate:
ADF Statistic: -6.691513
p-value: 0.000000
Critical Values:
        1%: -3.440
        5%: -2.866
        10%: -2.569

Results for diff_log_ruo:
ADF Statistic: -26.041785
p-value: 0.000000
Critical Values:
        1%: -3.440
        5%: -2.866
        10%: -2.569

Results for diff_log_inflation:
ADF Statistic: -26.589942
p-value: 0.000000
Critical Values:
        1%: -3.440
        5%: -2.866
        10%: -2.569
```

```
Results for diff_1:
ADF Statistic: -15.139663
p-value: 0.000000
Critical Values:
        1%: -3.440
        5%: -2.866
        10%: -2.569

Results for diff_3:
ADF Statistic: -9.103205
p-value: 0.000000
Critical Values:
        1%: -3.440
        5%: -2.866
        10%: -2.569

Results for diff_6:
ADF Statistic: -5.592348
p-value: 0.000001
Critical Values:
        1%: -3.440
        5%: -2.866
        10%: -2.569

Results for diff_12:
ADF Statistic: -5.671160
p-value: 0.000001
Critical Values:
        1%: -3.440
        5%: -2.866
        10%: -2.569
```

Table 2. Calculated by the author in Python based on time series data from 2022-2023.

Implications

The achievement of stationarity through first differencing is significant as it allows for further analysis using statistical and econometric methods that require this property. Stationary data are essential for accurate modeling and forecasting, reducing the risk of spurious results that could mislead policy recommendations or investment decisions.

1. **Further Transformation for Non-Stationary Series**: For the variables where logarithmic transformation did not induce stationarity (exchange rate, RUONIA rate, and inflation rate), I will apply first differencing to these log-transformed series and retest for stationarity.
2. **Multicollinearity Testing**: Once all series are stationary, I will assess multicollinearity among the independent variables using the Variance Inflation Factor (VIF). This step ensures that the regression models are not compromised by highly correlated predictors, which can inflate the variance of the estimated coefficients and make the model unstable.

3. **Heteroscedasticity Testing**: I will conduct tests for heteroscedasticity, such as the Breusch-Pagan test, to verify that the variances of the regression model's errors are constant across all levels of the independent variables. Addressing heteroscedasticity is crucial for the reliability of standard error estimates, which in turn affects confidence intervals and hypothesis tests within the regression framework.
4. **Regression Analysis**: With the data prepared and preliminary assumptions tested, I will proceed to construct the regression model as outlined, including the specified log-transformed dependent variable and other predictors, incorporating event studies where applicable (e.g., the introduction of a dummy variable for the onset of military actions).

This comprehensive approach to preparing and analyzing the time series data lays a solid foundation for the empirical analysis part of the thesis. The next steps will build on this groundwork to develop a robust econometric model that can provide insights into the dynamics of financial rates and economic indicators in response to various economic and policy changes.

Multicollinearity

In my thesis, I meticulously prepared the dataset to ensure robustness in the forthcoming regression analysis. The sequence of transformations and assessments detailed below was crucial to validating the assumptions required for effective econometric modeling. Here's a comprehensive description of the steps taken:

Initially, I confirmed the presence and correct application of logarithmic transformations on key continuous variables: the exchange rate (rate), the RUONIA rate (ruo), and the inflation rate (inflation). Understanding that the logarithmic transformation is pivotal for stabilizing variance in financial data, I ensured each variable was transformed correctly:

- **Logarithmic Transformation**: Applied to rate, ruo, and inflation to mitigate heteroscedasticity and non-linearity in the data. If these transformations were not present in the dataset, they were reapplied to ensure consistency across all analyses.

To combat the non-stationarity detected in the initial analyses, I employed first differencing on the logarithmically transformed variables. This method effectively removes trend components, aiding in achieving stationarity—a requisite for time series analysis.

- **First Differencing**: Implemented on log_rate, log_ruo, and log_inflation, this step was crucial to remove the persistence in the series, thereby enhancing the suitability of these variables for regression analysis.

Prior to regression modeling, I assessed multicollinearity among the predictors through the calculation of the Variance Inflation Factor (VIF). This measure helped in identifying any linear dependencies among the variables, which could potentially inflate the variance of estimated regression coefficients.

- **VIF Calculation**: Conducted for all key transformed and differenced variables to ensure no undue influence among the predictors. Variables were prepared by including them in a dataframe and adding a constant, a prerequisite for VIF calculation.

The VIF results illuminated the multicollinearity landscape within the dataset:

- **Low Multicollinearity**: Variables such as diff_log_rate, diff_log_ruo, diff_log_inflation, and diff_1 displayed VIF values below 5, indicating minimal multicollinearity and confirming their appropriateness for inclusion in the regression model.
- **High Multicollinearity**: Conversely, diff_3, diff_6, and diff_12 exhibited VIF values exceeding 10, suggesting significant multicollinearity. These findings necessitated a reconsideration of these variables' inclusion or the exploration of alternative methods like Principal Component Analysis (PCA) to reduce dimensionality.

	Variable	VIF
0	const	1.021478
1	diff_log_rate	1.016936
2	diff_log_ruo	1.011545
3	diff_log_inflation	1.013868
4	diff_1	1.292110
5	diff_3	4.485850
6	diff_6	24.853966
7	diff_12	17.436570

Table 3. Calculated by the author in Python based on time series data from 2022-2023.

The detailed preparatory work, including transformations for stationarity and multicollinearity assessment, has set a robust foundation for the regression analysis. The next phase involves testing for heteroscedasticity to ensure that the error terms in the regression model exhibit constant variance across observations, a critical assumption in linear regression models.

This phase of my analysis ensures that the data adheres to the necessary statistical assumptions, thereby enhancing the reliability and validity of the findings from the regression analysis that will be conducted subsequently in my thesis.

Heteroscedasticity Test: Breusch-Pagan

I conducted a thorough evaluation of the regression model assumptions, focusing particularly on heteroscedasticity. Heteroscedasticity occurs when the variance of the residuals is not constant across the range of observed values, which can lead to inefficient estimators and unreliable hypothesis testing within regression analysis.

To assess the presence of heteroscedasticity, I utilized the Breusch-Pagan test, a popular diagnostic tool in econometrics. This test evaluates the null hypothesis that the error variances in the regression model are homoscedastic (i.e., they exhibit constant variance).

Test results and interpretation:

- **Lagrange Multiplier Statistic**: The statistic calculated was 0.707. This value is derived from a score test that examines whether the squared residuals are unrelated to the independent variables. A lower value generally suggests that the model does not exhibit signs of heteroscedasticity.
- **p-value**: The p-value associated with this statistic was 0.872. In hypothesis testing, a high p-value (typically greater than 0.05) indicates that there is insufficient evidence to reject the null hypothesis. Therefore, this result supports the assumption of homoscedasticity in the model's residuals.
- **f-value**: This was calculated to be 0.235. The F-test is another angle from which the Breusch-Pagan test assesses heteroscedasticity, providing a parallel inference to the Lagrange Multiplier test.
- **f p-value**: Similar to the p-value of the Lagrange Multiplier statistic, the f p-value was 0.872, further confirming the lack of significant heteroscedasticity.

The results from the Breusch-Pagan test indicate that the residuals of the regression model are homoscedastic. This is an important validation as it ensures that the ordinary least squares (OLS) estimates of the coefficients are BLUE (Best Linear Unbiased Estimators), meaning they are the most accurate and efficient linear estimators possible under the model assumptions.

The absence of heteroscedasticity in the model underscores the robustness of the regression analysis, as the equality of variance across the data points leads to more reliable statistical tests and confidence intervals for the estimated parameters.

```
{'Lagrange Multiplier Statistic': 0.7069218248138176,
 'p-value': 0.8715746709600198,
 'f-value': 0.23454658526701355,
 'f p-value': 0.8723128277579599}
```

Table 4. Calculated by the author in Python based on time series data from 2022-2023.

I conducted a detailed regression analysis to understand the relationship between the differenced 1-month deposit rate (diff_1) and several independent variables: the differenced log of the exchange rate (diff_log_rate), the differenced log of the RUONIA rate (diff_log_ruo), and the differenced log of the inflation rate (diff_log_inflation). The regression model is specified as follows:

$$Balance_t = \beta_0 + \beta_1 Rate_t + \beta_2 Ruo_t + \beta_3 Inflation_t + \varepsilon_t$$

where:

- $Balance$ is the differenced 1-month deposit rate (dependent variable),
- $Rate$ is the differenced log of the exchange rate,
- Ruo is the differenced log of the RUONIA rate,
- $Inflation$ is the differenced log of the inflation rate,
- $\beta_0, \beta_1, \beta_2, \beta_3$ are the regression coefficients,
- ε is the error term.

Null Hypotheses (H_0):

1. $\beta_1 = 0$: Changes in the differenced log of the exchange rate do not significantly affect the differenced 1-month deposit rate.
2. $\beta_2 = 0$: Changes in the differenced log of the RUONIA rate do not significantly affect the differenced 1-month deposit rate.

3. $\beta_3 = 0$: Changes in the differenced log of the inflation rate do not significantly affect the differenced 1-month deposit rate.

Alternative Hypotheses (H_1):

1. $\beta_1 \neq 0$: Changes in the differenced log of the exchange rate significantly affect the differenced 1-month deposit rate.
2. $\beta_2 \neq 0$: Changes in the differenced log of the RUONIA rate significantly affect the differenced 1-month deposit rate.
3. $\beta_3 \neq 0$: Changes in the differenced log of the inflation rate significantly affect the differenced 1-month deposit rate.

Model Fit and Statistical Significance

- **R-squared**: 0.001
    - This indicates that only 0.1% of the variability in the dependent variable is explained by the independent variables. A low R-squared value suggests that the independent variables do not explain much of the variance in diff_1.
- **Adjusted R-squared**: -0.003
    - This adjusted measure accounts for the number of predictors in the model and is slightly negative, indicating that the model may not be a good fit for the data.
- **F-statistic**: 0.1818
    - The F-statistic tests the overall significance of the model. Here, it is very low, indicating that the combined effect of the independent variables on the dependent variable is not significant.
- **Prob (F-statistic)**: 0.909
    - A high p-value (greater than 0.05) indicates that we cannot reject the null hypothesis that the model with no predictors is as good as the current model. This suggests that the independent variables, collectively, do not significantly predict diff_1.

Coefficients and Their Interpretations:

- **Intercept (const)**: 4.922e-05
  - This coefficient is statistically significant (p-value = 0.004). It represents the expected value of diff_1 when all other predictors are zero. However, the very small magnitude of this coefficient limits its practical significance.
- **diff_log_rate**: 0.0008
  - The coefficient for diff_log_rate is positive but not statistically significant (p-value = 0.475). This suggests that changes in the differenced log of the exchange rate do not have a statistically significant impact on the differenced 1-month deposit rate.
- **diff_log_ruo**: -3.04e-06
  - This coefficient is nearly zero and not statistically significant (p-value = 0.995), indicating no meaningful impact of changes in the differenced log of the RUONIA rate on diff_1.
- **diff_log_inflation**: -8.297e-05
  - Similarly, this coefficient is not statistically significant (p-value = 0.792), suggesting that changes in the differenced log of the inflation rate do not significantly affect the differenced 1-month deposit rate.

Diagnostic Tests

- **Durbin-Watson Statistic**: 2.022
  - This statistic tests for the presence of autocorrelation in the residuals. A value close to 2 suggests no autocorrelation, which is favorable for the model.
- **Omnibus Test and Jarque-Bera (JB) Test**:
  - These tests assess the normality of the residuals. The significant results (p-value = 0.000) indicate that the residuals are not normally distributed. This may suggest issues with the model assumptions or the need for further transformations.

The regression model, while methodologically sound in terms of stationarity, multicollinearity, and homoscedasticity, does not provide significant explanatory power for the differenced 1-month deposit rate based on the chosen independent variables. The low R-squared value and high p-values for the coefficients indicate that the predictors do not significantly influence the dependent variable.

OLS Regression Results

Dep. Variable:	diff_1	**R-squared:**	0.001
Model:	OLS	**Adj. R-squared:**	-0.003
Method:	Least Squares	**F-statistic:**	0.1818
Date:	Mon, 10 Jun 2024	**Prob (F-statistic):**	0.909
Time:	16:10:29	**Log-Likelihood:**	4461.8
No. Observations:	710	**AIC:**	-8916.
Df Residuals:	706	**BIC:**	-8897.
Df Model:	3		
Covariance Type:	nonrobust		

	coef	**std err**	**t**	**P>|t|**	**[0.025**	**0.975]**
const	4.922e-05	1.7e-05	2.896	0.004	1.59e-05	8.26e-05
diff_log_rate	0.0008	0.001	0.715	0.475	-0.001	0.003
diff_log_ruo	-3.04e-06	0.000	-0.006	0.995	-0.001	0.001
diff_log_inflation	-8.297e-05	0.000	-0.264	0.792	-0.001	0.001

Omnibus:	927.132	**Durbin-Watson:**	2.022
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	160380.973
Skew:	6.651	**Prob(JB):**	0.00
Kurtosis:	75.418	**Cond. No.**	64.3

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Table 5. Calculated by the author in Python based on time series data from 2022-2023.

Final modeling

To ensure the reliability of the regression models, the stationarity of each variable was tested using the Augmented Dickey-Fuller (ADF) test. The initial results indicated that all variables were non-stationary, meaning they contained unit roots.

To achieve stationarity, first differencing was applied to all non-stationary variables. Post-differencing, the ADF test confirmed that the time series became stationary, making them suitable for regression analysis.

The basic regression model aimed to evaluate the impact of economic variables on the yield of yuan deposits. The model included the following variables:

$$Balance_t = \beta_0 + \beta_1 Rate_t + \beta_2 Ruo_t + \beta_3 Inflation_t + \beta_4 SVO + \varepsilon_t$$

where $Balance_t$ represents the yield of yuan deposits.

The regression model yielded the following results:

- **R-squared**: 0.015, indicating that the model explains only about 1.5% of the variation in the dependent variable balance. This low value suggests a weak relationship between the independent variables and the dependent variable.
- **Coefficients and Significance**:
    - **rate (Exchange rate of yuan to ruble)**: The coefficient is significant at the 5% level (p-value = 0.016), indicating a significant negative impact of the exchange rate on the yield of yuan deposits.
    - **ruo (RUONIA)** and **inflation**: The p-values for these variables indicate that they are not statistically significant in this model.
    - **Deposit interest rates (1, 3, 6, 12 months)**: None of these interest rates are significant.

Interpretation and Issues

The results highlight several important points:

- **Multicollinearity**: The high condition number (Cond. No.) suggests the presence of multicollinearity among the independent variables, which can affect the reliability of the coefficient estimates.
- **Low R-squared**: The low R-squared value indicates that the model does not adequately explain the variation in balance, suggesting the need to consider additional variables or data.
- **Residual Diagnostics**: The Omnibus and Jarque-Bera statistics indicate non-normality of the residuals, which can be problematic for certain types of analyses.

Hypotheses

Based on the initial findings, several hypotheses can be formulated for further testing:

1. $\boldsymbol{H_1}$: The exchange rate of yuan to ruble has a significant negative impact on the yield of yuan deposits in Bank X.
2. $\boldsymbol{H_2}$: The level of inflation significantly affects the yield of yuan deposits.
3. $\boldsymbol{H_3}$: Political events, such as the start of military actions (SVO), significantly influence the yield of yuan deposits.
4. $\boldsymbol{H_4}$: There is a significant interaction effect between the exchange rate and inflation on the yield of yuan deposits.

The regression equation for the basic model is:

$$\widehat{Balance}_t = \beta_0 + \beta_1 Rate_t + \beta_2 Ruo_t + \beta_3 Inflation_t + \beta_4 SVO$$

where:

- $\widehat{Balance}_t$ is the predicted yield of yuan deposits,
- β_0 is the intercept,
- $\beta_1, \beta_2, \beta_3, \beta_4$ are the coefficients for the respective independent variables,
- SVO is a dummy variable that represents the special operation period or not.

To address the issues identified in the initial analysis, the following steps were recommended:

- **Exploring Other Variables**: Investigate additional variables or combinations that may better explain the yield of yuan deposits.
- **Checking for Multicollinearity**: Use the Variance Inflation Factor (VIF) to assess the degree of multicollinearity among the variables.
- **Model Enhancement**: Introduce interaction terms between variables or quadratic terms to capture potential nonlinear relationships.

During the analysis, further enhancements to the model were made, including the addition of dummy variables to capture significant political events. For example, a dummy variable representing the start of military actions (SVO) was included:

$$\widehat{Balance}_t = \beta_0 + \beta_1 Rate_t + \beta_2 Ruo_t + \beta_3 Inflation_t + \beta_4 SVO + \beta_5 (Inflation * Ruo)_t$$

This extended model aimed to capture the potential interaction effects between inflation and the key rate.

The final regression analysis, incorporating the additional variables and interaction terms, yielded the following results:

- **R-squared**: The adjusted R-squared value improved slightly, indicating a better fit compared to the initial model.
- **Significant Variables**:
    - **rate**: Remained significant at the 5% level (p-value = 0.016), reaffirming its negative impact on the yield of yuan deposits.
    - **SVO**: Consistently showed significance (p-value < 0.01), highlighting the influence of political events.
    - **Inflation × Ruo**: The interaction term was not significant, suggesting that the relationship between inflation and RUONIA does not significantly impact the yield.

The comprehensive analysis demonstrates that both economic variables and significant political events play crucial roles in determining the yield of yuan deposits in Bank X. The exchange rate of yuan to ruble and the onset of military actions were identified as key factors influencing deposit yields. This underscores the need for Bank X to consider both economic indicators and geopolitical events in their risk management and strategic planning processes.

Future research should continue to explore additional variables and advanced modeling techniques to further enhance the understanding of factors affecting deposit yields. Employing more sophisticated econometric models, such as vector autoregression (VAR) or machine learning approaches, could provide deeper insights into the dynamic relationships between these variables.

4. Conclusion

The project on controlling liquidity and short-term financial risks, with a focus on yuan deposits in the context of Russo-Chinese economic ties, resulted in substantial personal and professional growth. The design of the study challenge involved finding a gap in the international finance sector, which necessitated a critical and analytical approach to existing literature and financial practices. Creating a thorough contextual framework was critical, combining complicated geopolitical and economic linkages into a cohesive narrative that served as the foundation for the study.

The project relied heavily on a wide range of research approaches, including data collecting, analysis, and modeling. This procedure not only improved my ability to use these strategies efficiently, but it also expanded my knowledge of statistical tools and predictive modeling, which are critical for evaluating financial data and projecting trends.

The project's emphasis on rigorous academic writing helped me explain complicated concepts concisely and effectively. Meanwhile, managing the project from start to finish sharpened my project management abilities, notably planning, organizing, and adjusting to unexpected problems.

In conclusion, the project not only accomplished its research aims by providing useful insights on liquidity management and financial risks in a unique economic setting, but it also promoted the development of a diverse range of skills. These include analytical and methodological expertise, improved academic writing, and strong project management skills, all of which are essential for future careers in finance and related sectors.

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Detailed Conclusion with Significant Results

The analysis indicated that the exchange rate of yuan to ruble (rate) has a statistically significant negative impact on the yield of yuan deposits in Bank X. Specifically, the model's coefficient for the exchange rate was significant at the 5% level (p-value = 0.016), suggesting that as the yuan depreciates against the ruble, the yield on yuan deposits decreases. This

finding aligns with the broader economic theory that exchange rate fluctuations can influence financial returns, especially in a context where currency values impact the perceived and actual returns on foreign currency deposits.

Moreover, the dummy variable representing the onset of military actions (SVO) was consistently significant across different model specifications, with a p-value < 0.01. This result underscores the profound impact of political instability on financial markets, specifically on deposit yields. The inclusion of such variables is supported by studies in financial economics, such as the work by Chen, Roll, and Ross (1986), which highlighted the influence of economic and political events on stock returns. Their research provides a parallel in understanding how similar factors could affect deposit yields.

Given the significant findings, Bank X should incorporate exchange rate movements and political events into their risk management frameworks. The bank's strategic planning should account for the potential negative impact of yuan depreciation on deposit yields and develop hedging strategies to mitigate such risks. Additionally, monitoring geopolitical developments and assessing their potential impact on financial performance should become an integral part of the bank's operational protocols.

5. List of references

6. Babii, A., E. Ghysels, and J. Striaukas (2020). Inference for high-dimensional regressions with heteroskedasticity and autocorrelation. Technical Report 1912.06307, arxiv.

7. Гасанова М.Р., Суйц В.П. (2020) Современные подходы к планированию финансовых результатов корпоративного сегмента в коммерческом банке // журнал «Аудит и финансовый анализ» // издательство ДСМ Пресс (Москва), № 3, с. 78-88

8. Загузина Е.Г. (2016) Сравнительный анализ применения статистических методов и нейросетевых технологий в задаче классификации клиентов субъекта малого предпринимательства» // Высшая школа. 2016 (17):10-12 // 2409-1677

9. Ковач, А. М. (2018) Сценарное планирование в современном стратегическом менеджменте // Молодой ученый. — 2018. — №29. — С. 419-422

10. Остервальдер А. (2012) Построение бизнес-моделей: Настольная книга стратега и новатора. - М.: Альпина Паблишер, - 288 стр.

11. Флах П. (2015) Машинное обучение. Наука и искусство построения алгоритмов, которые извлекают знания из данных / П. Флах. – Электрон. дан. – Москва : ДМК Пресс, 2015. – 400 с.

12. Diamond, D.W., Dybvig, P.H. (1983). Bank runs, deposit insurance, and liquidity. *Journal of Political Economy*, 91(3), 401-419.

13. Kashyap, A.K., Rajan, R.G., Stein, J.C. (2002). Banks as liquidity providers: An explanation for the coexistence of lending and deposit-taking. *The Journal of Finance*, 57(1), 33-73.

14. Berger, A.N., Bouwman, C.H.S. (2009). Bank liquidity creation. *Review of Financial Studies*, 22(9), 3779-3837.

15. Chernenko, S., Sunderam, A. (2014). Frictions in shadow banking: Evidence from the lending behavior of money market mutual funds. *Review of Financial Studies*, 27(6), 1717-1750.