DETERMINANTS OF THE BANKING SYSTEM LIQUIDITY: THE CASE OF UKRAINE

by

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Date _____

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NBU National Bank of Ukraine

CAR Capital adequacy ratio

CHAPTER 1. INTRODUCTION

Banks have a crucial function in the economy as intermediaries serving different economic sectors. The performance of the banking system has a considerable impact on economic growth. It serves as the primary source of funds for the general public, businesses, governments and the industrial sector. Countries with a thriving and profitable banking sector are adept in managing financial hardships and upholding the stability of the financial sector. Thus, it is imperative to identify and analyze the key factors influencing the profitability of banks. (Bilal, Ali Gull Toquer Akram, 2013)

Furthermore, banks have a pivotal role in creating and managing the money supply. Through fractional reserve banking, they have the ability to lend a portion of the deposits they receive, creating currency in the form of credit. The accessibility of money and credit supply has a direct impact on inflation, interest rates, as well as economic activity.

Banks face diverse risks, including liquidity risk, the risk of obtaining cash to fulfill funding obligations. Understanding the factors that influence liquidity helps banks to assess and manage these risks, develop liquidity management strategies, as well as to maintain sufficient reserves and adapting to changing economic conditions.

Banking system liquidity is closely related to financial stability. If liquidity is insufficient, the consequences can be financial distress and occurences like bank runs and so on, which can have a large influence on the financial system as a whole.

Analyzing how both individual bank-related and broader macroeconomic factors impact the liquidity of a banking system provides valuable perspectives for policymakers to maintain the soundness of a financial system.

Hence, the objective of this research is to determine the impact and significance of bank-related and macroeconomic factors on the liquidity of the Ukrainian banking system. This study is important for understanding the operations of the banking sector, assessing the health of the financial system, making informed decisions, and formulating effective policies.

We carried out this analysis by curating a linear regression which included liquidity as the dependent variable and the bank-related and macroeconomic factors as independent variables. We found that the variable that influences the liquidity of the banking system the most is the marginal rate of interest.

CHAPTER 2. LITERATURE REVIEW

Numerous studies have investigated the liquidity levels within the banking systems of diverse countries. These studies have taken into account both internal factors specific to individual banks and external macroeconomic variables.

Bank liquidity and the factors determining it are a vital ingredient in banking and finance, as there is a significant volume of theoretical literature on the topic. Diamond and Dybvig's work in 1983 seem to have provided the stepping stone for bank liquidity analysis and bank runs. Also the researches by Diamond et Rajan (2001), Drehmann et Nikolaou (2009), Freixas et al. (2011), Bianchi et Bigio (2022), as well as the empirical researches by Bilal et al. (2013) and Singh et Sharma (2016) on the influence of bank-related and macroeconomic factors on the liquidity of Pakistani commercial banks and Indian banks, respectively, have provided a significant contribution to bank liquidity analysis.

Other empirical researches worth mentioning are: the one by Roman et Sargu (2014) on the banks' liquidity risk in Bulgaria and Romania, the one by Murithi et Waweru (2017) on the liquidity risk and financial performance of Kenyan commercial banks, the one by Mazreku et al. (2018) on the liquidity risk factors in the Balkan region banking systems and the one by Adelopo et al. (2021) on the impact of increased capital requirements and high liquidity levels on the profitability of European banks.

Most of the aforementioned empirical studies analyze the effect of the bank-related and macroeconomic variables on the banking systems of respective countries by developing linear regression models based on time series analysis or panel data analysis. For the dependent variable, they use different variables as the liquidity of the banking system. Adelopo et al. (2021) use the return on assets as the dependent variable, Murithi et Waweru (2017) use the return on equity, Bilal et al. (2013) curated two models: one using the return on assets and the other using the return on equity. Roman et Sargu (2014) and Singh et Sharma (2016) use the ratio of liquid assets to total assets. Roman et Sargu (2014) also

create another model, with the ratio of total loans to total assets as the dependent variable. Mazreku et al. (2018) use the ratio of short-term assets to short-term liabilities.

The selections of bank-related variables as independent variables vary strongly from one paper to another. Murithi et Waweru (2017) studied the influence of the liquidity coverage ratio (LCR) and of the net stable funding ratio (NSFR) on the return on equity to determine the liquidity risk and financial performance of Kenyan commercial banks, which seems to be not a very comprehensive model, as it includes so few independent variables. The opposite can be said about the papers by Roman et Sargu (2014) and by Singh et Sharma (2016), as they utilize return on assets and on equity, the ratio of deposits, the bank size as the log of total assets, the capital adequacy ratio as the independent bank-related variables. The paper by Bilal et al. (2013) utilizes deposit-, loan- and interest-related bank-related variables. The more recent paper by Adelopo et al. (2021) also puts very versatile bank-related independent variables into use, namely the total equity to total assets, total loans to total deposits, total deposits to total funding, non-performing loans to gross loans, as well as the bank size, determined by taking the log of the total assets of banks.

The most widespread macroeconomic independent variables, if used in the paper, are inflation (Bilal et al., 2013; Singh et Sharma, 2016; Mazreku et al., 2018; Caliskan et Lecuna, 2020; Adelopo et al, 2021), the Gross Domestic Product (GDP) (Bilal et al., 2013; Singh et Sharma, 2016), GDP growth rate change (Adelopo et al., 2021), the CPI (Adelopo et al., 2021) and the unemployment (Bilal et al., 2013; Singh et Sharma, 2016; Mazreku et al., 2018). Also the variables that could be found in papers on the topic, were the interest rate in loans to interest rate in deposits (Mazreku et al., 2018), the Industry Protection Growth Rate (Bilal et al., 2013) and the GDP per capita (Mazreku et al., 2018).

Of all of the abovementioned studies, those that resembled our analysis the most are: the one by Singh et Sharma, 2016 on the macroeconomic and bank-related factors affecting liquidity of Indian banks, which utilized data on each of the commercial Indian banks; and the one by Mazreku et al., 2019 on the Liquidity Risk Factors in the Balkan Region Banking

System, which utilized aggregated data for each of the countries of the Balkans. We used a mix of the variables used in these two studies due to the limited availability of data on some of the variables.

There are fewer studies on the liquidity of the banking systems of newer European Union member states, as well as of non-EU European countries, especially Ukraine, which makes it important to study the influence of bank-related and macroeconomic factors on the liquidity of the banking sector in Ukraine. It is also important to see the effects that the COVID-19 pandemic and the inception of the full-scale Russian invasion into Ukraine has had on banking and on finance in general in Ukraine.

CHAPTER 3. METHODOLOGY

The objective of this research is to examine the influence and role of bank-related and macroeconomic factors on the liquidity of the Ukrainian banking system. These variables considered include: bank size (log of total assets), profitability (return on assets), deposits ratio (deposits over total assets), capital adequacy ratio, inflation, marginal rate of interest and Industrial Production Index. (Dinger, 2009; Bonfim & Kim, 2012; Delechat et al., 2012; Singh et Sharma, 2016; Mazreku et al., 2019).

The model with the variables used in our analysis is the following:

LIQ= $\beta 0 + SIZEt + ROAt + DEPt + CARt + INFLAt + IRMt + IDIt + \varepsilon t$.

Monthly data of commercial banks pertaining to the period 2016-2022 have been considered. The banks include private banks, public banks and foreign banks operating in Ukraine. We have focused on the data placed on the NBU website, as well as on the data of the State Statistics Service of Ukraine (Ukrstat).On the basis of the literature, significant variables expected to have a major impact on the bank liquidity. Here is a summary of the variables:

Table 1. Summary of variables used in the analysis

Variable	**Measurement**	**Notation**	**Expected relationship**	**Data source**	**Other papers using the variable**
Dependent variable					

Liquidity	Liquid assets over total assets.	LIQ		NBU, own calculations	Roman et Sargu (2014), Singh et Sharma (2016), Delechat et al. (2012), Caliskan et Lecuna (2020)
Independent variables (bank-related variables)					
Profitability	Return on assets	ROA	Positive/ negative	NBU	Bonfim et Kim (2012), Roman et Sargu (2014), Singh et Sharma (2016), Mazreku et al., Caliskan et Lecuna (2020)

Bank size	Log of total assets	SIZE	Negative	NBU, own calculations	Dinger (2009), Delechat et al. (2012), Singh et Sharma (2016), Caliskan et Lecuna (2020)
Deposits	Deposits over total assets	DEP	Positive	NBU, own calculations	Bonner et al. (2013), Singh et Sharma (2016)
Capital adequacy ratio	Total equity over risk-weighted assets	CAR	Positive	NBU	Singh et Sharma (2016), Adelopo et al. (2021)
Macroeconomic variables					
Inflation	Monthly percentage	INFLA	Positive/ negative	NBU	Singh et Sharma (2016), Mazreku et

					al. (2018), Caliskan et Lecuna (2020), Adelopo et al. (2021)
Marginal rate of interest	Interest rates on new loans granted to residents over interest rates on new deposits granted to residents	IRM	Negative	NBU	Singh et Sharma (2016), Mazreku et al. (2018)
Industrial production index	Industrial Production Index	IDI	Positive/ negative	State Statistics Service of Ukraine (Ukrstat)	Singh et Sharma (2016), Adelopo et al. (2021).

As mentioned above, liquidity is measured as the relation between liquid assets and total assets. We have determined the quantity of liquid assets by adding up the quantity of cash, funds on NBU accounts, correspondent accounts with other banks and securities.

Data on the Capital adequacy ratio was only available from 2018 to 2022. Due to these limitations in the availability of the data, we did three regressions: on data from 2016 to 2022 and on data from 2018 to 2022 without CAR and on data from 2018 to 2022 with CAR.

Many studies, including the one by Singh et Sharma and Mazreku et al., also include unemployment to the macroeconomic variables analyzed, but due to the lack of monthly data on unemployment in Ukraine, we have used the marginal rate of interest. The way of determining it is shown in the table above.

GDP per capita and GDP growth data was also not available monthly. Therefore, an index close to the GDP, which is the Industrial Production Index, has been utilized.

CHAPTER 4. DATA[1]

As mentioned above, the data we used in the study was monthly, from 2016 to 2022. The graphs for the dynamics of liquidity, the internal rate of return, the bank size and the deposits to total assets ratio. The graphs displaying the dynamics of the variables used are displayed in the appendices.

1. As mentioned earlier, we will use data from 2016 to 2022 without CAR for the first linear regression. Here are the descriptive statistics and the correlation matrix for this data (including CAR from 2018 to 2022):

Figure 1. Descriptive statistics for data from 2016 to 2022 (without CAR)

```
> summary(df)
      IRM             LIQ              SIZE            ROA          
 Min.   :1.320   Min.   :0.3100   Min.   :14.01   Min.   :-12.6000  
 1st Qu.:1.500   1st Qu.:0.4475   1st Qu.:14.07   1st Qu.:  0.1575  
 Median :1.655   Median :0.4900   Median :14.12   Median :  1.9850  
 Mean   :1.927   Mean   :0.4882   Mean   :14.23   Mean   :  1.6613  
 3rd Qu.:2.410   3rd Qu.:0.5500   3rd Qu.:14.42   3rd Qu.:  3.6875  
 Max.   :3.120   Max.   :0.6100   Max.   :14.62   Max.   :  6.2500  

      DEP              INFLA             IDI              CAR       
 Min.   :0.00000   Min.   : 1.70   Min.   : 48.10   Min.   :8.600  
 1st Qu.:0.01000   1st Qu.: 7.90   1st Qu.: 95.40   1st Qu.:9.000  
 Median :0.03000   Median : 9.95   Median : 99.75   Median :9.200  
 Mean   :0.02893   Mean   :11.49   Mean   : 96.12   Mean   :9.155  
 3rd Qu.:0.04000   3rd Qu.:13.78   3rd Qu.:104.10   3rd Qu.:9.300  
 Max.   :0.10000   Max.   :40.20   Max.   :113.80   Max.   :9.600  
```

```
> sd(df$IRM)
[1] 0.5348097
> sd(df$LIQ)
[1] 0.07942809
> sd(df$SIZE)
[1] 0.1920247
> sd(df$ROA)
[1] 2.750196
> sd(df$DEP)
[1] 0.02409909
> sd(df$INFLA)
[1] 7.035825
> sd(df$IDI)
[1] 15.13154
```

```
> cor(df11)
             IRM        LIQ       SIZE        ROA        DEP       INFLA        IDI
IRM    1.00000000  0.7336951  0.8233307  0.2412165 -0.6835545 -0.08200223 -0.3388566
LIQ    0.73369507  1.0000000  0.7642751  0.5691211 -0.9394913 -0.23027541 -0.3110046
SIZE   0.82333071  0.7642751  1.0000000  0.2662001 -0.7760874  0.13470154 -0.6038181
ROA    0.24121650  0.5691211  0.2662001  1.0000000 -0.5811447 -0.50823782  0.1568299
DEP   -0.68355446 -0.9394913 -0.7760874 -0.5811447  1.0000000  0.24453219  0.3641853
INFLA -0.08200223 -0.2302754  0.1347015 -0.5082378  0.2445322  1.00000000 -0.4810544
IDI   -0.33885659 -0.3110046 -0.6038181  0.1568299  0.3641853 -0.48105438  1.0000000
```

```
> skewness(df11$IRM)
[1] 0.6535842
> skewness(df11$LIQ)
[1] -0.6643832
> skewness(df11$SIZE)
[1] 0.6232102
> skewness(df11$ROA)
[1] -1.805508
> skewness(df11$DEP)
[1] 1.007133
> skewness(df11$INFLA)
[1] 1.42348
> skewness(df11$IDI)
[1] -1.710271
```

The variables having positive and significant correlations to liquidity are the marginal rate of interest and bank size. Return on assets also has a positive correlation to liquidity. The deposits to total assets ratio has a high negative correlation to liquidity. Inflation and the industrial production index also have a negative correlation, but not as significant.
The skewness and standard deviation are very large for the return on assets, inflation and the industrial production index, as these variables were still stabilizing in 2016, and there

[1] See the original data and R-codes here: https://drive.google.com/drive/folders/1Cdj9fuxvIED-oZDOevrhSuZ1Urq18867?usp=sharing

were significant changes in these variables following the inception of the russian invasion into Ukraine. These variables also have the largest spread in this regression and other regressions in the study.

2. For the second regression, we will use the same data, but from 2018 to 2022:

```
> df2 <- df11[-c(1:24), ]
> summary(df2)
      IRM             LIQ              SIZE            ROA              DEP             INFLA            IDI        
 Min.   :1.350   Min.   :0.4500   Min.   :14.07   Min.   :-1.930   Min.   :0.000   Min.   : 1.70   Min.   : 48.10  
 1st Qu.:1.560   1st Qu.:0.4875   1st Qu.:14.12   1st Qu.: 1.570   1st Qu.:0.010   1st Qu.: 6.40   1st Qu.: 94.83  
 Median :2.130   Median :0.5350   Median :14.28   Median : 3.025   Median :0.010   Median : 9.35   Median :100.15  
 Mean   :2.082   Mean   :0.5288   Mean   :14.30   Mean   : 2.757   Mean   :0.017   Mean   :10.21   Mean   : 94.33  
 3rd Qu.:2.575   3rd Qu.:0.5700   3rd Qu.:14.46   3rd Qu.: 4.110   3rd Qu.:0.030   3rd Qu.:11.18   3rd Qu.:104.10  
 Max.   :3.120   Max.   :0.6100   Max.   :14.62   Max.   : 6.250   Max.   :0.040   Max.   :26.60   Max.   :113.80  
> View(df2)
> cor(df2)
             IRM         LIQ       SIZE         ROA         DEP       INFLA        IDI
IRM    1.00000000  0.81032467  0.7835268 -0.14759153 -0.74068571  0.04626667 -0.3104421
LIQ    0.81032467  1.00000000  0.7882102 -0.04720503 -0.81802928  0.10722178 -0.3755402
SIZE   0.78352675  0.78821016  1.0000000 -0.25740432 -0.90139590  0.49183388 -0.6452526
ROA   -0.14759153 -0.04720503 -0.2574043  1.00000000  0.08675447 -0.70036638  0.5103493
DEP   -0.74068571 -0.81802928 -0.9013959  0.08675447  1.00000000 -0.27527787  0.6012380
INFLA  0.04626667  0.10722178  0.4918339 -0.70036638 -0.27527787  1.00000000 -0.7127602
IDI   -0.31044214 -0.37554021 -0.6452526  0.51034935  0.60123803 -0.71276018  1.0000000
> sd(df2$IRM)
[1] 0.5568093
> sd(df2$LIQ)
[1] 0.04318238
> sd(df2$SIZE)
[1] 0.1831103
> sd(df2$ROA)
[1] 1.724772
> sd(df2$DEP)
[1] 0.01252793
> sd(df2$INFLA)
[1] 6.434328
> sd(df2$IDI)
[1] 17.16231
> skewness(df2$IRM)
[1] 0.152949
> skewness(df2$LIQ)
[1] 0.05219206
> skewness(df2$SIZE)
[1] 0.1771799
> skewness(df2$ROA)
[1] -0.528245
> skewness(df2$DEP)
[1] 0.4150034
> skewness(df2$INFLA)
[1] 1.059096
> skewness(df2$IDI)
[1] -1.396797
```

The variables having positive and significant correlations to liquidity are the marginal rate of interest and bank size. Here, the return on assets and the inflation have an insignificant correlation to liquidity. The deposits to total assets ratio has a high negative correlation to liquidity. The industrial production index also have a negative correlation, but it is not as significant.

The skewness and standard deviation remain very large for the return on assets, inflation and the industrial production index, as these variables changed drastically following the shock which the Ukrainian economy and therefore, the Ukrainian financial and banking system received following the inception of the russian invasion into Ukraine.

3. For the third regression, we will use data from 2018 to 2022, CAR included:

```
> df3 <- df[-c(1:24), ]
> View(df3)
> df31<- subset(df3, select = -c(`Year..as.of.the.first.day.of.the.respective.month.`))
> summary(df31)
      IRM             LIQ              SIZE            ROA              DEP             INFLA            IDI        
 Min.   :1.350   Min.   :0.4500   Min.   :14.07   Min.   :-1.930   Min.   :0.000   Min.   : 1.70   Min.   : 48.10  
 1st Qu.:1.560   1st Qu.:0.4875   1st Qu.:14.12   1st Qu.: 1.570   1st Qu.:0.010   1st Qu.: 6.40   1st Qu.: 94.83  
 Median :2.130   Median :0.5350   Median :14.28   Median : 3.025   Median :0.010   Median : 9.35   Median :100.15  
 Mean   :2.082   Mean   :0.5288   Mean   :14.30   Mean   : 2.757   Mean   :0.017   Mean   :10.21   Mean   : 94.33  
 3rd Qu.:2.575   3rd Qu.:0.5700   3rd Qu.:14.46   3rd Qu.: 4.110   3rd Qu.:0.030   3rd Qu.:11.18   3rd Qu.:104.10  
 Max.   :3.120   Max.   :0.6100   Max.   :14.62   Max.   : 6.250   Max.   :0.040   Max.   :26.60   Max.   :113.80  
      CAR       
 Min.   :8.600  
 1st Qu.:9.000  
 Median :9.200  
 Mean   :9.155  
 3rd Qu.:9.300  
 Max.   :9.600  
> View(df31)
> cor(df31)
             IRM         LIQ       SIZE         ROA         DEP       INFLA         IDI         CAR
IRM    1.00000000  0.81032467  0.7835268 -0.14759153 -0.74068571  0.04626667 -0.31044214 -0.10300531
LIQ    0.81032467  1.00000000  0.7882102 -0.04720503 -0.81802928  0.10722178 -0.37554021 -0.14104208
SIZE   0.78352675  0.78821016  1.0000000 -0.25740432 -0.90139590  0.49183388 -0.64525263 -0.22450953
ROA   -0.14759153 -0.04720503 -0.2574043  1.00000000  0.08675447 -0.70036638  0.51034935 -0.04137782
DEP   -0.74068571 -0.81802928 -0.9013959  0.08675447  1.00000000 -0.27527787  0.60123803  0.05474887
INFLA  0.04626667  0.10722178  0.4918339 -0.70036638 -0.27527787  1.00000000 -0.71276018 -0.10232115
IDI   -0.31044214 -0.37554021 -0.6452526  0.51034935  0.60123803 -0.71276018  1.00000000 -0.02979662
CAR   -0.10300531 -0.14104208 -0.2245095 -0.04137782  0.05474887 -0.10232115 -0.02979662  1.00000000
> sd(df31$IRM)
[1] 0.5568093
> sd(df31$LIQ)
[1] 0.04318238
> sd(df31$SIZE)
[1] 0.1831103
> sd(df31$ROA)
[1] 1.724772
> sd(df31$DEP)
[1] 0.01252793
> sd(df31$INFLA)
[1] 6.434328
> sd(df31$IDI)
[1] 17.16231
> sd(df31$CAR)
[1] 0.1952183
> skewness(df31$IRM)
[1] 0.152949
> skewness(df31$LIQ)
[1] 0.05219206
> skewness(df31$SIZE)
[1] 0.1771799
> skewness(df31$ROA)
[1] -0.528245
> skewness(df31$DEP)
[1] 0.4150034
> skewness(df31$INFLA)
[1] 1.059096
> skewness(df31$IDI)
[1] -1.396797
> skewness(df31$CAR)
[1] -0.3494381
```

The variables having positive and significant correlations to liquidity are the marginal rate of interest and bank size. Inflation and the capital adequacy ratio have an insignificant correlation to liquidity. The deposits to total assets ratio has a large negative correlation to liquidity. The industrial production index also has a negative correlation, but it is not as significant.
The skewness and standard deviation remain are still very large for the return on assets, inflation and the industrial production index.

We can draw the conclusion that the marginal rate of interest and the bank size are the most closely correlated to liquidity. The variable having the most significant negative correlation with liquidity is the deposits to total assets ratio. The skewness and standard deviation are adequate for the carrying out of the research. The fact that inflation and the Industrial Production Index have such significant skewness and standard deviation is because there have been significant changes in these variables due to the economic crises in Ukraine that occurred in 2014 and in 2022 with the start of the full-scale russian invasion into Ukraine.

CHAPTER 5. RESULTS

5.1. The results for the first regression are displayed below. We have not included the capital adequacy ratio, as the ratio data was absent for 2016 and 2017.

```
> model1 <- lm(LIQ ~ IRM + SIZE + ROA + DEP + INFLA + IDI, data = df11)
> summary(model1)

Call:
lm(formula = LIQ ~ IRM + SIZE + ROA + DEP + INFLA + IDI, data = df11)

Residuals:
      Min        1Q    Median        3Q       Max
-0.053883 -0.016415  0.004084  0.015121  0.055083

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.7132387  0.5742540   1.242  0.21800
IRM          0.0321603  0.0104161   3.088  0.00281 **
SIZE        -0.0170253  0.0404681  -0.421  0.67514
ROA          0.0022684  0.0015238   1.489  0.14066
DEP         -2.6560724  0.2530165 -10.498  < 2e-16 ***
INFLA        0.0005728  0.0005845   0.980  0.33017
IDI          0.0002262  0.0002903   0.779  0.43822
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.02553 on 77 degrees of freedom
Multiple R-squared:  0.9041,    Adjusted R-squared:  0.8967
F-statistic:   121 on 6 and 77 DF,  p-value: < 2.2e-16
```

The statistically significant variables are the marginal rate of interest with a high positive t-value and the deposits to total assets ratio with a significant negative t-value. The return on assets, inflation and the industrial production index have an insignificant t-value, so they do not have large statistical significance. The R-squareds imply that the model is fit for the explanation of the dependent variable by the independent variables.

5.2. The results of the second regression are as follows:

```
> model2 <- lm(LIQ ~ IRM + SIZE + ROA + DEP + INFLA + IDI, data = df2)
> summary(model2)

Call:
lm(formula = LIQ ~ IRM + SIZE + ROA + DEP + INFLA + IDI, data = df2)

Residuals:
      Min        1Q    Median        3Q       Max
-0.046469 -0.014326  0.005217  0.011963  0.059184

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.0713181  0.9556553  -0.075   0.9408
IRM          0.0289476  0.0134806   2.147   0.0364 *
SIZE         0.0385563  0.0687897   0.560   0.5775
ROA          0.0003747  0.0029472   0.127   0.8993
DEP         -1.5666475  0.6731046  -2.327   0.0238 *
INFLA       -0.0003499  0.0012583  -0.278   0.7820
IDI          0.0001870  0.0003069   0.609   0.5450
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.0219 on 53 degrees of freedom
Multiple R-squared:  0.7689,    Adjusted R-squared:  0.7428
F-statistic:  29.4 on 6 and 53 DF,  p-value: 3.262e-15
```

The marginal rate of interest and the deposits to total assets ratio remain the most statistically significant variables, with the marginal rate of interest with a significant positive t-value and the deposits to total assets ratio with a significant negative t-value. The t-values of the bank size, return on assets, inflation and the industrial production index are insignificant.

We see that the R-squareds become lower in this model than in the first linear regression model.

5.3. The results of the third regression are as follows:

```
> model3 <- lm(LIQ ~ IRM + SIZE + ROA + DEP + INFLA + IDI + CAR, data = df31)
> summary(model3)

Call:
lm(formula = LIQ ~ IRM + SIZE + ROA + DEP + INFLA + IDI + CAR,
    data = df31)

Residuals:
      Min        1Q    Median        3Q       Max
-0.047289 -0.015089  0.005155  0.011988  0.053599

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.4189578  1.1518425   0.364   0.7175
IRM          0.0313571  0.0138908   2.257   0.0282 *
SIZE         0.0127126  0.0767979   0.166   0.8692
ROA          0.0003839  0.0029586   0.130   0.8973
DEP         -1.7717657  0.7264422  -2.439   0.0182 *
INFLA       -0.0002026  0.0012776  -0.159   0.8746
IDI          0.0001577  0.0003104   0.508   0.6135
CAR         -0.0132136  0.0171807  -0.769   0.4453
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.02199 on 52 degrees of freedom
Multiple R-squared:  0.7715,    Adjusted R-squared:  0.7408
F-statistic: 25.09 on 7 and 52 DF,  p-value: 1.4e-14
```

The marginal rate of interest and the deposits to total assets ratio remain the most statistically significant variables, with the marginal rate of interest with a significant positive t-value and the deposits to total assets ratio with a significant negative t-value. The t-values of the bank size, return on assets, inflation and the industrial production index are insignificant.

We see that the R-squareds become lower in this model than in the first linear regression model and are at almost the same rate as in the previous model.

We have done the third regression model as a robustness check for the second model. We have noticed that the variables included in both models have similar levels of statistical significance.

After adding the capital adequacy ratio, the model showed that this variable has a negative t-value, but with rather significant statistical significance.

CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS

We have noticed that the most statistically significant variables when regressed in a model with liquidity as its dependent variable are: the marginal rate of interest and the deposits to total assets ratio. The sign of the marginal rate of interest is strictly positive, whilst it is strictly negative for the deposits to total assets ratio.

Let us now return to the expected signs of the variables in the methodology:

Table 2. Summary of the signs of variables in the literature and in our analysis

Independent variable	**Expected sign**	**Sign in the linear regression**
Bank-related variables		
Profitability (return on assets)	Positive / negative	Positive (insignificant in models 2 and 3)
Bank size	Negative	Negative in model 1, positive in models 2 and 3 (insignificant in all of the models)
Deposits	Positive	Negative
Capital adequacy ratio	Positive	Negative (insignificant)
Macroeconomic variables		
Inflation	Positive / negative	Positive in models 1 and 3, negative in model 2 (insignificant in all of the models)

Marginal rate of interest	Negative	Positive
Industrial production index	Positive / negative	Positive and insignificant

Some of the variables have had the same signs in our study as in the literature and some did not. Whilst searching for data for the study, we noticed that we had issues finding variable data for a period of many years, especially for years earlier than 2016, which led us to using monthly data for the variables considered.

Another aspect which might be a drawback to our study is that the macroeconomic variables considered in the literature did not have monthly data on them. In some cases, we had to search data for similar indexes or measures, like the Industrial Production Index for GDP growth / GDP per capita, which were mostly found in the literature. For example, in the studies by Mazreku et al. and Singh et Sharma, which served us as the closest analogies to our analysis on the factors influencing the liquidity of the Ukrainian banking system.

The reasons for these issues could be the fact that Ukraine has only been received its independence a little over 30 years ago, in 1991. Obtaining independence from the Soviet Union did not lead Ukraine to becoming a market economy straightaway. Instead, Ukraine had to conduct reforms to make the transition from a command economy to a market economy.

However, this study could serve as an insight into what influences the liquidity of the Ukrainian banking system and to what degree these factors influence it.

When conducting similar studies on the banking systems of other countries, it might be a lot easier to do if the country exists for a significantly longer time than 30 or 40 years. This means that with time similar researches on Ukraine will have more scientific value. Probably the variables we used in our research could even be of the same signs as determined in the literature if data was more easily available.

Another conclusion from this study is that for the time being there might be other economic factors and aspects that could be examined scientifically to determine or at least provide an insight into the health of the Ukrainian financial system.

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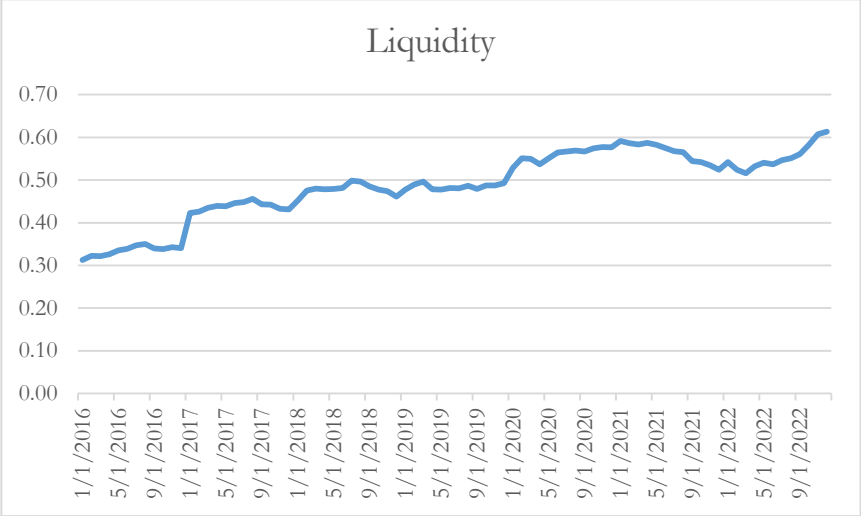
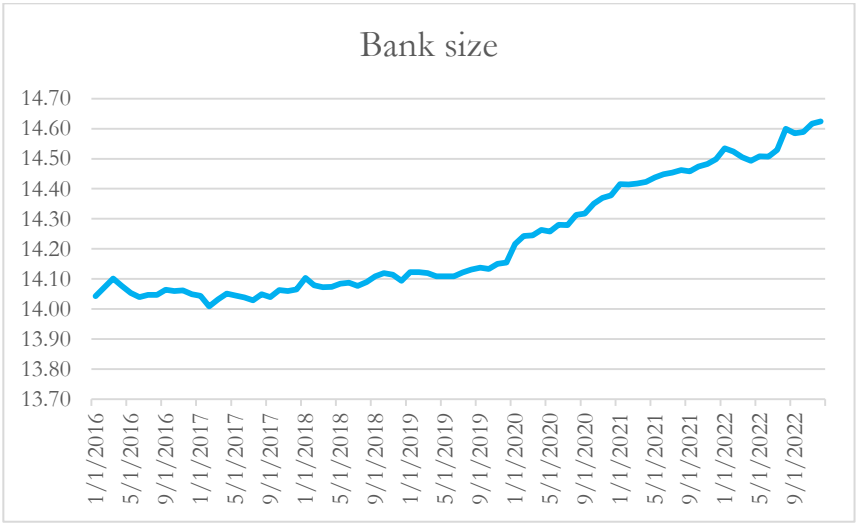
APPENDIX

APPENDIX A
DYNAMICS OF LIQUIDITY IN 2016-2022

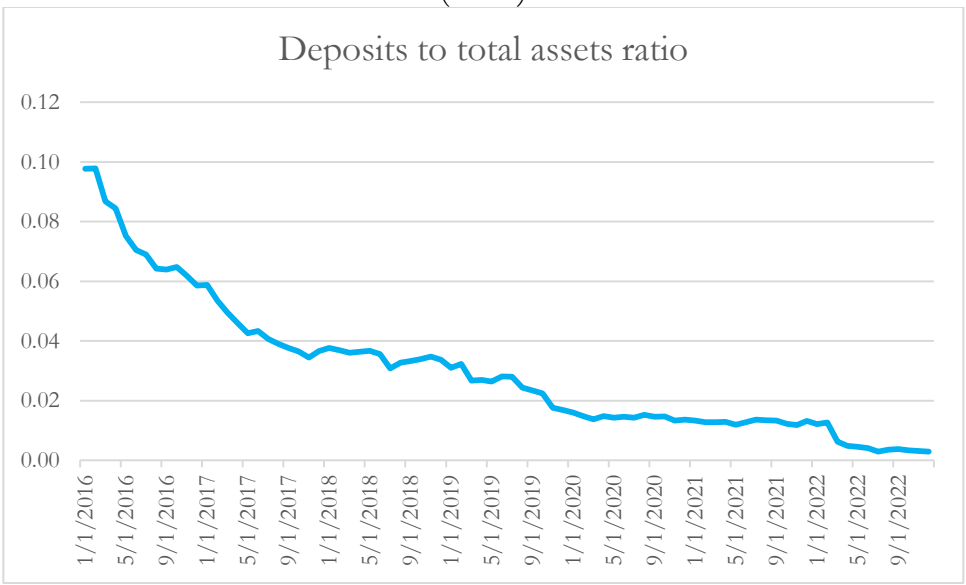


APPENDIX B
DYNAMICS OF BANK SIZE IN 2016-2022

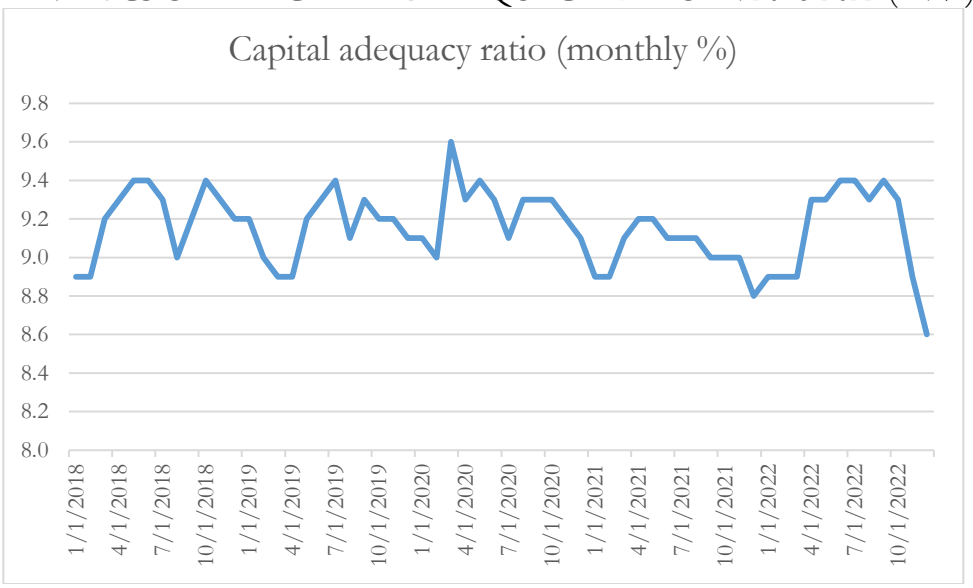


APPENDIX C
DYNAMICS OF THE RETURN ON ASSETS IN 2016-2022 (IN %)

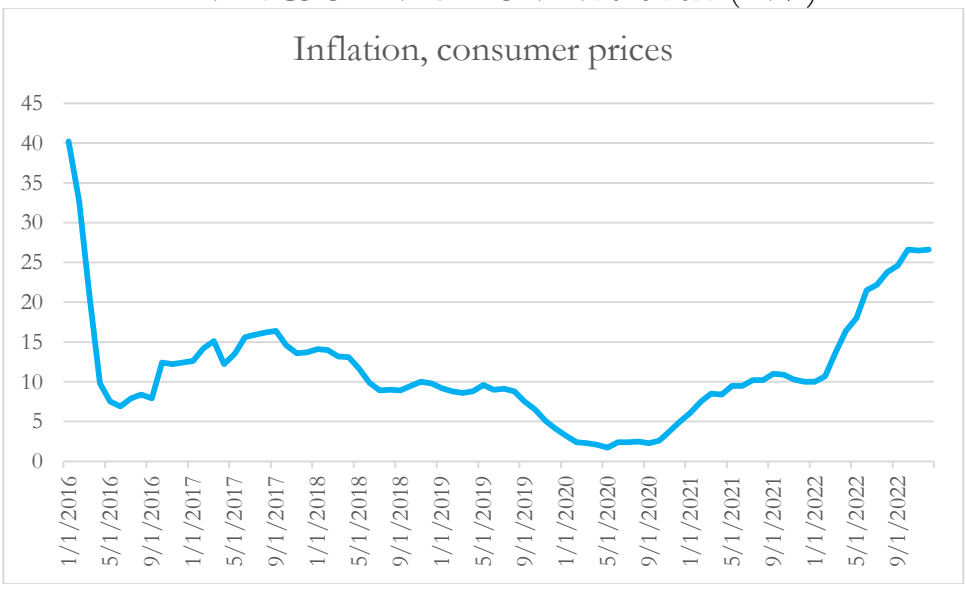
APPENDIX D
DYNAMICS OF THE DEPOSITS TO TOTAL ASSETS RATIO IN 2016-2022 (IN %)



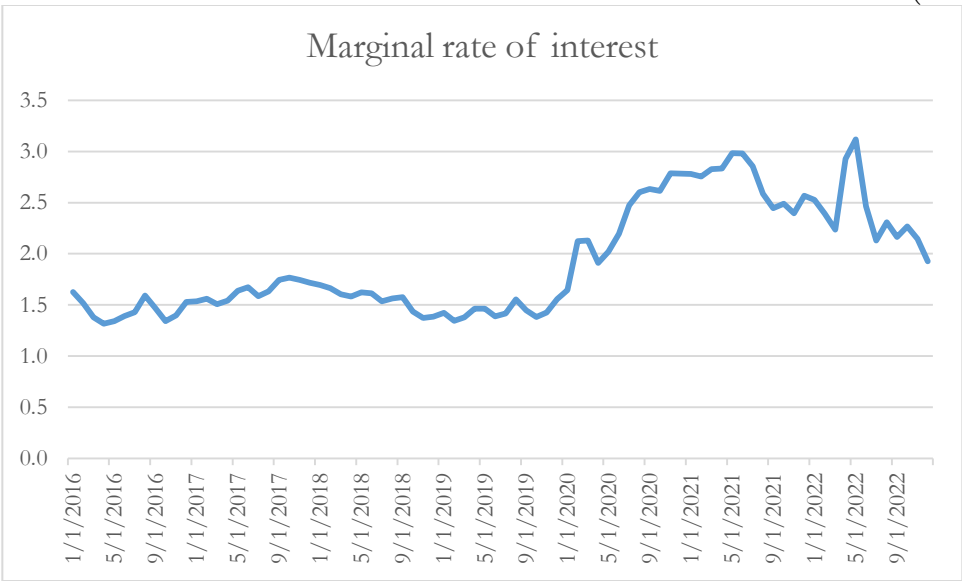
APPENDIX E
DYNAMICS OF THE CAPITAL ADEQUACY RATIO IN 2016-2022 (IN %)



APPENDIX F
DYNAMICS OF INFLATION IN 2016-2022 (IN %)



APPENDIX G
DYNAMICS OF THE MARGINAL RATE OF INTEREST IN 2016-2022 (IN %)



APPENDIX H
DYNAMICS OF THE INDUSTRIAL PRODUCTION INDEX, 2016-2022