

# **UKRAINE'S GLOBAL PERCEPTION POST-INVATION: A MULTISOURCE SENTIMENT ANALYSIS AND ECONOMIC IMPACT STUDY**

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## **1. INTRODUCTION**

Europe has been the busiest battleground in the 20<sup>th</sup> Century, but it continues to be so now as well, when the largest nation in size, Russia, declared war on Ukraine on the 24<sup>th</sup> of February 2022, quoting a “Special Military Operation” in the nation, thereby effectively declaring war on Ukraine [1]. Neither Russia nor Ukraine is a member of NATO or EU, but they are both former members of the USSR, and the conflict is still active between the nations [2][3]. The Ukrainian President himself has confirmed that Ukraine needs the support of the Western nations to stop this war [4], thus making the people of the Western countries, who govern the Government, all too important, and most notably, their “Sentiment” towards Ukraine, and Russia’s invasion and war on Ukraine.

Ukraine’s image on the global stage is especially important for this war, as the Western Governments, driven by their people, would want to stop all support to Ukraine if they feel fearful of the war, and that it will affect them negatively if they continue. This would be a nightmare for the Ukrainian people and the Government. Whereas, if the Western people were to be hopeful of winning the war, then their governments, with the support of the people can continue to support Ukraine. Hope and Fear are uncountable, but we can understand what cause hope and fear in people, and also find out the current trend in terms of the sentiment, and how to change that sentiment based on the topics discovered that cause the respective sentiments, that is, hope and fear.

## **2. DATA COLLECTION AND METHODOLOGY OF ANALYSIS**

### **2.1 NEWS ARTICLES**

A collection of news articles from the top 20 news platforms/companies such as CNN, BBC, NY Times, AP, Reuters etc. was gathered for the period of Feb 2022 to March 2023. The articles contain the keywords “Ukraine”, “Russia”, and “War” and were scraped for their headlines. The purpose of collecting these articles is three-fold. Firstly, to validate the sentiment analysis conducted on social media, particularly the positive/negative and hope/fear sentiment analysis. Secondly, to identify the primary drivers of people's perspectives on the war, as well as their opinions on Ukraine, Russia, and how these factors affect their lives and the economy. Finally, the collected data and sentiment analysis are expected to reflect the actual occurrences of the war.

### **2.2 REDDIT POSTS**

Reddit is a social media platform widely used where people can post and discuss about specific topics under topics called as Sub-Reddits. Reddit posts under the below mentioned sub-Reddits were scraped for two durations: May-July 2022 and Jan-March 2023. May-July 2022 was chosen as it was when the conflict was at its peak and the resulting the high level of interest in the topic during that period. The Jan-March 2023 period was selected to compare the trends in the general interest in the topic, changes in opinion, and the factors that influence it.

Posts from the popular sub-Reddits related to Ukraine & Russia were analyzed to compute “Hope factor” and “fear factor” for the two durations to understand how the sentiments hope and fear vary through the durations. Also, the reddit posts are rated by fellow users, similar to the concept of “likes”, as upvotes, reddit awards, etc. These indicators are used to compute the popularity of posts and use the metric to check through the sub-Reddits to find the posts that were supported most. Finally, the impact of the war on USD/Ruble’s exchange prices, Gas prices were studied to understand the impact of the conflict on the economy.

Sub-Reddits
r/ukraine
r/worldnews
r/UkrainianConflict
r/UkraineWarVideoReport
r/UkraineWarReports

Table 1. Sub-Reddits

## 2.3 TWITTER TWEETS

Twitter is a widely used social media platform where people share their opinions and emotions through short and concise messages called tweets. One of the advantages of tweets is that they are easy to analyze, and hashtags make it easy to post and discuss specific topics with a larger audience. Furthermore, Twitter is a platform where public figures, politicians, and celebrities can sway public opinion.

For sentiment analysis, tweets with specific hashtags were collected to identify positive and negative tweets about Ukraine, and to determine the factors that drive the sentiment. Two different periods were chosen for this analysis: May-July 2022 and Jan-March 2023. May-July 2022 was chosen as it was when the conflict was at its peak and the resulting the high level of interest in the topic during that period. The Jan-March 2023 period was selected to compare the trends in the general interest in the topic, changes in opinion, and the factors that influence it. This analysis helps to determine if Ukraine is viewed more positively or negatively compared to the previous year.



**Fig. 1 Word Cloud from all the Tweets**

Hashtags
#zelensky
#putin
#ukraine
#russia
#ukrainewar
#russiawar
#ukrainerussiawar

### Table2. Hashtags

### 3. ANALYSIS

### 3.1 TWEET ANALYSIS

Tweets were classified as positive, negative, and neutral and the plots below show the segregation between the sentiments for specific hashtags and sentiment frequency over the months. In the frequency plot, it is evident that the frequency of neutral and negative posts about Ukraine reach their nadir at mid of May 2022, and positive posts soar at

this period, as this was when the war was at its peak, and thus it can be seen that the support for Ukraine was high as well.

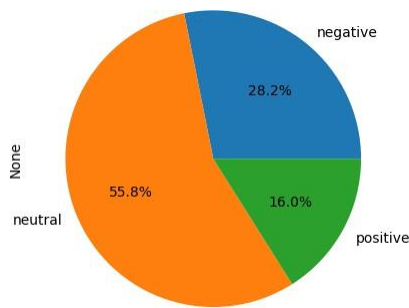


Fig. 1 #ukraine Sentiment Distribution, May-July 2022

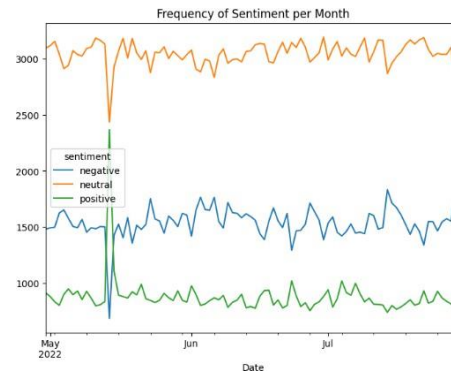


Fig. 2 #ukraine Frequency of Sentiment, May-July 2022

The main objective of the tweet analysis is to identify factors causing sentiments during the May-July 2022 and Jan-Mar 2023 periods. From the analysis on Tweets from May to July in 2022, these are the various topics that drove sentiments towards Ukraine:

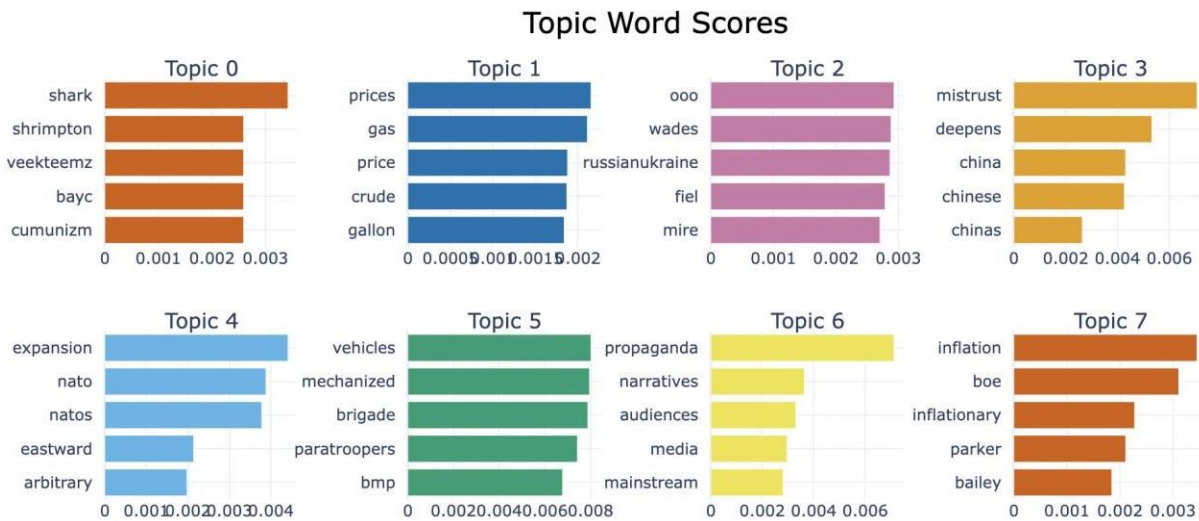


Fig. 3 Positive Topic Scores May-July 2022

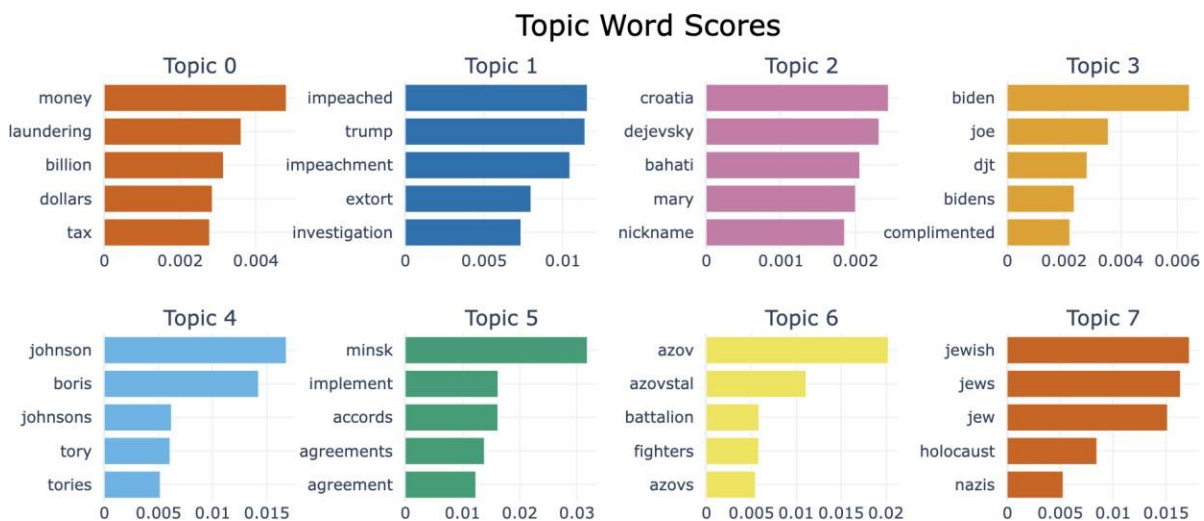


Fig. 4 Negative Topic Scores May-July 2022

It should be noted that the topics identified as positive and negative are plotted based on the model's understanding of the English Language and not on any single perspective. It should be inferred from the plots as to which factor drives the positive or negative sentiment towards Ukraine. This is where human analytical skills are used to identify whether the factor drives the sentiment as positive or negative using news articles from that time period.

FACTORS DRIVING POSITIVE SENTIMENT	FACTORS DRIVING NEGATIVE SENTIMENT
1. Ukraine's deal to continue Grain Exports to EU and African Countries.	1. Billions of tax dollars spent on supporting the Ukrainian government on the war.
2. Expansion of NATO and its Allied Members.	2. The inflation of Oil & Gas prices.
3. Reports of people of Ukraine falling victims to sexual crimes.	3. The threat of a nuclear war and the use of nuclear of weapons.
4. Ukraine's participation in Eurovision 2023 in Liverpool, England in 2023.	4. The imposed sanctions on Russia hurting the economy.
5. The plunge of Russia's currency Rubles and its failed push in Crypto currencies.	5. Corruption in Ukraine and the release of the Pandora Papers.
6. Ukraine's stand against Russia during peace negotiations and refusing to cede territory.	6. The mainstream media and news reports being branded as propaganda and lies.
7. The unwavering desire of the world to stop the invaders/oppressors and help and support the defenders/oppressed.	

Table 3. Topics – Tweets from May to July 2022

To validate the factors selected, we use news articles from the same time period. The first factor driving positive sentiment, "Ukraine's deal to continue Grain Exports to EU and African Countries" is validated to be a factor driving positive sentiment on Ukraine through the News Article "BREAKING: Russia and Ukraine signed separate agreements with Turkey and the United Nations clearing the way for exporting millions of tons of desperately needed Ukrainian grain — as well as Russian grain and fertilizer." By Ayse Wieting and Suzan Frazer, AP News, July 22, 2022.

Further, the factor driving the negative sentiment "Billions of tax dollars spent on supporting the Ukrainian government on the war" is validated through the news article "New AP-NORC poll: Americans are becoming less supportive of punishing Russia for launching its invasion of Ukraine if it comes at the expense of the U.S. economy, a sign of rising anxiety over inflation and other challenges." By Nomaan Merchant and Hannah Fingerhut, AP News, May 24, 2022. For further visuals and validations, refer the Appendix document.

Now considering tweets from the period of Jan to March 2023, this is the sentiment distribution and frequency of sentiments:

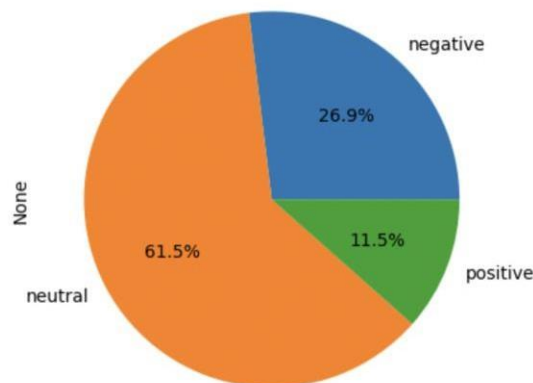


Fig. 5 #ukrainerussiawar Sentiment Distribution Jan-Mar 2023

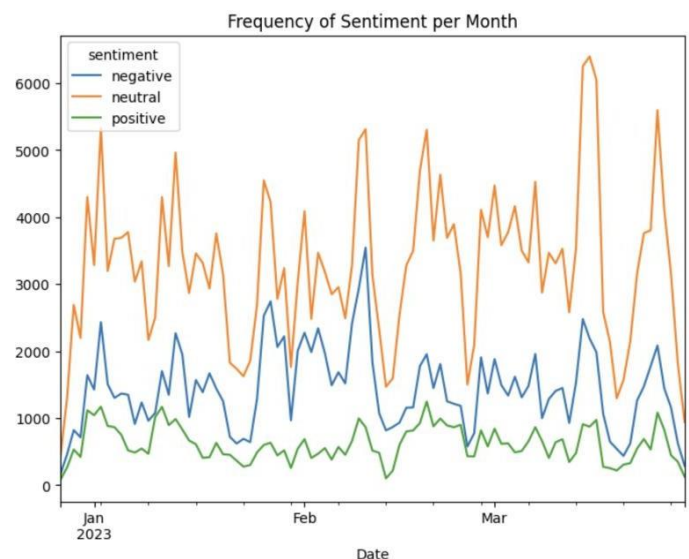


Fig. 6 #ukrainerussiawar Frequency of Sentiment, Jan-Mar 2023



From the plots, it is evident that the neutral sentiment tweets are at the majority. The frequency plot shows that there are fluctuation patterns for all three sentiments but ultimately the neutral sentiments occur at the highest frequencies, but after that, negative sentiments are expressed the most about Ukraine. This shows that the topic is not trending or discussed with such emotional spectrums as compared to the May-July 2022 duration, when the conflict was at its peak and was trending. The topics identified through the analysis are presented below:

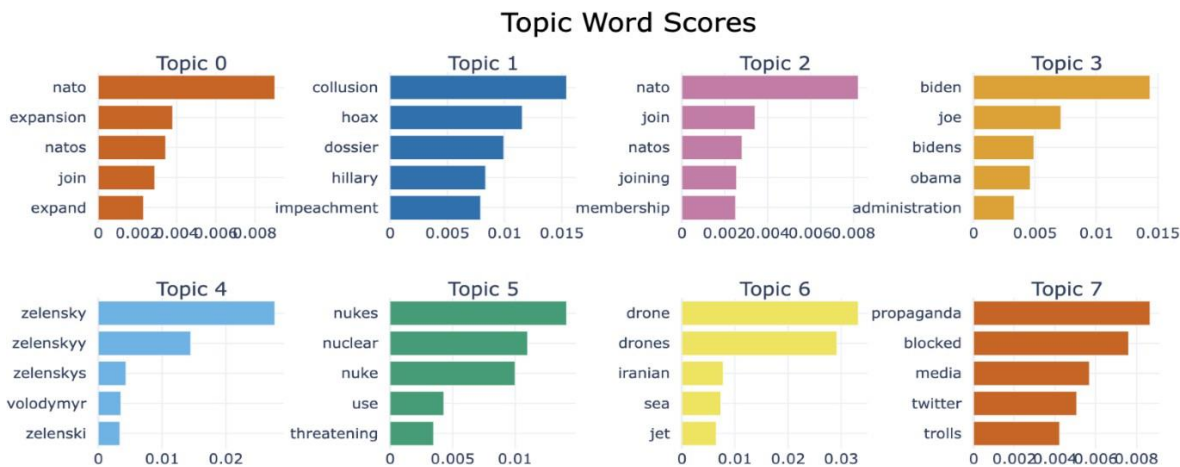


Fig. 7 Positive Topic Scores Jan-Mar 2023

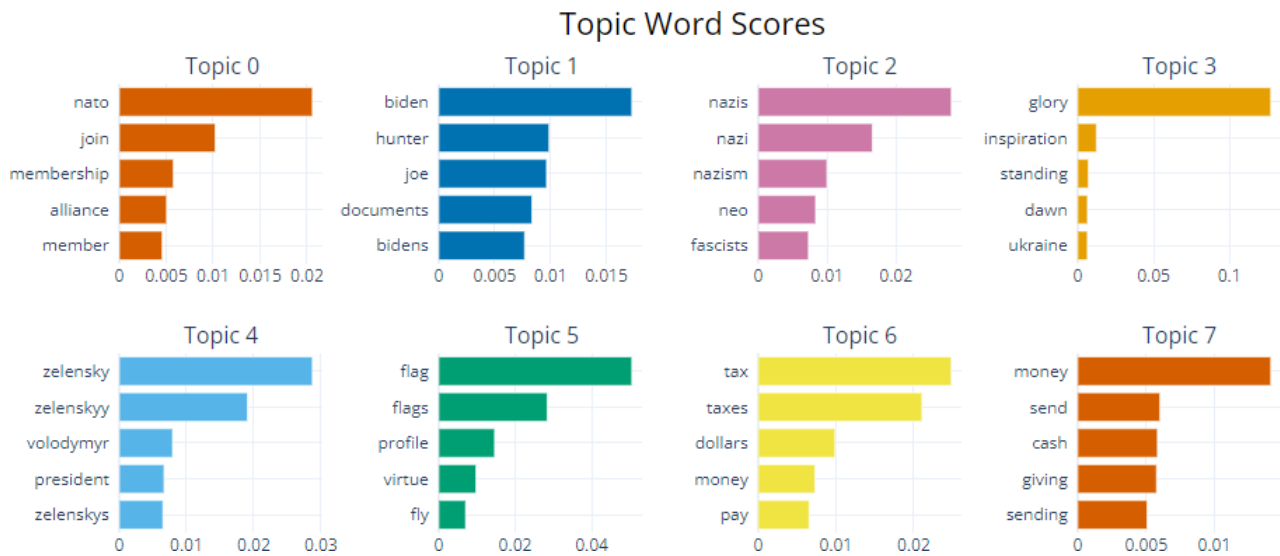


Fig. 8 Negative Topic Scores Jan-Mar 2023

Based on the topic scores bar plot, we can formulate factors that drive positive and negative sentiments on Ukraine in the period of Jan-Mar of 2022. The topics are presented below:

FACTORS DRIVING POSITIVE SENTIMENT	FACTORS DRIVING NEGATIVE SENTIMENT
1. Ukraine’s skepticism and denial of Russia’s request for a ceasefire during Orthodox Christmas.	1. Billions of tax dollars spent on supporting the Ukrainian government on the war.
2. Expansion of NATO and its Allied Members.	2. The threat of a nuclear war and the use of nuclear weapons.
3. Trust in Ukrainian leadership.	3. The inflation of Oil & Gas prices.
	4. Ukrainian population accused of Neo-Nazism.

Table 4. Topics – Tweets from Jan-Mar 2023.

Validation for factor “Ukraine’s skepticism and denial of Russia’s request for a ceasefire during Orthodox Christmas” driving positive sentiment is performed through news articles “Orthodox Christmas has been thrust into the spotlight by Putin’s call for a temporary 36-hour ceasefire in Ukraine — a proposal swiftly dismissed as “hypocrisy” and “propaganda” by Ukrainian officials. Here’s what you need to know about the holiday.” By Sophie Tanno, CNN, Jan 26, 2023 and “Despite Moscow’s declaration of a ceasefire for Eastern Orthodox Christmas, shelling continued in the Ukrainian town of Bakhmut, the current focus of the most intense fighting in Russia’s invasion of Ukraine” By Herbert Villaraga, Reuters News, Jan 7, 2023.

The factor “The threat of a nuclear war and the use of nuclear weapons” can be validated for the time period of Jan-Mar 2023 through the news article “Former Russian leader and Putin ally Dmitry Medvedev warns NATO that Moscow’s defeat in Ukraine could trigger a nuclear war” By Caitlin McFall, Liz Friden, Fox News, Jan 19, 2023 and “Putin says he plans to strengthen Russia’s nuclear forces, as his invasion of Ukraine reaches the one-year mark.” By Patrick Smith, NBC News, Feb 23, 2023.

### 3.2 REDDIT ANALYSIS

We separated Reddit posts referring to both President Zelensky and Putin. For each set of posts, we classified between positive and negative posts, and utilized Reddit scores to calculate mean popularity. This was calculated for both time periods outlined above to determine any changes in popularity of both positive and negative sentiments towards both leaders. The bar plots below outline these popularity metrics.

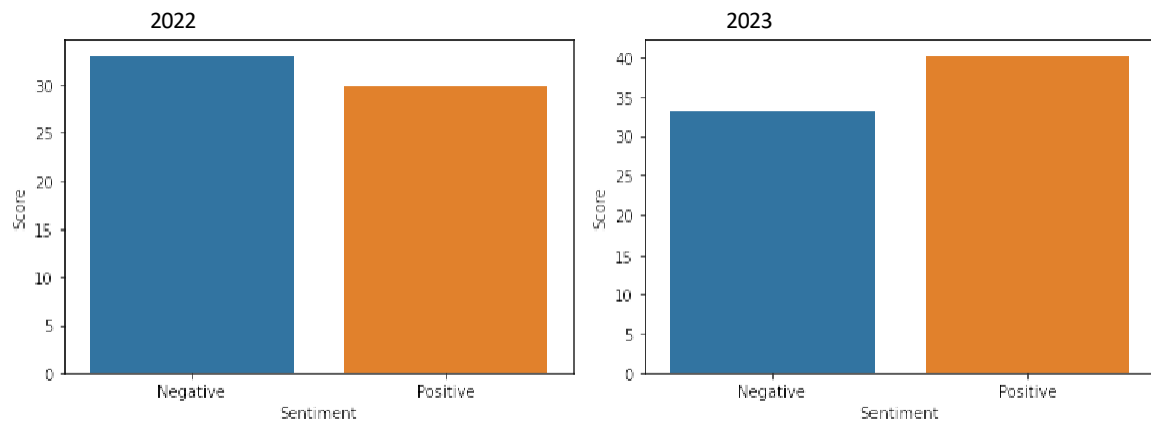


Fig. 9: Mean Reddit scores for posts referring to President Zelensky

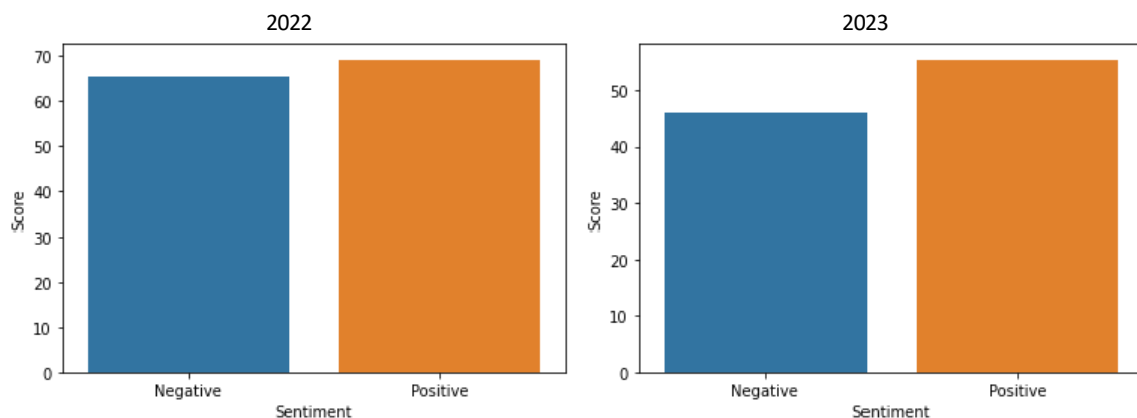
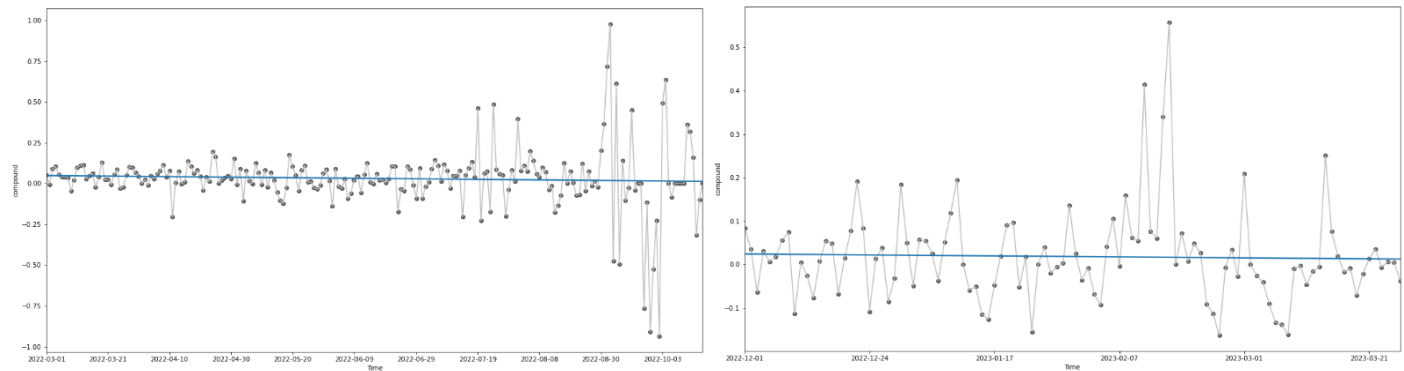


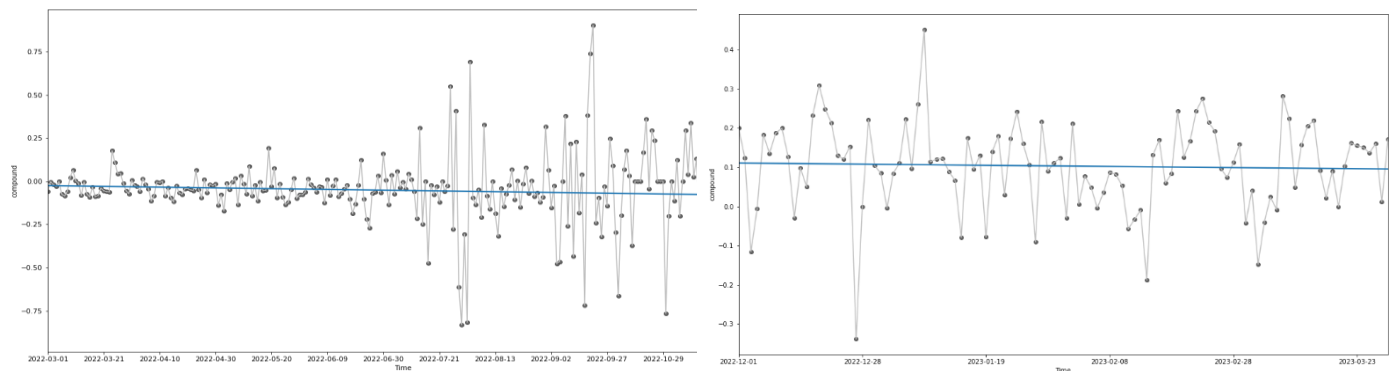
Fig. 10: Mean Reddit scores for posts referring to Putin.

These scores demonstrate a trend of increasing popularity of positive posts towards both figures, with positive posts referring to Putin demonstrating surprisingly higher scores across both time periods. These findings imply the presence of disproportionately large volumes of pro-Russian forces and bots operating across Reddit. This is supported by investigations from 2018 which found that Reddit was a major target for activities by Russia’s largest troll farm, the Internet Research Agency, which contributed to disinformation through large volumes of content and upvotes [cite][cite].

While Reddit claimed to act against these troll accounts in 2018, they remained largely active up to the beginning of the Russian invasion, and more recently Reddit was forced to take emergency action to quarantine their r/Russia subreddit, which had become a hotbed of Russian disinformation and propaganda. Our finding demonstrates that despite this quarantine, these troll accounts continued to engage with other subreddits related to the war, attempting to shape Reddit sentiment. Time series analyses of daily mean sentiment scores of Reddit posts referring to Putin and President Zelensky across 2022 and 2023 are displayed below.



**Fig. 11: Daily mean sentiment scores for posts referring to President Zelensky**



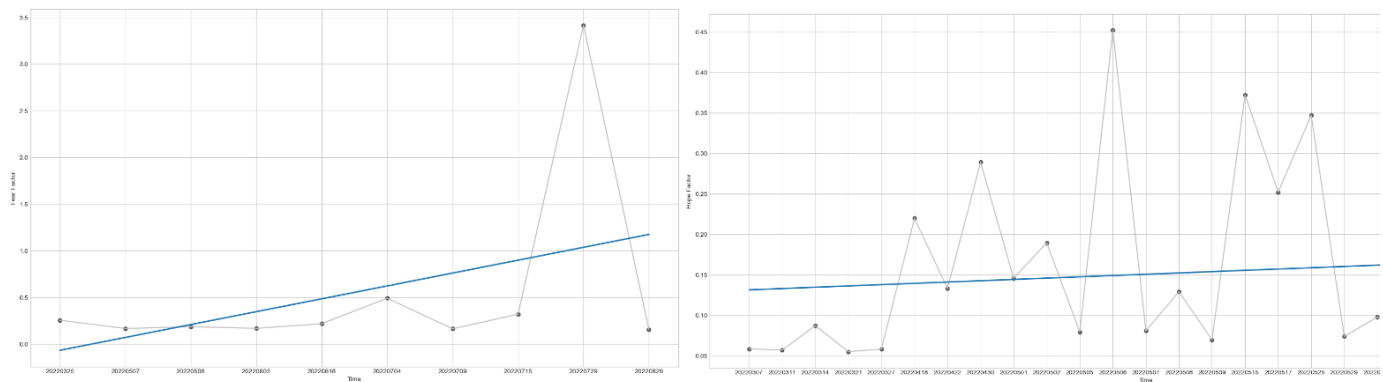
**Fig. 12: Daily mean sentiment scores for posts referring to Putin.**

We can identify that there were several prominent peaks and nadirs in sentiment towards both leaders across the time series. For President Zelensky, there were significant peaks around the first week of September 2022 and the middle of February 2023. These peaks can be validated using analysis of news from around those periods. The peak in September can be attributed to President Zelensky’s interview with CNN on September 11, 2022 [1] and the subsequent positive media coverage surrounding it. The peak in mid-February can be attributed to President Zelensky’s meeting with President Biden during his surprise trip to Ukraine [2], as well as his defiant stance in refusing to entertain any territory deal with Putin. There was a significant nadir in the first week of October 2022. This nadir corresponded to a public social media clash between President Zelensky and Elon Musk, following a controversial Twitter poll initiated by Musk regarding a potential “peace plan” [3].

For Putin, there were significant peaks in the last week of September 2022 and in the second week of January 2023. The peak in the end of September corresponded to Putin’s speech in which he ordered partial mobilization of reserve forces [4]. This could have led to positive engagement on Reddit by firing up Russian nationalist figures and through an influx of trolls and bots targeted at firing up Russian disinformation around mobilization. The January peak was around the time of the Russian government’s first meeting of 2023 [5], around which period Putin made several high-profile changes, including replacing his war commander [6] and claiming to be acting towards ending the ‘war’ started in 2014 [7]. These actions were largely targeted to control narratives and fire up Russian nationalist forces, as displayed by the reaction in Reddit sentiment. These speeches were also periods of large Russian troll activity aimed at magnifying the disinformation and increasing positive engagement.

There were significant nadirs in the beginning of August and November 2022. In early August there was several major reports regarding Putin losing control of the war efforts and miscalculating Ukrainian strength [1]. Several on-camera appearances also presented him as weak, undermining his appearance as a strongman. In early November, there were several public setbacks which could potentially have contributed to negative sentiment. Chief among them was Putin's decision to introduce conscription among prisoners, which was highly controversial even in Russia. There was also a public rebuke by a prominent Russian billionaire [2].

To provide an extra dimension in the analysis of long form Reddit posts, we developed a model to classify post sentiment as hopeful or fearful. This data was utilized to classify posts from major subreddits focused on the war. A time series analysis of these posts was performed to identify period of high hope and fear across the duration of the war. Below are plots of the time series for changes in fear and hope factors of the posts in the major Ukraine subreddit.



**Fig 13. Fear and Hope Factors of posts in Ukraine subreddit**

There was a significant peak in fear in the last week of July 2022 and a significant peak in hope in early May 2022. The peak in fear coincided with the release of a report by the World Health Organization outlining the scale of the tragedy and identifying the war as one of the largest humanitarian and displacement crises in modern history [3]. The peak in hope could be attributed to an address by President Biden reaffirming US armament support to Ukraine [4] as well as to a solidarity visit to Kyiv by Prime Minister Trudeau [5].

### **3.3 STOCK ANALYSIS**

Four different tickers, regarding four different aspects connected to the war, were chosen: (1) Gas stock price, (2) Ruble – US Dollar exchange rate, (3) Wheat price. In particular, the most influential one is gas prices which have been used as a leverage for a good chunk of the conflict. Many western countries, including but not limited to Italy and Germany, provide weapons and support to Ukraine, but used to rely heavily on Russian gas for their energy needs. Russia has manoeuvred the gas price and supply (for example closing the gas pipeline North Stream One) to try to weaken the support for the Ukrainians and lift the sanctions imposed on them. Furthermore, through the increase of gas price, Russia secured record earnings and export levels. As always, in the stock market, prices are not only a reflection of current demand and offer, but also the projected demand and offer in the future. For all those reasons, we found it interesting to explore if a relationship existed between the hope and fear towards the conflict and the price of gas.

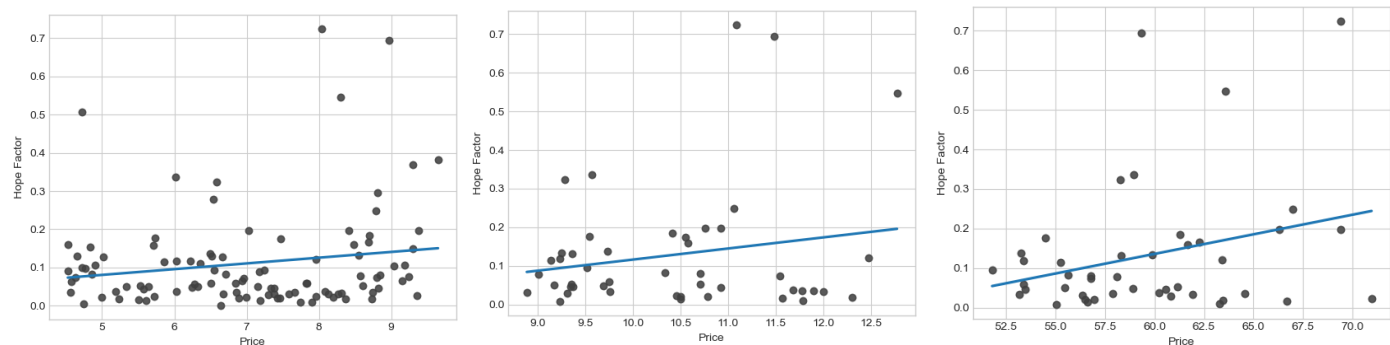
One of the very first consequences of western sanctions on Russia, was the fall of the Ruble. Many speculations were done on how this would have affected the Russian economy and their ability to repay their debts. The matter became even more interesting when after it started to climb back, even reaching higher values than pre-conflict period. Since Russia sells a significant part of its gas in Rubles, the swinging of the value of the Ruble are very important to the Russian economy and they are not to be underestimated. The perception of the stability of the country, hence the trust of the market in its currency could be put in jeopardy by losing this war. This is a good reason to expand the study to the exchange rate between US dollar and Russian Ruble. Another important factor that determines the tide of the war is the food prices and the



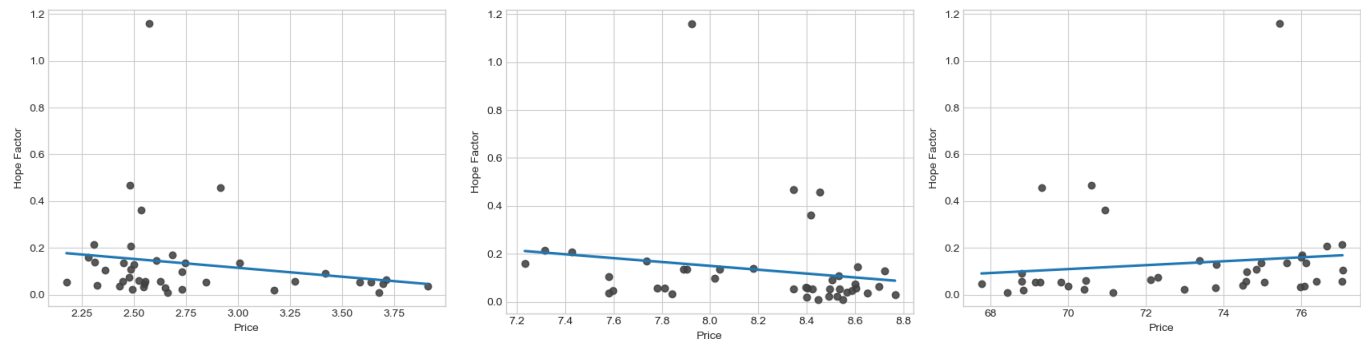
surplus available in each nation which will be rationed during these times, With the outbreak of war, foreign countries backed up Ukraine with food surplus which had put Russia into huge disadvantage. Analysing all these factors with the score would give an idea how sentiment around the stock prices varies.

We run a linear regression analysis between each of these stock market elements and the proposed hope/fear score for time-period May-Jul 2022 and Jan-Mar 2023. Evaluating the results, we conclude that in terms of p-value there was no significant correlation between hope/fear score and Wheat prices for both the year considered, clearly showing that the Ukraine only received surplus from other countries thus not increasing the overall price of the wheat. The similar insignificant relationship mentioned above was also obtained between fear score and gas prices, Oil prices. However, in terms of the hope score, a significant relationship was found between hope and the gas price, Oil prices. To interpret the relationship between the hope score and gas prices a linear regression was run, having the average daily hope score as the independent variable and the daily closing price as the dependent one. Upon conducting a study on the relationship between all stock variables as regressors and the hope/fear score as the target. Considering a significance threshold value of 0.1 (10%) for p-value, all the prices returned a significant relationship with the hope score whilst fear score does not provide a significant relationship with any of the regressors. Through the figures below we can conclude that a clear relationship between the hope score and three-regressor model (Gas, Oil and USD-RUB) with a relatively low R squared value and again with a reciprocal proportion.

**This analysis means that the public hope for the result of the conflict is not the primary driver for gas, Oil and Exchange prices, but there is indeed a relationship to be explored.**



**Fig 13. 2022 Relationship between hope and fear factor and price of (a) Gas, (b) Wheat (c) USD-Ruble**



**Fig 14. 2023 Relationship between hope and fear factor and price of (a) Gas, (b) Wheat (c) USD-Ruble**

#### 4. DISCUSSION AND RECOMMENDATION

As the world is looming towards an economic recession, the populace feels that the support to help the novel and just cause for Ukraine should not be at the expense of their livelihood. Even if no aid is given to Ukraine, the conflict still has detrimental effects on the global supply chain which in turn leads to the worsening of the current economic conditions. If the global economy worsens any further, there is a very high possibility that the people of the supporting nations would want to end the conflict at any cost, which would end with Ukraine losing the required support and funding, and ultimately having to succumb to defeat. When the public becomes fearful of the situation, things turn difficult for Ukraine.

In order to retain the support for the war, Ukraine must develop ways to increase hope in the public towards Ukraine's victory. This can be done by a multi-faceted approach. The first strategy is for Ukraine to establish that the aid and support received are utilized effectively and that a victory is a good possibility. This can be done by reporting on all the advancements made by the military on the battlefield, and also report on the improvements on the weaponry and manpower to better establish strength.

Secondly, they have to instill in the public that the conflict is hurting Russia economically, as the MNCs operating in Russia had to shut down operations due to sanctions imposed, which resulted in huge unemployment numbers, ultimately resulting in the poor economic state. Now, the dependency of Russia has turned to its exports of natural resources (Oil, Gas, Rare Metals, etc.), which already have severe sanctions imposed upon, proving to be highly difficult for Russia to attain stability in its economy. And also, the unemployment populace is being forced to serve in the military in order to support their family. Russia is also known for recommissioning old soviet era weapons back into combat duty due to its inability to manufacture new weapons.

Third, Ukraine must seek support from Western allies to combat Russian disinformation, bot and troll activities on prominent social media platforms. As seen from the analysis of Reddit data, significant Russian campaigns were able to have an effect on Reddit-wide sentiment analysis despite quarantining of the major r/Russia subreddit. Ukraine should lobby its major allies to put pressure on large social media companies to provide more comprehensive content review and moderation, while targeting Russian bots and troll farms and removing them immediately from site access. This will help ensure false narratives do not proliferate through social media to influence sentiment among the public in allied nations.

And finally, Ukraine can try to project that they are also proving to be beneficial to the supporting nations' economies. This can be instituted by showing that the refugees from Ukraine displaced by the war to the supporting nations are contributing to their economies positively. The general opinion of the public is that providing refuge in their countries would incur an additional expenditure for their governments that cannot be recovered. This opinion can be tackled with a systematic approach. Firstly, the Ukrainian Government should show that these refugees spend their money to run their lives in the refuge nation, injecting capital, thereby boosting their economy. Secondly, it can be shown that the Ukrainian refugees are skilled workers who can add value to the existing labour market of the refuge nations. And lastly, by gaining employment, they will be paying the local taxes, which will also help boost the economy of the nation providing refuge.

#### 5. CONCLUSION

Our team provided a comprehensive analysis of sentiment across two major social media platforms. By analyzing such sentiment over two distinct time periods during the course of the Russian invasion, we were able to identify specific points of interest influencing public opinion and social media usage. By analyzing these changes over time, we were able to validate any potential sentiment changes using a review of news, media and real-world events shaping perceptions of the war, and the two leaders at the centre of it all, President Zelensky and Putin. By analyzing the differences in identified sentiment across the two platforms, we were also able to identify key points of concern regarding Russian disinformation, bot, and troll activity in Reddit especially. By consolidating our findings, we were able to provide four key recommendations to the Ukrainian government and NGOs to tackle the potential roadblocks presented by negative social media sentiment: **(1) Transparent communication regarding aid and war gains, (2) Proliferation of information regarding Russian economic and military losses, (3) Lobbying for regulation tackling Russian disinformation, and (4) Highlighting the positive financial impacts provided by Ukrainian refugees to host nations through consumption, labor and taxation.**

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