# Evaluating The Significance of Uncertainty on Bank Liquidity: A Case Study of Ukrainian Banks in Russian Military Aggression

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**Abstract**. *The article provides an overview of the scientific discussion on the impact of uncertainty on the liquidity of Ukrainian banks in a war. The study's primary purpose is to analyze the existing literature, systematize various approaches and study the impact of uncertainty on the bank's liquidity. This study examines the arguments and counterarguments associated with this issue through a comprehensive review of scientific sources, considering geopolitical risks, economic fluctuations, and regulatory changes. The relevance of solving this scientific problem lies in understanding the problems that Ukrainian banks face when managing liquidity in a war. The study of the topic follows a logical sequence, starting with the systematization of literary sources and approaches to solving the problem. The research methodology includes an empirical analysis using relevant data and statistical methods to analyze the relationship between uncertainty indicators and the bank's liquidity. The object of the study is Ukrainian banks operating in war conditions, as they face unique challenges in connection with the full-scale military aggression of the Russian Federation. The paper presents an empirical analysis that reveals a robust negative relationship between uncertainty indicators and liquidity ratios set by the National Bank of Ukraine (NBU). This conclusion highlights the negative impact of uncertainty on banks' liquidity, as evidenced by the decrease in liquidity below the established NBU standards. The study empirically confirms and theoretically proves that increased uncertainty negatively affects the liquidity of Ukrainian banks. The results can be helpful to bank authorities, regulators, and policy makers in developing effective liquidity risk management strategies and formulating appropriate policies to mitigate the adverse effects of uncertainty on banks' liquidity. In conclusion, this study contributes to understanding uncertainty's impact on Ukrainian banks' liquidity under wartime conditions. The empirical analysis provides insight into the challenges faced by banks and offers insights for improving liquidity risk management practices in the banking sector.*

## Introduction

The banking system plays a crucial role in the stability and functioning of the economy. One of the critical aspects that determines the stability of banks is their liquidity. An adequate level of liquidity ensures that banks can meet their obligations and meet the demand for loans even in difficult times. However, the

uncertainty surrounding banks' operations can significantly impact their liquidity position.

In the context of Ukrainian banks, the situation is complicated by the full-scale military aggression of the Russian Federation. This aggression has introduced many threats and uncertainties, posing significant challenges to the financial system's stability. Implementing many threats, including geopolitical tensions, territorial losses, and destruction of the economy, has created an environment of heightened uncertainty for Ukrainian banks. As a result, bank management entities must understand and consider the impact of uncertainty on the bank's liquidity to ensure its management mechanism's effectiveness.

**Literature Review.** We discovered that the scientific work in this field needs to be improved; the research activities started not so long ago.

Baum, Caglayan and Xu (2021) investigated the impact of uncertainty on critical aspects of the financial sector. The authors determined that inflation uncertainty reduces the availability of private-sector loans; reduces bank efficiency and sector stability as liquidity, bank risk appetite, and credit risk increase. The findings provide evidence that uncertainty creates a significant level of threats to the stability of the financial sector (Baum, Caglayan and Xu, 2021). Anis and Hamdi (2022) analyzed the impact of economic uncertainty on the liquidity risk of Islamic banks in Indonesia by observing the impact of economic uncertainty (global uncertainty index), macroeconomic factors (GDP growth and inflation rate), and bank-specific factors (CAR, ROA). The study applies autoregressive distributed lag (ARDL) and error correction term (ECT) to determine the long-run impact and short-run response to economic uncertainty, inflation rate, GDP growth, ROA, and CAR on Islamic bank liquidity risk (Anis and Hamdi, 2022). The study shows that economic uncertainty positively and significantly affects liquidity risk in the short and long term. An increase in the uncertainty index caused by a crisis, war, or pandemic will increase the liquidity risk of Islamic banking. At the same time, the inflation rate significantly negatively impacts liquidity risk in the short and long term. Berger et al. (2022) hypothesizes that a higher level of economic policy uncertainty (EPU) forces banks to take a more cautious approach, increasing the accumulation of liquidity through assets, liabilities, and off-balance sheet activities. The rationale for this hypothesis is that banks face significant risks and potential disruptions in financial markets during periods of high uncertainty. To mitigate these risks, banks can hold more liquid assets, such as cash or short-term securities, which can protect against unexpected shocks. Regression analyses show that higher *EPU* results in statistically and economically significant increases in total bank liquidity hoarding, as well as increases in the asset-, liability- and off-balance sheet-side components (Berger et al., 2022). Dang and Nguyen (2021) and Dang (2022) explores the relationship between uncertainty at the micro level, such as income fluctuations and volatility, affects the ability of banks to create liquidity. The hypothesis put forth in the article is that banks with a more diversified income structure are better equipped to handle micro-level uncertainty and are more effective in creating liquidity. This hypothesis is based on the idea that a diverse income structure can provide banks with a stable and resilient revenue base, supporting their liquidity creation activities despite income volatility. As a result of the study, the author determined that banks are less aggressive in expanding liquidity creation under conditions of more significant uncertainty; the impact of uncertainty on the creation of bank liquidity is negative (Dang, 2022). Analysis of bank heterogeneity indicates that the effect of uncertainty on liquidity accumulation is significantly more substantial for weaker banks, that is, smaller, less capitalized, and riskier banks (Dang and Nguyen, 2021).

In the Ukrainian scientific space, the issue of the impact of uncertainty on the parameters of bank functioning in general and liquidity, in particular, needs to be more present. At the same time, understanding the relationship between uncertainty and bank liquidity is essential for bank management and regulators to manage and mitigate liquidity risks effectively. By analyzing the impact of uncertainty on bank liquidity, this research aims to provide an understanding of the specific challenges faced by Ukrainian banks operating under the conditions of the realization of a significant number of threats due to the full-scale military aggression of the Russian Federation.

**Methodology and research methods**

The paper studies the development patterns of the uncertainty and liquidity theory, implemented based on a systematic combination of trend, bibliometric and comparative analysis. The Google Trends toolkit was used to study the trends in the theory of uncertainty and liquidity. This analysis made it possible to track changes in the popularity of these topics over a time. Using Google Trends data, interest in key terms related to uncertainty and liquidity was measured and analyzed, which helped to determine the general trend and dynamics of these concepts in the public. Bibliometric and comparative analysis was carried out using Google Books Ngram Viewer, which made it possible to estimate the frequency of use and distribution of the terms "uncertainty" and "liquidity" in the literature over a certain period. The analysis of bibliometric data made it possible to identify changes in using these terms in the scientific literature, reflecting their evolution and distribution. The systematic combination of trend, bibliometric, and comparative analysis provided a deeper understanding of the development of the theory of uncertainty and liquidity, complementing the empirical basis of the study and providing a broader context for considering the impact of uncertainty on banks' liquidity.

Empirical analysis will also be conducted in the study. The first stage involves the formation of a system of uncertainty factors. Each factor will be quantified using its respective textual indices, such as Geopolitical Risk Index, Economic Policy Uncertainty Index, World Uncertainty Index. In the second stage, the relationship between uncertainty and bank liquidity will be analyzed based on the liquidity ratios established by the NBU.

The statistical database of indicators is formed from monthly data from 01.04.2021 to 01.01.2023, according to the criterion of its availability. Calculations were made after statistical data processing (normalization, autocorrelation testing, heteroskedasticity). Regression analysis will quantify the relationship between uncertainties and bank liquidity. The statistical significance of the equations was checked using the coefficient of determination and Fisher's test, approximation error.

The results will make it possible to draw definitive conclusions about the impact of uncertainty on the banking liquidity of Ukrainian banks operating in the face of the implementation of a significant number of threats due to the full-scale military aggression of the Russian Federation. These findings will contribute to the existing body of knowledge and will inform bank authorities, regulators, and liquidity risk management policies during times of heightened uncertainty.

## Results

A bank's liquidity determines its ability to fulfill its obligations and provide loans to solvent customers. Liquidity deficits at the level of an individual bank can lead to a bank's inability to meet its obligations, trigger a crisis of confidence, bank runs, and systemic risks.

The importance of bank liquidity is emphasized by its role in maintaining the financial system's stability and ensuring economic growth. Banks with sufficient liquidity can better withstand unexpected shocks, such as changes in market conditions, economic downturns, or sudden withdrawals by depositors. In addition, liquidity management is a critical component of effective risk management in banks. Uncertainty is the need for predictability and unknowns surrounding future events and outcomes. In banking, it can arise from various economic, political, regulatory, and technological factors. Uncertainty can disrupt normal business operations, create instability in financial markets and affect the stability of banks.

The relationship between uncertainty and bank liquidity is complex and interrelated, as uncertainty can directly affect the state of bank liquidity, influencing the behavior of bank clients, counterparty banks and correspondents, and other counterparties. Uncertainty can affect banks' funding sources, as depositors and investors may become risk-averse and withdraw funds, leading to the threat of liquidity loss. Uncertainty can also affect the quality of a bank's assets, as economic downturns or social risks can lead to loan defaults and lower collateral values. In addition, uncertainty may prompt banks to activate more conservative liquidity risk management strategies, such as holding higher liquid assets or reducing reliance on short-term funding. These actions may contribute to the increase of liquidity buffers, but may also have consequences for the profitability of banks and the general functioning of financial markets.

We will explore the interest in these concepts through dynamic analysis. It involves constructing Google Trends using Google's public web application. Its main advantage is that the obtained results make it possible

to form a scientifically based opinion about the current dynamic situation in society in the field of the studied issues. User queries for terms such as:

➢»Liquidity» for all categories, which will allow assessing the level of public interest in the problem of liquidity as such;

➢ «Liquidity» for the «Finance» category, which will contribute to the identification of trends of interest in the liquidity of banking institutions;

➢ «Uncertainty» taking into account all categories to assess the level of interest in this concept;

➢ «Uncertainty» for the «Finance» category, which will allow identifying trends that occur in the financial systems of the country and are carried out with the help of computer technologies.

Figure 1 shows the results of the query analysis of Internet users since 2004 who are interested in liquidity problems in various fields, particularly the financial field.
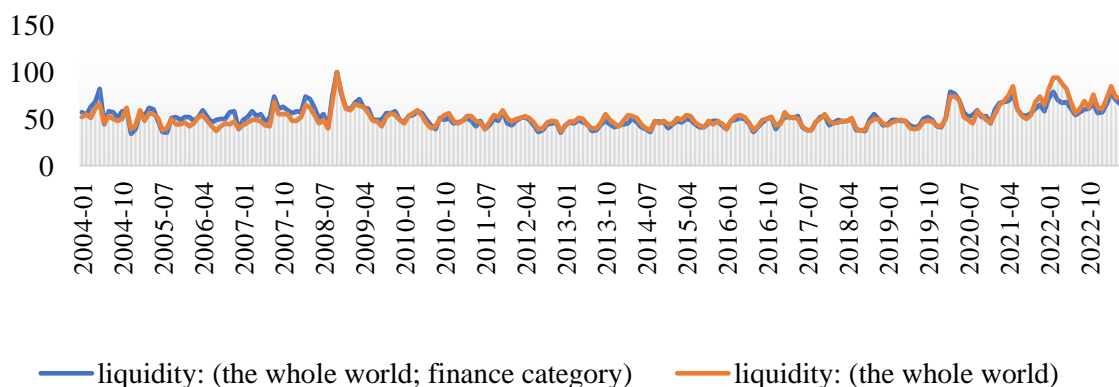


**Figure 1. Dynamic analysis of user requests regarding "Liquidity" for the period 01.01.2004 - 01.05.2023**

Source: Compiled by the authors.

The presented data confirm the constant interest in this topic. At the same time, large surges of requests are observed in crisis periods, or those periods when, according to network users, certain adverse events are taking place, which may affect liquidity in general and in the financial sphere in particular.

The results of the dynamic analysis of user queries regarding the term "Uncertainty" are presented in Figure 2.
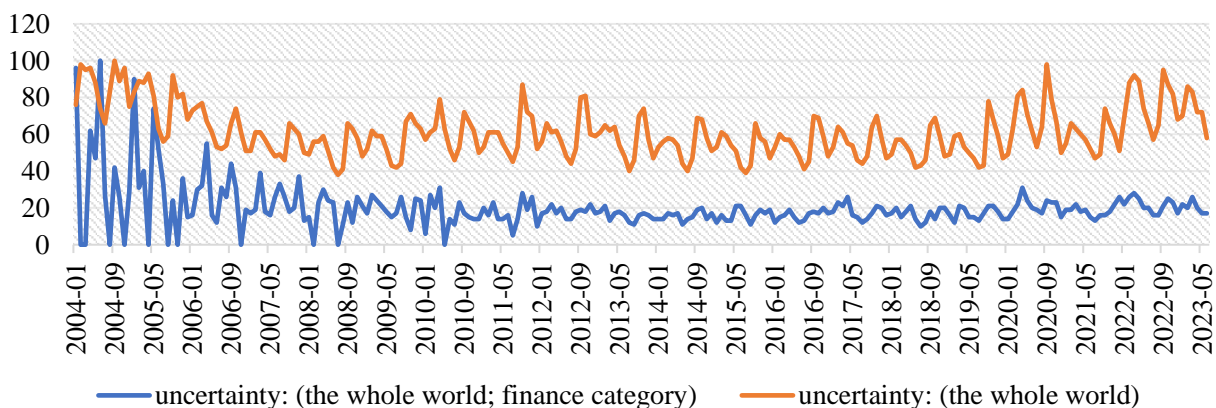


**Figure 2. Dynamic analysis of user requests regarding "Uncertainty" for the period 01.01.2004 - 01.05.2023**

Source: Compiled by the authors.

The data presented in Figure 2 confirm the significant interest in such a concept as "Uncertainty" without significant periodic emissions. At the same time, interest is higher in all categories, unlike requests in the "Finance" category.

So, based on the obtained results, we can confirm the presence of constant user interest in such categories as "Liquidity" and "Uncertainty".

A comparative analysis was carried out using the Google Books Ngram Viewer, which characterizes the frequency of mentions (not in absolute, but in relative terms – as a ratio to the maximum number of mentions per period) of the corresponding terms in English-language books for a certain period. The results of the analysis of the popularity of such concepts as «Liquidity» and «Uncertainty», were published in English-language books around the world from 2004-2019 (similar to the analysis period using Google Trends) are presented in Figure 3.
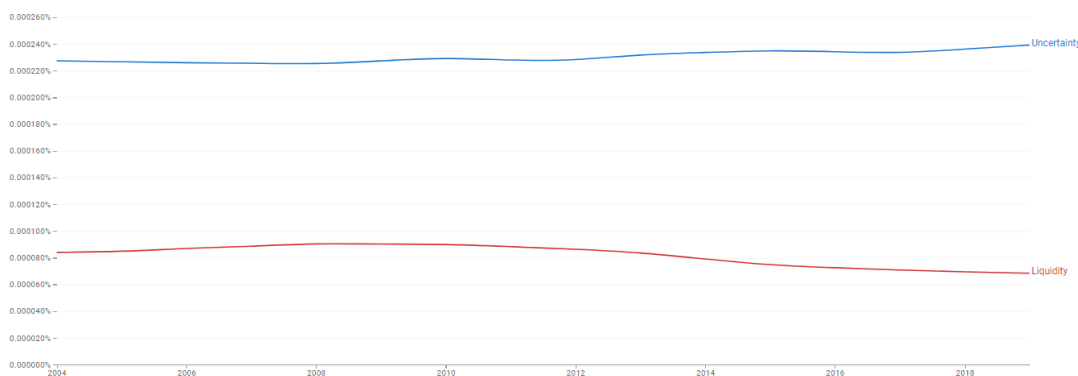


**Figure 3. The analysis results of the frequency of understanding "Liquidity" and "Uncertainty", published in English books around the world for 2004-2019**

Source: Compiled by the authors.

The data indicate the presence of a reasonably stable interest in the research topic. At the same time, it is evident that the concept of "uncertainty" is almost three times more popular than the concept of «liquidity», since it is associated with many subject areas. This confirms the expediency of focusing attention in the framework of this study on the first category, that is, the need to consider this factor when forming a mechanism for ensuring bank liquidity.

Summarizing the results of the research, we identified the following requirements for indicators that should be included in the model of the impact of uncertainty on bank liquidity:

➢ economic plausibility – the indicator and its dynamics according to their economic content should correspond to the processes they describe; that is, they should characterize the level of uncertainty and the most critical parameters of banks' liquidity;

➢ availability of information – availability of statistical data on selected indicators both from the standpoint of data volumes and from the point of view of their availability;

➢ periodicity of information – data on indicators must be updated on a permanent and systematic basis with an update period of no more than one month;

➢ volatility - the indicators should have a significant potential for dynamic changes since it is these changes that will act as signals regarding the possible onset of a liquidity crisis;

➢ unambiguity – stationary and dynamic values of the indicator must be unambiguously interpreted from the point of view of use to model the impact of uncertainty on banks' liquidity;

➢ completeness of coverage – the selected indicators should comprehensively characterize the parameters of the model;

➢ sufficiency – the number of indicators should be sufficient to form qualitative assessments and, simultaneously, minimal to avoid unnecessary model complications.

An essential element of the model developed by us is the definition of indicators that will act as indicators of the level of uncertainty. To form a system of indicators, we consider it expedient to use the system of factors that determine uncertainty, shown in Figure 4.
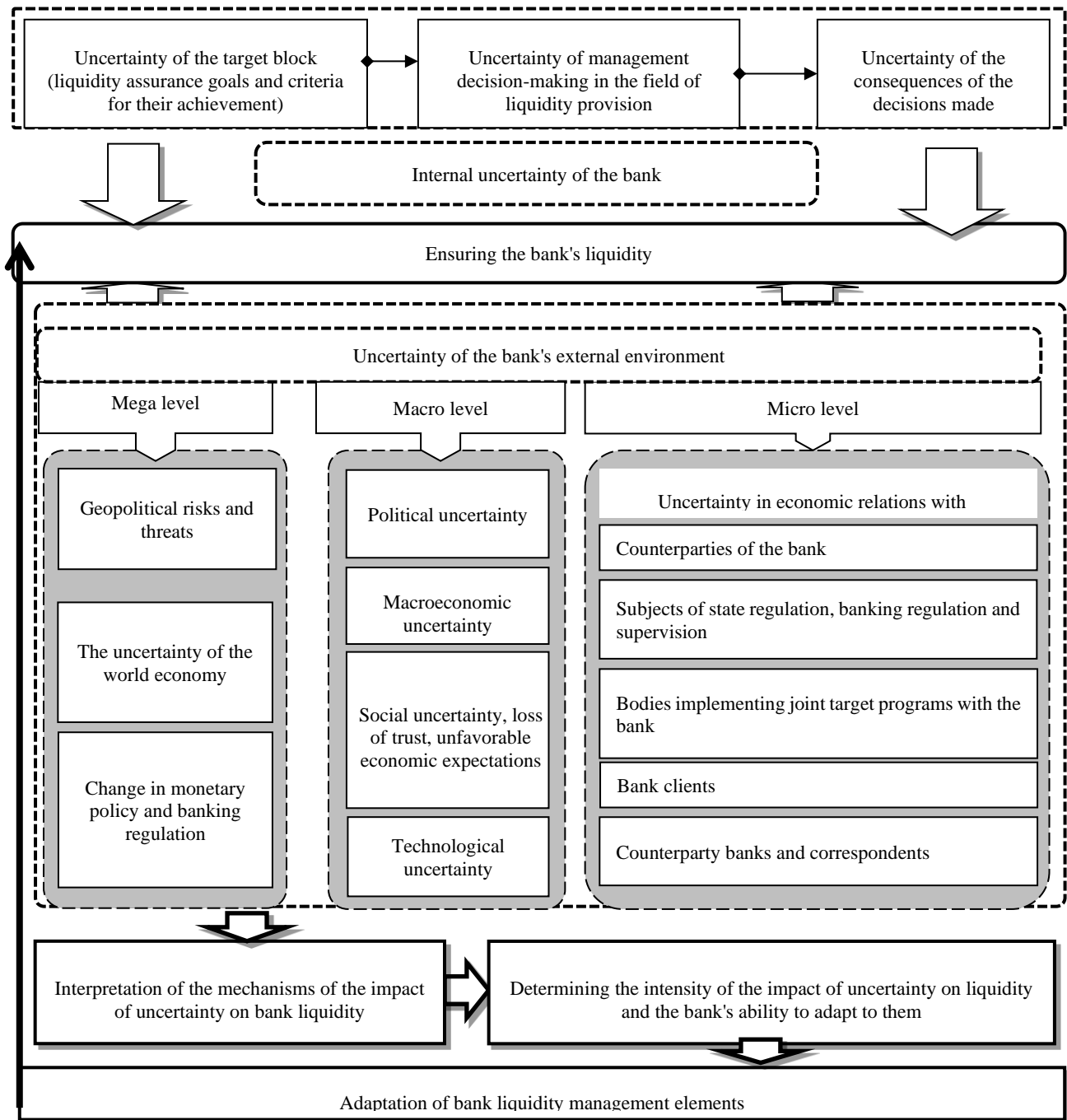
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│ ┌──────────────────────────┐   ┌──────────────────────┐   ┌────────────────────┐ │
│ │ Uncertainty of the target │◆→│ Uncertainty of        │◆→│ Uncertainty of the  │ │
│ │ block (liquidity          │   │ management            │   │ consequences of the │ │
│ │ assurance goals and       │   │ decision-making in    │   │ decisions made      │ │
│ │ criteria for their        │   │ the field of          │   │                     │ │
│ │ achievement)              │   │ liquidity provision   │   │                     │ │
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         ┌───────────────────────────────────────────────────┐
         │        Internal uncertainty of the bank           │
         └───────────────────────────────────────────────────┘
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Ensuring the bank's liquidity

Uncertainty of the bank's external environment

| Mega level | Macro level | Micro level |
| --- | --- | --- |

**Mega level**
- Geopolitical risks and threats
- The uncertainty of the world economy
- Change in monetary policy and banking regulation

**Macro level**
- Political uncertainty
- Macroeconomic uncertainty
- Social uncertainty, loss of trust, unfavorable economic expectations
- Technological uncertainty

**Micro level**
Uncertainty in economic relations with
- Counterparties of the bank
- Subjects of state regulation, banking regulation and supervision
- Bodies implementing joint target programs with the bank
- Bank clients
- Counterparty banks and correspondents

Interpretation of the mechanisms of the impact of uncertainty on bank liquidity → Determining the intensity of the impact of uncertainty on liquidity and the bank's ability to adapt to them

Adaptation of bank liquidity management elements

**Figure 4. Factors determining the level of uncertainty in the context of the impact on banks' liquidity**

Sources: developed by the author based on (Gushlo, 2021).

Considering the formed system of factors and requirements for the system of indicators, we chose text indicators of uncertainty, the dynamics of which are presented in Figure 5: global geopolitical uncertainty index (GPR), the geopolitical uncertainty index of Ukraine (GPR_UKR), the global economic policy uncertainty index (GEPU), the world uncertainty index (WUI) and the uncertainty index in Ukraine (WUI_UKR).
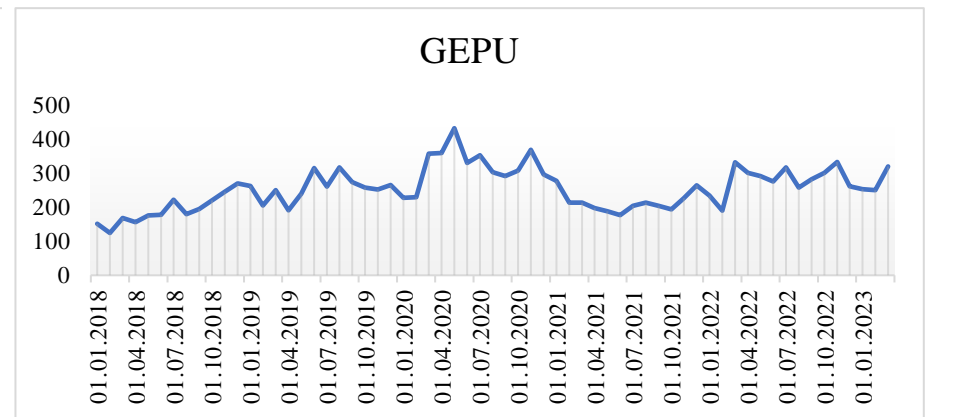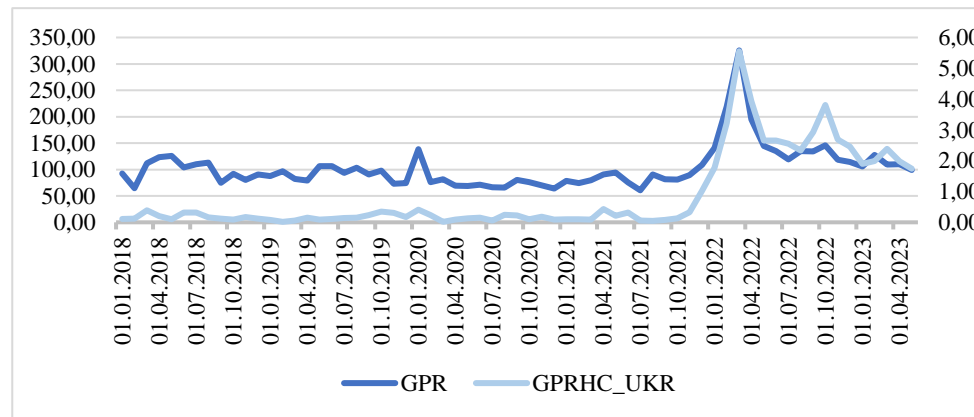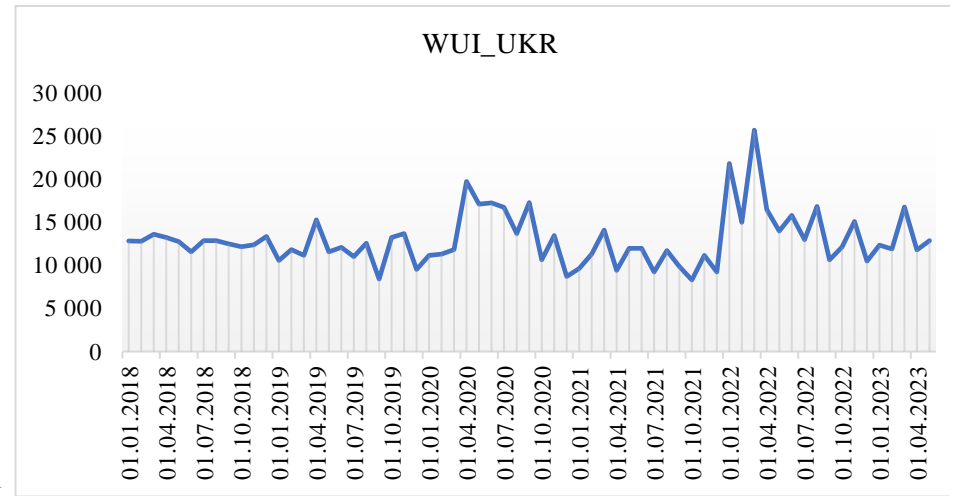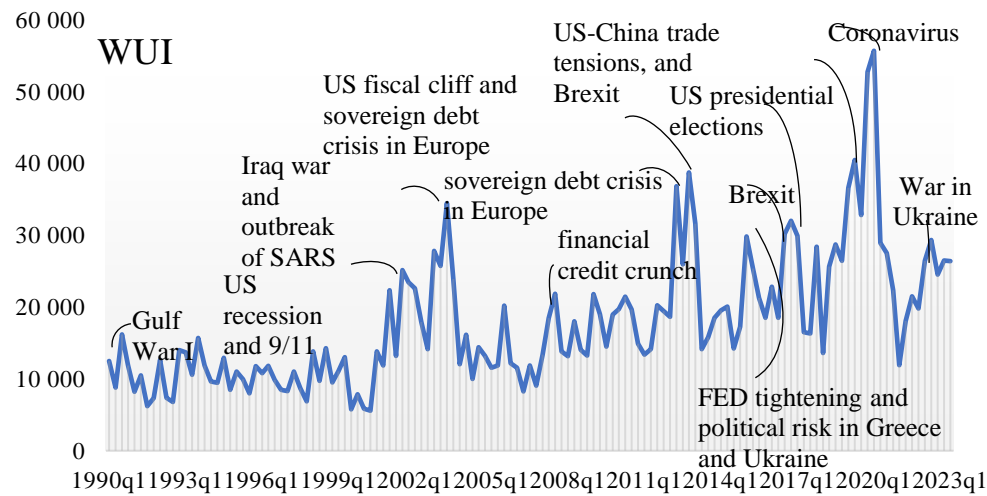
**Figure 5. Dynamics of uncertainty indicators: the world uncertainty index (WUI), the uncertainty index in Ukraine (WUI_UKR), global geopolitical uncertainty index (GPR), the geopolitical uncertainty index of Ukraine (GPR_UKR), the global economic policy uncertainty index (GEPU)**

Source: Compiled by the authors.

The next stage is the analysis of the impact of uncertainty on banks' liquidity indicators. For this purpose, liquidity ratios calculated by the National Bank of Ukraine were used.

Based on these conclusions, it is expedient to assess the impact of uncertainty due to the influence of these indicators on the actual dynamics of Liquidity Coverage Ratio (LCRvv, LCRiv), and Net Stable Funding Ratio (NSFR) established by the NBU.

The regression analysis results after statistical data processing are presented in Table 1.

Table 1. Impact of uncertainty indicators on bank liquidity ratios

| Indicator of uncertainty | Liquidity ratios | Regression equation | Change | Characteristic | Direction and strength |
|---|---|---|---|---|---|
| **GPR** | LCRvv | $-1.044 * GPR + 359.776$ | 41.09% | An increase in GPR leads to a decrease in LCRvv by 1.044 | The effect is opposite, moderate |
| | LCRiv | $-1,013 * GPR + 315.91$ | 53.37% | An increase in GPR leads to a decrease in LCRiv by 1.013. | The effect is opposite, strong |
| | NSFR | $-0,609 * GPR + 209.485$ | 41.69% | An increase in GPR leads to a decrease in NSFR by 0.609. | The effect is opposite, strong |
| **GPR_UKR** | LCRvv | $-32.91 * GPR\_UKR + 288.126$ | 29.04% | An increase in GPR_UKR leads to a decrease in LCRvv by an average of 32.91 | The effect is opposite, strong |
| | LCRiv | $-34.503 * GPR\_UKR + 251.165$ | 44.02% | An increase in GPR_UKR leads to a decrease in LCRiv on average by 34.503. | The effect is opposite, strong |
| | NSFR | $-18.555 * GPR\_UKR + 166.439$ | 44.02% | An increase in GPR_UKR leads to a decrease in NSFR by an average of 18.555. | The effect is opposite, strong |
| **GEPU** | LCRvv | The parameters of the model are not statistically significant | | | |
| | LCRiv | $-0.871 GEPU + 403.597$ | 28.7% | An increase in GEPU leads to a decrease in LCRvv by an average of 0.871. | The effect is opposite, strong |
| | NSFR | The parameters of the model are not statistically significant | | | |
| **WUI** | LCRvv | The parameters of the model are not statistically significant | | | |
| | LCRiv | $-0.00532 * WUI + 311.83$ | 23.45% | An increase in WUI leads to a decrease in LCRvv by an average 0.00532 | The effect is opposite, moderate |
| | NSFR | The parameters of the model are not statistically significant | | | |
| **WUI_UKR** | LCRvv | $0.0119 * WUI\_UKR + 384.578$ | 28.08% | An increase in WUI_UKR leads to a decrease in LCRvv by an average 0.0119. | The effect is opposite, strong |
| | LCRiv | $LCRi_B = -0.0111 * WUI\_UKR + 333.755$ | 33.57% | An increase in WUI_UKR leads to a decrease in LCRiv by an average 0.0111. | The effect is opposite, strong |
| | NSFR | $NSFR = -0.00645 * WUI\_UKR + 217.259$ | 24.49% | An increase in WUI_UKR leads to a decrease in NSFR by an average 0.00645 | The effect is opposite, strong |

Source: Compiled by the authors.

According to the results, it was determined that the short-term liquidity of the bank in the national currency LCRvv is negatively affected by the growth of the global index of geopolitical uncertainty (GPR), the index of geopolitical uncertainty of Ukraine (GPR_UKR) and the index of uncertainty in Ukraine (WUI_UKR).

The short-term liquidity of the bank in foreign currency LCRvv is negatively affected by the growth of the global geopolitical uncertainty index (GPR), the geopolitical uncertainty index of Ukraine (GPR_UKR), the global economic policy uncertainty index (GEPU), the world uncertainty index (WUI) and the uncertainty index in Ukraine (WUI_UKR). The given data show that because the state of the foreign exchange market of Ukraine and its parameters significantly depends on the mega-environment, the bank's liquidity level in foreign currency is significantly affected by the influence of all types of uncertainty.

The long-term liquidity of the NSFR bank is negatively affected by the growth of the global index of geopolitical uncertainty (GPR), the index of geopolitical uncertainty of Ukraine (GPR_UKR), the index of the uncertainty of global economic policy (GEPU), and the index of uncertainty in Ukraine (WUI_UKR).

## Conclusions

Ukrainian banks operating under wartime conditions face specific challenges associated with increased uncertainty. The full-scale military aggression of the Russian Federation and the geopolitical and economic risks arising from it contributes to an increase in uncertainty, which negatively affects banks' liquidity. These issues highlight the need for targeted strategies and policies to manage liquidity risk in such an environment.

In the article, we examined the impact of uncertainty on bank liquidity. The empirical analysis confirmed the presence of a robust negative relationship between the uncertainty indicators and liquidity ratios set by the National Bank of Ukraine. As uncertainty grows, the liquidity of Ukrainian banks will decrease. This finding highlights the adverse impact of uncertainty on bank liquidity, especially in wartime.

The results of this study build on previous research that examined the impact of uncertainty on banks' liquidity. They also contribute to the existing body of knowledge by explicitly examining these relationships in the context of Ukrainian banks operating under wartime conditions.

Based on the study's results, it is recommended that banking authorities implement sound liquidity risk management practices. This includes maintaining adequate liquidity buffers, diversifying funding sources, and developing contingency plans to address liquidity shortages during heightened uncertainty.

This study forms the basis for further research on uncertainty and bank liquidity. Future research will include the specific mechanisms by which uncertainty affects bank liquidity, considering factors such as withdrawals of deposits, funding constraints, asset quality, and market dynamics.

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