#Stoprussia: Weaponizing Social Media for Foreign Support

Ernesto Calvo
University of Maryland

Roya Talibova
Vanderbilt University

Erik Wibbels
University of Pennsylvania

When engaged in external wars, governments around the world seek to build foreign support for their people and policies. Although significant research has investigated how political actors use social media to influence domestic politics, we lack similar evidence on the objectives, strategies, and efficacy of social media messaging when directed at foreign audiences. Why and when do political leaders direct content to their foreign followers on social media? What explains why some externally targeted messages amplify and others do not? We use the war in Ukraine to understand why social media strategies tailored to promote foreign support succeed or fail and how the content and sentiment of these internationally targeted postings impact their efficacy. We gather the universe of Twitter behavior by the top several hundred Ukrainian officials both before and after the 2022 Russian invasion. Combining network analysis and Natural Language Processing tools, we assess how Ukrainian elites' postings on distinct political, military, and social issues changed in response to the war. The findings demonstrate that after the invasion, diverse pre-war social media communities that reflected different domestic Ukrainian constituencies converged into a single community with strong links to the international community.

Version 1: August 2023

Keywords: social media, war, foreign support

Very preliminary draft: Please do not cite or circulate.

1. Introduction

When confronted with a strong enemy, governments often solicit foreign support for their war efforts. Yet, observing any state's attempts at influencing outside actors has, until recently, been a challenging endeavor because most of those efforts occur behind closed doors. Social media has altered the landscape of political discourse by bringing wartime foreign policy decisions out to the open. Most state officials and their respective agencies now utilize online channels to disseminate information to garner support for their agenda among a wider international audience. The increasingly public nature of official decision-making through social media allows us to assess the efficacy of such attempts at an unprecedented level of granularity. Although significant research has investigated how political actors use social media to influence domestic politics, we lack similar evidence on the objectives, strategies, and efficacy of social media messaging by government officials explicitly targeting foreign audiences.

A long line of research emphasizes how powerful countries use traditional tools – trade, aid and coercion – to influence foreign governments and citizens (Schelling, 1980; Flores-Macías and Kreps, 2013; Dietrich and Wright, 2015). Particularly with the rise of Russian and Chinese foreign activism, there has been considerable research on how their international activities impact everything from conflict in recipient countries (Gehring, Kaplan and Wong, 2019; Strange et al., 2017) to economic growth (Dreher et al., 2019; Knutsen and Kotsadam, 2020) to government repression (Gehring, Kaplan and Wong, 2019; Kishi and Raleigh, 2017) and the incidence of union membership (Isaksson and Kotsadam, 2018). For the most part, however, there is little evidence of the government's use of social media to influence foreign attitudes, despite a growing recognition that it is changing traditional interstate relations, extending even to war (Zeitzoff, 2017). Thus, while we have a growing body of evidence how governments use digital tools to engage or repress their own citizens (Garbe, 2023; King, Pan and Roberts, 2013; Stukal et al., 2019) and how citizens evade or organize against governments (Gleditsch, Macías-Medellín and Rivera, 2023; Acemoglu, Hassan and Tahoun, 2018; Enikolopov, Makarin and Petrova, 2020), we have limited insight into how social media is (re)shaping international relations.

We provide original insight into this issue by examining how Ukrainian officials have used social media to solicit foreign support for its ongoing war with Russia. The Ukrainian government has been at the forefront of digitizing government – from public procurement to paying taxes to warnings of incoming missile attacks. Members of the government have also been highly active on social media as part of an attempt to shape the interna-

tional narrative around Russia's invasion on February 24, 2022. The resulting individual-level data is extremely rich and provides an opportunity to take a more micro-analytical approach than is typical in research on foreign policy and inter-state relations. We theorize that social media allows Ukrainian government officials to target messages to distinct foreign audiences. Indeed, we posit that Ukrainian social media posts will disseminate more or less among distinct foreign networks depending on both the topics and tone of the messages.

We empirically test this argument using social media data from Twitter focused on the Russia-Ukraine war, the aggression that started with the full-scale invasion of Ukraine by Russian armed forces on February 24, 2022 and triggered a massive humanitarian crisis. Several features of the war in Ukraine, the largest and the costliest conflict in Europe since World War II, render it an ideal case for testing this theory. In a short period following the initial incursion, social media platforms swiftly emerged as central players in the struggle for influence: documenting instances of human rights abuses, rallying the international community to take action, and seeking foreign support. Ukrainian government members have also become highly active on social media as part of an attempt to shape the international narrative around Russia's invasion. The popularity of Twitter among journalists, activists, and policymakers means that the platform is often the first place many people turn to learn about the world. The high granularity of the collected data allows us to observe shifts in temporal patterns across different topics and accounts. Finally, the Twitter platform provides us with an opportunity to measure political and public agendas using the same source (Barberá et al., 2019).

We integrate two large-scale datasets to explore the hypothesized relationship between online solicitation and foreign support. First, we use metadata of tweets related to the war in Ukraine – the #Data4Ukraine dataset – to detect relevant communities in a network of international actors. Second, we identify Ukrainian officials in key executive and legislative positions who were active on Twitter for a substantial period before and after the invasion and collect their Twitter handles to build a separate dataset covering the entire tweet history of these officials from August 18, 2010 through December 31, 2022. The data enable us to analyze how message content and tone influence online amplification through global networks. We examine tweets by ministers, heads of executive agencies, and members of parliament, as well as tweets by individuals who retweeted them on Twitter before and after the invasion. By merging these datasets and employing diverse statistical models, automated translation, and unsupervised machine learning approaches, we demonstrate that government officials frequently utilize social media as a platform to solicit foreign support. Specifically, we combine network analysis and Nat-

ural Language Processing tools to assess how Ukrainian officials' postings on distinct political, military, and social issues changed in response to the conflict and how the content and sentiment of postings impacted the extent to which they successfully circulated in key foreign influence networks.

The inherent openness of Twitter allows us to gather data on every tweet government officials have ever made, the international networks that consume those tweets, and a clean measure of the extent to which each of those tweets disseminates across distinct international networks. The results provide uniquely granular evidence on how the content and sentiment of tweets impact their success in reaching distinct international audiences. We measure shifts in the volume, content, language use, tone, and engagement of online activity. The study provides the first large-scale, systematic test of the efficacy of social media outreach efforts to solicit foreign support during war.

This study argues that social media can be pivotal in asymmetric conflicts. Consistent with our expectation that Twitter is a strategic tool for communicating with international audiences, our findings show that the volume of government officials' tweets increases dramatically and shifts toward English-language posting as soon as the invasion begins. We find that the content and tone of the tweets by these accounts alter significantly post-invasion, leading to changes in the number, frequency, and direction of engagements by foreign audiences. We also demonstrate that certain topics are more likely to generate engagement within well-defined communities and that the general tone of the social media posts also affects how the messages get amplified in the broader Twitter network. The study offers insight into how online social media communication can be strategically utilized to set the agenda for wider media reporting and coalition building.

By demonstrating the downstream effects of the state's official messaging strategy on foreign support, these findings contribute to the broader literature on social media as a medium of political communication (Gilardi et al., 2022), crisis leadership (Barberá et al., 2022), the importance of digital media in shaping political discourse (Fazekas et al., 2021), and public diplomacy (Zaharna, Arsenault and Fisher, 2014). Prior research has explored the role of social media in mobilizing social and political activism (González-Bailón et al., 2011; Tufekci and Wilson, 2012), increasing political polarization (Bail et al., 2018), shaping public views about leadership (Barberá and Zeitzoff, 2018), and overall agenda-setting (Feezell, 2018; Barberá et al., 2019; Jungherr, Posegga and An, 2019). Scholarly work on digital diplomacy – using social media platforms for diplomatic objectives and its potential and constraints – is still in its early stages. Understanding what public communication strategies government officials choose to broadcast messages that bolster support for their (and condemnation for the opponent's) cause during foreign policy crises and what

audiences they engage with such strategies would provide valuable insights into the online discourse and communication patterns within specific communities, contributing to a deeper understanding of information diffusion and network dynamics, as well as enhancing our comprehension of politicians' communication repertoire in the digital age.

2. Social Media, Politics and War

There is widespread recognition that political actors often use social media to rally audiences in times of conflict (Zeitzoff, 2017; Larson, 2021). Most relevant work, however, has focused on how governments deploy digital media for or against their own citizens and vice versa. For instance, a growing body of work describes how autocratic regimes capture media outlets and manipulate domestic information environments (Szeidl and Szucs, 2021; Knight and Tribin, 2019*b*,*a*; Di Tella and Franceschelli, 2011; Rozenas and Stukal, 2019). Those approaches to controlling formal digital media are often echoed in efforts to manage social media. For instance, Russian social media is filled with pro-government and anti-government bots (Stukal et al., 2019), and the Chinese government employs sophisticated methods to prevent users from accessing information with collective action potential (King, Pan and Roberts, 2013). Those autocrats (aspiring and otherwise) aim to win hearts and minds by controlling the flow of information to divide the opposition, encourage nationalism, conceal repression, and justify the rolling back of checks and balances – even if their efforts can fail (Pan and Siegel, 2020). In many ways, this quest to control the information environment defines the global spread of these "informational autocrats" (Guriev and Treisman, 2019).

A parallel body of work examines how citizens use media to organize anti-government protests and otherwise challenge incumbents. For instance, even in only partially free media environments, citizens are able to use digital media to mobilize collective action against autocrats (Gleditsch, Macías-Medellín and Rivera, 2023). Again, work on digital media writ large is echoed in more fine-grained work on social media. Steinert-Threlkeld (Steinert-Threlkeld, 2017) and Acemoglu et al. (Acemoglu, Hassan and Tahoun, 2018), for example, shows how the coordination of activity of Twitter precedes protests during the Arab Spring. Even when research designs account for the difficult challenge of self-selection in the use of social media, it seems that access is associated with greater protest activity, even in repressive environments (Enikolopov, Makarin and Petrova, 2020).

For all the research on the use and abuse of digital tools by governments and their citizens, there is much less on how strategic governments use social media to influence international audiences, particularly during war. One partial exception is the growing

body of work around state-sponsored mis- and disinformation. For instance, several papers examine Russian efforts to shape international perceptions of Syrian 'white helmets', i.e., the volunteer force focused on medical support for victims during that country's civil war (Wilson and Starbird, 2020; Pacheco, Flammini and Menczer, 2020). That work shows how Russian news factories, coordinated retweets, and content duplication have served to spread disinformation impugning the humanitarian work of the White Helmets. Nevertheless, most of that work has been diagnostic, i.e., it has focused on uncovering the role of the Russian government and related networks in creating and disseminating misinformation, rather than on which factors impact the success or failure of any particular message intended for international audiences.

Here, we combine insights from international relations with growing evidence from political communications on social media consumption to hypothesize how government officials will use social media to target different international audiences during war and what kinds of messages are most likely to 'work' with different international audiences. In research on international relations, there is a growing recognition that states can deliver highly nuanced messages to diverse foreign audiences. Examples abound: The Chinese government tries to curry favor with government elites in Sub-Saharan Africa by providing their children with scholarships at Chinese universities, even as they target some local communities with substantial investments to blunt the negative environmental impacts of Chinese mining operations and elicit positive attitudes toward China. This capacity to target foreign audiences has only grown with the diffusion of social media. Indeed, recent work shows both increased volume and nuance from government-sponsored media and diplomatic social media accounts in countries as diverse as Turkey and China (Fan, Pan and Sheng, 2023; Uysal and Schroeder, 2019). Social media also offers governments with tremendous capacity to micro-target different audiences. Russian intelligence operations, for instance, have targeted minority voters in the US to dissuade voting, promoted conspiracy theories among conservatives, and disseminated false information about the #BlackLivesMatter movement (Bradshaw, DiResta and Miller, 2022).

Given that the government of Ukraine and its officials were amongst the most social media savvy even before the Russian invasion, we hypothesize that after the invasion they used social media as a tool for framing and disseminating their message to foreign audiences and that they did it in ways that discriminated amongst important international constituencies. We expect that the most relevant audiences for Ukrainian leaders were the North American and European governments that subsequently provided the country with enormous aid, the international press that has the capacity to impact popular opinion across many countries, and the human rights community that was responsible

for mobilizing humanitarian relief for Ukrainian war victims. We also expect this targeted messaging to result in an increase in the overall volume of social media posting, a shift in the topics governmental officials post about (i.e., topics bearing on the war), and a move toward posting in English, i.e., the language of international diplomacy.

Our theoretical expectations about the volume, language, and content of the social media posts of state officials lead to the following formal predictions:

H1: *Social media posts by Ukrainian officials will increase in volume in the immediate post-invasion period.*

H2: *The language of official accounts will shift from Ukrainian and Russian language postings to English as a means to solicit foreign support.*

H3: *Official posts will shift from attention to domestic issues and events to messages about war and humanitarian crises.*

Above and beyond these macro-level dynamics, we rely on recent findings from research on social media and political communications to develop hypotheses bearing on the kind of social media messages that are more or less likely to be successful with international audiences. One of the marvelous features of social media data is that it provides an objective measure of the extent to which a message or post circulates through clearly identifiable communities of social media consumers. When more users share, re-tweet, or otherwise indicate agreement with a post, it indicates that a message has "worked". The boom in research on social media has provided valuable insights into how a broad range of factors influence the dissemination of messages.[1] It shows that everything from the ideology (González-Bailón et al., 2022) and reputation (Aruguete, Calvo and Ventura, 2023) of sources to issue framing and topics (Valenzuela, Piña and Ramírez, 2017) impact the incidence of sharing and likes on social media.

One overarching insight that emerges from this growing body of research is that different kinds of messages circulate across distinct social media networks. Below, we define the networks most relevant to Ukrainian officials with reference to communities that share and re-share information with each other. In light of those strategically important networks, we derive the following testable hypotheses:

H4: *There will be an increase in engagement with the tweets posted by the Ukrainian official accounts in the immediate post-invasion period.*

[1]For instance, see Kümpel, Karnowski and Keyling (2015) for a review of research bearing on the sharing of news via social media.

H5: *Social media posts related to the Russian attacks and military developments will disseminate more broadly in local and global media networks because violence and personalized stories about the invasion (i.e., those that frame Russia and Putin as an aggressive, autocratic, violent invader of neighbors) make for popular news.*

H6: *Messages bearing on war crimes, violence against women, and humanitarian needs will broadly disseminate across Western government networks.*

H7: *Media will tend to amplify tweets with a predominantly negative tone compared to those with a positive tone.*

3. Russia's Invasion of Ukraine

We test our arguments about the importance of social media as a strategic tool for digital diplomacy using Russia's recent full-scale invasion of Ukraine, where social media became a separate battleground in the Russia-Ukraine war. Since Russia's first aggression in 2014, when it annexed Crimea and openly backed separatists in Eastern Ukraine, government and state officials from both sides have inundated the public discourse with propaganda and narratives targeting domestic and foreign audiences to rally support. While Russia's primary messages centered around imperialistic and colonial narratives (i.e., Great Russia and its "fraternal nations") aimed at domestic audiences and the countries near abroad, Ukraine has been fighting an information war of its own directed toward foreign audiences.

As the war unfolded, for many Ukrainians, social media became an effective vehicle for shaping public perceptions of the war abroad, especially against the background of diminishing Russian influence on popular social media channels, such as Twitter, Facebook, and Instagram. Although television is the dominant news medium in Ukraine (96.8% of the overall population), the country also boasts a relatively high social media penetration rate, with 64.6% of the population going on social media channels for news at least once a week (*Digital 2022: Ukraine*, 2022). As of 2022, Facebook was leading social media channels at 35.7% of the overall population (45% of the 28 million social media users in Ukraine), while Twitter trailed at 2.4% of the eligible adult audience in Ukraine.

Twitter has particularly become a popular platform for discussing and disseminating news about the war and countering Russian disinformation campaigns since 2022. Ukrainian government initiated concerted policy efforts to combat the threats posed by Russian state-linked media agencies (Kowalski, 2022). Indeed, President Volodymyr Zelensky himself took on an active user role since the invasion, using the platform to post selfie videos of himself walking on the streets of Kyiv amidst growing attacks on the city.

The president's videos, once posted, reached and circulated among millions of individuals, serving as a catalyst for bolstering support from other nations in favor of Ukraine's embattled government. The circulation of a brief video on Twitter featuring President Zelensky's remark during a video conference with EU leaders, where he concluded by saying, "This might be the last time you see me alive," was enough to trigger the implementation of severe sanctions against Russia (Feldstein, 2022).

4. DATA

We use three sets of original Twitter data to evaluate how social media messaging affects support for conflict.

4.1. Ukraine Metadata

Our main data builds on the Data4Ukraine Project (*Data4Ukraine Project*, 2022). Relying on Twitter's academic API and a small list of general query terms, we collected a dataset of approximately 500 million tweets related to the war in Ukraine, which we used to map, classify, and deliver data on the war on a near real-time, hourly basis from March 2022-February 2023.[2] The data are drawn from an initial collection of more than 400 Twitter accounts and their followers, including politicians, civil society activists, journalists, and media at the national and local level all across Ukraine, encompassing as broad a range of political positions as possible. We use this collection primarily for community detection methods.

4.2. Tweets by Ukrainian Officials

To understand how government online political discourse shapes foreign support for war, we identified Ukrainian state officials who held official state executive and legislative positions and were active on Twitter between August 18, 2010 and December 31, 2022.[3] We identified and included all Ukrainian Rada (parliament) members and state ministers who had Twitter accounts and actively tweeted between 2010-2022, including at the time of our data collection.[4] These efforts yielded a group of 107 active individual Twitter

[2]Data For Ukraine is a major international collaboration between scholars at The Kyiv School Of Economics, the MOBILISE project at the Universities of Manchester and Oxford, the Machine Learning for Peace project at Duke University, political scientists at the University of North Carolina and the Inter-Disciplinary Lab for Computational Social Science at the University of Maryland.

[3]We collected Twitter Ukraine metadata in December 2022, which marked the end of our data collection period.

[4]We use the full timelines of each member of the Ukrainian Rada, ministers and other executive branch officials on Twitter. August 18, 2010 marks the start of the earliest tweet of officials in our data.

accounts out of 475 relevant officials on our list (450 Rada members and 25 state ministers). Online Appendix A lists all included officials, including information about their position, the date range of their Twitter accounts, as well as the number of their followers at the time of data collection. Using Twitter's Historical API, we build on this identifying information to collect all their public social media posts from their entire Twitter timeline. This collection of approximately 150,000 tweets (70% of which have been retweeted across international networks) provides the complete corpus of government tweets both before and after the Russian invasion, which we utilize for topic and sentiment analysis methods.

Twitter accounts in the final dataset include an average of 241,828 followers and 356 friends. The average number of days the accounts existed on Twitter is 1470 days (more than four years), with a maximum of 4449 days (more than 12 years). The daily average tweeting from these accounts is around 142 tweets. These Twitter accounts have a strong presence and network support. On average, tweets posted by each official in the data are retweeted 543 times.

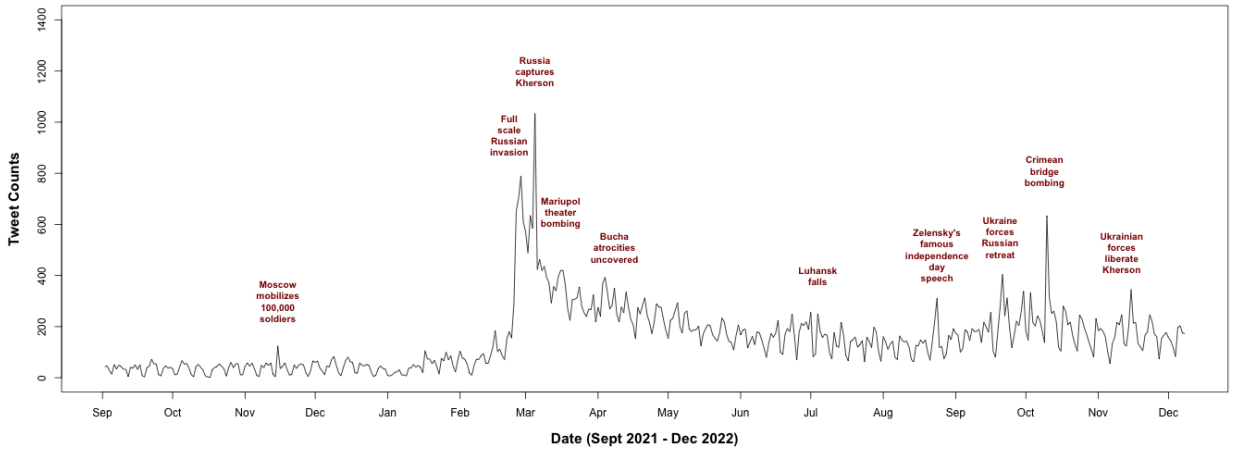
By combining the Ukrainian officials' timelines with the broader corpus of tweets on the war in Ukraine, we are able to map out the distinct international networks that consume and disseminate each tweet by a Ukrainian official. In Figure 1, we plot the daily timelines of counts of tweets disseminated by Ukrainian officials and their retweets by the international community. The graph demonstrates that both the original tweets and their retweets are concentrated around key events of the war timeline.

4.3. Accounts Retweeting Tweets by Ukrainian Officials

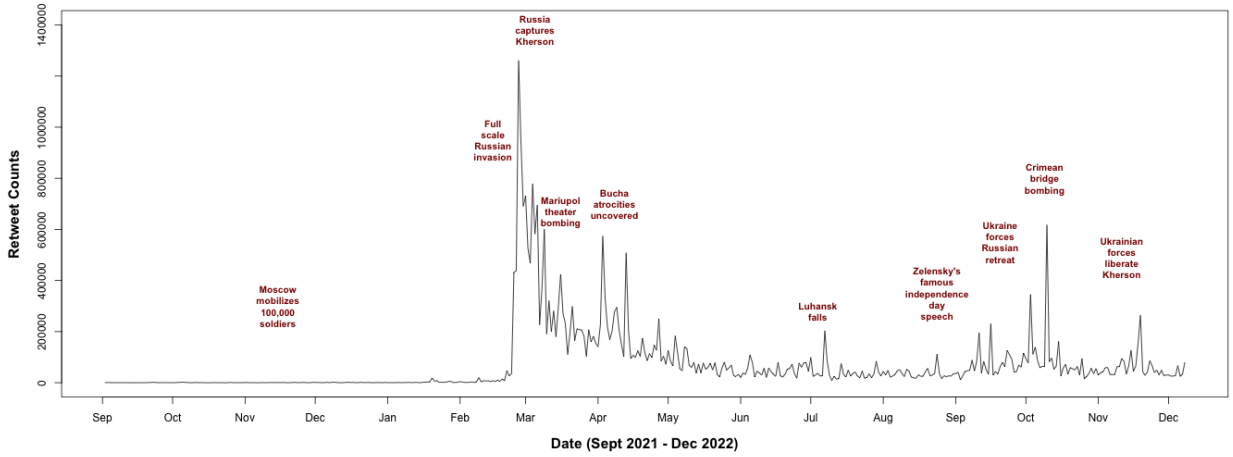
To examine the effects of specific messages on the frequency of retweets – how the original tweets are amplified and disseminated across international networks – we use the Ukraine metadata to identify all accounts publicly engaging with (retweeting) Ukrainian officials since 2022. We left-censor the data in 2022 because we are interested in engagement with war-related tweets. We first identify tweets that overlap in both datasets by doing an exhaustive search within a week-long period from the time of the creation of the original tweet. We then proceed with merging by unique Twitter IDs, which results in a dataset of approximately 15,000 tweets corresponding to 4,189,260 retweets for which we could identify unique retweeting accounts.[5] Approximately 15% (2,158) of the tweets

[5]It is worth noting that there are multiple reasons why we end up with 10% of the original data: a) the Ukraine metadata only starts in 2022, whereas the timelines of original Ukrainian officials date as far back as 2010. This does not create bias since we are only interested in war-related tweets for our community detection analysis; b) The Ukraine metadata includes tweets that are only focused on the war (based on term-specific inquiries), whereas the Twitter data for Ukrainian officials use the entire historical archive of

Figure 1: Timeline of 147,489 Twitter Posts of Ukrainian Officials and their 34,307,407 Retweets with Key Events Around the Volume Spikes



(a) Daily volume of original tweets



(b) Daily volume of retweets

in this collection have zero retweets. The tweet with the maximum number of retweets in this collection has 21,396 retweets, belongs to the Ukrainian Foreign Minister, Dmitry Kuleba, and features the following text: *"Bucha massacre was deliberate. Russians aim to eliminate as many Ukrainians as they can. We must stop them and kick them out. I demand new devastating G7 sanctions NOW."*

We use this collection of approximately 12,500 tweets with at least a single retweet to identify unique retweeted accounts and measure the effects of official tweets on engagement by various international communities. There are 554,546 unique engagements in this dataset.

5. Empirical Strategy

5.1. *Processing and Volume Analysis*

We start by preprocessing the text of the tweets by stemming and lemmatizing, removing URLs, handles, mentions, hashtags, digits, punctuation, and emojis. Using the preprocessed text, we detect the language of each tweet and retain the top three languages used by Ukrainian officials. The tweets in the data are predominantly in Ukrainian (61%), English (35.1%), and Russian (3.9%) languages. To avoid building multiple classifiers and dictionaries across different languages, we start by translating Russian and Ukrainian tweets using pre-trained Huggingface NLP translation models. We then include all translated tweets in topic and sentiment models.

We also calculate the average shift in the volume of tweets for all official postings from the pre-invasion to the post-invasion periods to conduct a placebo test that determines whether the observed change in volume falls outside the mass of the distribution of changes in volume generated by using placebo intervention dates at random – a simulation technique we adopt from Pan and Siegel (Pan and Siegel, 2020).

Finally, we use Autoregressive Interrupted Time Series Analysis to estimate changes in the volume of tweeting and engagement using the following model:

$$Y_t = \beta_1 \cdot \text{Timelapse} + \beta_2 \text{Invasion} + \beta_3 \text{Tweet} \boldsymbol{X_t} + \epsilon_t. \tag{1}$$

where Y_t is the number of tweets or retweets posted at time t, and Timelapse represents the number of days since the invasion. The second term is an indicator for invasion and β_3 is the coefficient for the interaction term (the slope change of the volume in the

the public tweets by the account holders.

post-invasion period). The intercept represents the baseline volume of tweets/retweets posted at $t = 0$. β_1 is the coefficient for the change in the volume of tweets/retweets associated with a one-unit time increase (daily pre-invasion trend). β_2 is the main coefficient of interest that shows the immediate effect of the invasion on the volume of posted tweets/retweets.

5.2. Topic Models

To identify relevant topics, we use an unsupervised topic modeling approach by training a transformer-based topic model with BertTopic (Grootendorst, 2022). In addition to transformers, BERTopic leverages UMAP dimensionality reduction, HDBSCAN hierarchical density-based clustering technique, and c-TF-IDF topic extraction to create dense clusters that allow for easily comprehensible topics while retaining keywords in the descriptions.[6] The unsupervised approach is a deliberate choice as we did not want to impose any priors on the number or accurate description of categories of political matters discussed by elites.

Following a number of cross-validations with different cutoff values, BertTopic modeling yields $K = 50$ topics that represent the wide range of issues the Ukrainian government officials discuss on Twitter. We then classify these topics into ten aggregate groups by merging them based on their relevance. We perform several robustness tests to demonstrate that the generated topics pass standard tests of predictive and semantic validity. Given that some of the resulting groups of topics are apolitical and, therefore, of no value for our discussion, we exclude those from our final analyses.

5.3. Sentiment Analysis

To assess the impact of tweets' sentiment on their amplification online, we train a separate transformer-based model (Twitter-RoBERTa) that classifies tweets into positive, negative, and neutral tweets by predicting sentiment scores and probabilities associated with each score. Twitter-RoBERTa is a variant of the RoBERTa model based on 58 million tweets and fine-tuned for sentiment analysis tasks with the TweetEval benchmark (Barbieri et al., 2020).

[6]For each datapoint, Uniform Manifold Approximation and Production (UMAP) searches through points to identify the kth nearest neighbor while maintaining the main distinguishable features.

5.4. *Community Detection*

One of our key arguments concerns the communities formed on Twitter around the discussion of the Russia-Ukraine war. Our aim was to map the relationships that connected certain accounts as a network and identify the key individuals within each of these hidden communities. We use the Leiden algorithm on the entire Ukraine metadata corpus (in addition to the dataset of Ukrainian officials) to implement the community detection process and identify clusters within the Ukraine Twitter network (Traag, Waltman and Van Eck, 2019). After constructing an undirected graph to assign accounts to different clusters, we assess the modularity of clustering[7] and identify influential accounts within each community based on various centrality measures, including degree and eigenvector centrality. These metrics help to identify accounts that are highly connected, have influence, and are pivotal in information flow within their respective communities.

5.5. *Modeling Strategies*

5.5.1 Fixed-Effects Model We use event count models to test the relationship between the volume of tweets by Ukrainian officials and engagement with these tweets from the broader Twitter community. Specifically, we use Negative Binomial Autoregressive models, in which our dependent variable is either the number of tweets or the number of retweets depending on the specification and the independent variable is a binary indicator for the post-invasion period. We run two sets of analyses for each of the outcomes: (re)tweet volume within a one-month window and within a one-year window.

We then move on to model the relationship between Twitter content and tone first with the trends in tweeting and with secondary engagements and amplification. Before we proceed with our main analyses, we transform the main tweet data into panel data by aggregating tweets to the account-month level. We fit the following fixed-effects linear regression models, where the dependent variable is the percentage of tweets on a given topic.

$$Y_{it} = \beta_1 \cdot \text{Invasion}_{it} + \beta_2 \cdot \text{Frequency} + \beta_3 \boldsymbol{X}' + \varphi_i + \lambda_t + \epsilon_{it}. \tag{2}$$

Y_{it} represents the percentage of tweets on a given topic that each individual i tweets in month t. Our main coefficient of interest is Invasion_{it}, which is an indicator variable for whether the tweets were posted before or after the invasion. Frequency_{it} stands for

[7]Modularity measure is a scalar value that measures the density of the links inside the communities as compared to links between communities.

the log number of tweets per month. The vector $\boldsymbol{X}'$ contains individual-level covariates (number of followers and friends). φ_i are account level fixed effects and λ_t are month fixed effects. Standard errors are clustered at the account level.

We use three different specifications for the fixed effect models: a two-way fixed effects for month and account holder, a pooled version with only month fixed effects, and an account-specific linear time trend to capture account-specific characteristics (Esberg and Siegel, 2021).

We use a similar empirical approach to test our theoretical expectations about the tone of the tweets. The dependent variable for the set of fixed-effects models that evaluates the tweet sentiment dynamics is the percentage of negative and positive tweets that each individual i tweets in month t in our panel data. The main independent variable – Invasion_{it} – remains the primary variable of interest and captures the shift in the messaging tone following the invasion.

To model how the communities formed on Twitter share and amplify information posted by Ukrainian officials, we use the left-censored tweet-level data with the community detection results. Our empirical approach leverages two features of the processed data: a) the updated data includes only the tweets posted by officials following the Russian invasion, and b) only the tweets that are related to the war are retained. Following preprocessing, merging, and retaining posts that could be matched to the metadata, we used 14,623 individual tweets to proceed with the analysis.

The base Negative Binomial model specification is:

$$Y_{ik} = \beta_1 \cdot \boldsymbol{Topic}_i + \beta_2 \boldsymbol{X}' + \varphi_i + \lambda_t + \epsilon_{it}. \tag{3}$$

where Y_i represents the number of retweets a given tweet i receives from a community k. $\boldsymbol{Topic}_i$ is a matrix of independent variables corresponding to the main topics. $\boldsymbol{X}'$ stands for tweet-level (language of the tweet) controls. φ_i are account and month-level fixed effects and λ_t are date fixed effects. Standard errors are clustered at the account level. Given that the dependent variable (volume of tweets and retweets) is a count variable with only positive integers and features overdispersion, we use a negative binomial model.[8]

Finally, similarly to the empirical strategy above, we test our hypothesis about the sentiments of tweets. We use the following specification:

[8]The negative binomial model addresses the issue of overdispersion by allowing the variance to exceed the mean.

$$Y_{ik} = \beta_1 \cdot \boldsymbol{Sentiment}_i + \beta_2 \boldsymbol{X}' + \varphi_i + \lambda_t + \epsilon_{it}. \quad (4)$$

where $\boldsymbol{Sentiment}_i$ represents a 14,623 x 2 matrix of variables corresponding to the two main sentiments captured from the text of the tweets, and all other terms remain the same.

6. RESULTS

6.1. *Tweeting and Retweeting Volume Changes*

We start by providing evidence of shifts in volume in the post-invasion period and the subsequent increase in engagement. The volume of tweeting by Ukrainian officials significantly increased after the February invasion. The first plot in Figure 3 displays this with the pre-arrest and post-release volume of tweets produced by official accounts with a loess-smoothed trend line. The placebo tests demonstrate that Ukrainian ministers and members of parliament tweeted significantly more in the post-invasion period compared to the pre-invasion period. Figure 2 displays the results of a nonparametric placebo test, which compares the actual difference in tweet volume associated with the invasion to the difference in volume generated by placebo intervention dates chosen at random within a period of a year before and after the invasion. The dotted vertical line shows the average daily tweet volume difference between the pre-invasion and post-invasion year. We see that Ukrainian officials tweeted less in the year before the invasion compared to the year after the invasion.

Additionally, we use Negative Binomial Autoregressive models to evaluate the effect of invasion on the volume of tweets posted by Ukrainian officials and retweets of these tweets by the Twitter communities. Table 1 displays the separate results within month and year periods.

Table 2 reports the Interrupted Time Series Analysis results. We see a significant positive shift in the online activity of Ukrainian officials and their engaged communities.

6.2. *Issue Topics of Ukrainian Government Tweets*

Tables 3 and 4 display the list of the original topics and consolidated topics we have classified into separate groups, while Table 5 provides a set of sample tweets from each category to illustrate the relevance of topics to the body of text. Among the consolidated topic groups, topics focusing on executive, legislative, and judicial matters (grouping 7),

Figure 2: Volume of Tweets by Ukrainian Officials

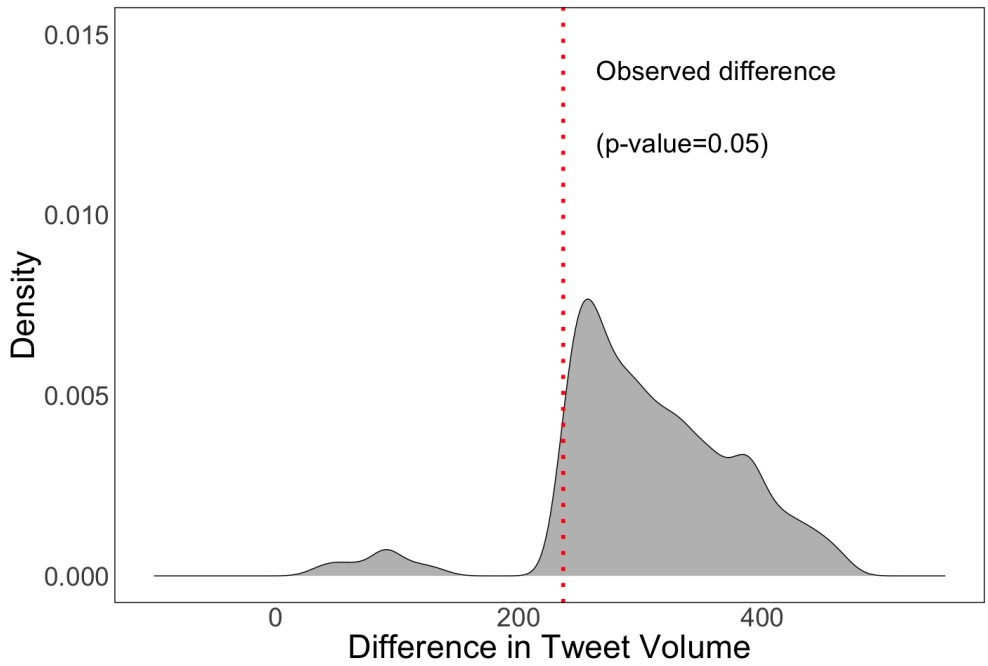


Table 1: Effect of Russia's Invasion on the Volume of Tweets and Retweets Negative Binomial Event Count Models

	Dependent variable: Volume			
	Tweet		**Retweet**	
	(1-month period)	(1-year period)	(1-month period)	(1-year period)
Post-Invasion	2.151***	1.846***	2.739***	2.863***
	(0.006)	(0.003)	(0.033)	(0.013)
Constant	4.120***	3.790***	4.085***	3.393***
	(0.004)	(0.002)	(0.022)	(0.008)
Observations	147,494	147,494	29,132	29,132

Note: Robust standard errors are reported in parentheses. Significance levels: *p < 0.1; **p < .05; ***p < .01.

Table 2: Effect of Invasion on Daily Volume of Tweets & Retweets (Ukrainian Official Accounts)

	Tweets	**Retweets**
Baseline	102.595^{***}	336.856^{***}
	(1.670)	(53.598)
Pre-Invasion Trend	0.180^{***} 0.356^{**}	
	(0.006)	(0.127)
Post-Conflict Level Change	621.675^{***}	474.567^{***}
	(2.228)	(46.856)
Post-Conflict Slope Change	-17.205^{***}	-12.187^{***}
	(0.105)	(2.080)
AIC	343226.115	520932.027
BIC	343275.791	520981.704
Log Likelihood	-171607.057	-260460.013
Num. obs.	29132	29132

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$; $^{\cdot}p < 0.1$

social issues (grouping 9), and economic and business matters (grouping 8) dominated the corpus in the pre-invasion period, while the tweets following the invasion center around humanitarian and human rights (grouping 2), international security (grouping 4), and attacks (grouping 1). Similarly, in the pre-invasion period, the most retweeted tweets were from the topic groupings of humanitarian and human rights (grouping 2), executive, legislative, and judicial issues (grouping 7), and cultural issues (grouping 10), while the top three retweeted topics in the post-invasion period are humanitarian and human rights (grouping 2), attacks (grouping 1), and international security (grouping 4). Initial descriptive analysis suggests that the distribution of discussion topics and their amplification in the networks differs significantly in the pre and post-invasion periods.

The results indicate that the invasion led to a shift from domestic to war-related topics: we see an increase in Ukrainian officials' postings on humanitarian issues and attack-related messages; discussions of domestic executive and legislative matters, social, cultural, and economic issues would not dominate the discourse. As our theory predicts, the invasion creates a change in incentives that leads to digital communication strategies directed at capturing the attention of foreign audiences. Further analyses demonstrate that invasion is associated with a significant increase in engagement with foreign audiences.

Table 3: List of Topics

N	Label	N	Label
0	Enemy/War/Crime/Day	25	Children/Killed/Ukrainian
1	Education/Medical/Health/School	26	No Fly Zone Over Ukraine/Americans/Support
2	See/Welcome	27	Energy/Efficiency/Zubkogennadiy
3	European/EU/Integration/Candidate	28	Women/Gender/Violence
4	Nazk/Anticorruption/Declaration	29	Education/Science/Ukraine/Students
5	Supreme/Council/Parliament	30	Kyiv/Region/Killed
6	Infrastructure/Ukraine/Ministry	31	Free Trade/Agrarian/Agricultural
7	Privatization/Auction/Start/Price	32	Museum/Nan/Exhibition
8	Zelensky/President/Ukrainian	33	Fighting/Combating/Corruption
9	Christmas/Day/Christ	34	MIP/Minister/Information Policy
10	Crimean/Tatars	35	Security/Organization/Security Work
11	Sanctions/Russian/Oil	36	Memory/Maxshcherbyna/Respect
12	Infrastructure/Minister/Andrey	37	Drones/Iranian/Kamikaze
13	Russia/Putin/Putin's	38	Crimes/War
14	COVID/Vaccinated/People/Cases	39	Finance/Minister/Budget
15	Grain/Food/Tons/Million	40	Kyiv/Missile/Explosions/Hit
16	Russian/Invasion/Ukraine	41	Green/President/Volodymir
17	Budget/Billion/State/Minfin	42	Pension/Reform/Pensioners
18	Missiles/Kharkiv/Russian	43	Genocide/Sky/Stop/Members/Plead/Protect
19	Draft/Act/Law	44	Video/Youtube/Like
20	Children/Disabilities/Rehabilitation	45	Poland/Warsaw/Andrzejduda
21	NATO/Ukraine/Membership	46	Digital/Transformation/Ministry
22	Humanitarian/Aid/Corridors	47	Good/Day/Morning
23	Information/Security/Operational	48	Reform/Reforms We Need/Government
24	Exports/Goods/Cubies	49	Courts/Judicial/Anticorruption

Note: Some of these topic numbers are later merged to create single topics from similar topics.

Table 4: Consolidated Topics

Topic Grouping 1 - Attacks		**Topic Grouping 2 - Humanitarian & Human Rights**	
18	Missiles/Kharkiv/Russian	0	Enemy/War/Crime/Day
30	Kyiv/Region/Killed	10	Crimean/Tatars
37	Drones/Iranian/Kamikaze	15	Grain/Food/Tons/Million
40	Kyiv/Missile/Explosions/Hit	22	Humanitarian/Aid/Corridors
		25	Children/Killed/Ukrainian
		28	Women/Gender/Violence
		38	Crimes/War
Topic Grouping 3 - Russia and Putin		**Topic Grouping 4 - International Security**	
13	Russia/Putin/Putin's	3	European/EU/Integration/Candidate
16	Russian/Invasion/Ukraine	11	Sanctions/Russian/Oil
		21	NATO/Ukraine/Membership
		26	No Fly Zone Over Ukraine/Americans/Support
		43	Genocide/Sky/Stop/Members/Plead/Protect
		45	Poland/Warsaw/Andrzejduda
Topic Grouping 5 - National Defense		**Topic Grouping 6 - Infrastructure**	
23	Information/Security/Operational	6	Infrastructure/Ukraine/Ministry
35	Security/Organization/Security Work	12	Infrastructure/Minister/Andrey
Topic Grouping 7 - Executive, Legislative & Judicial Issues		**Topic Grouping 8 - Economic & Business Issues**	
4	Nazk/Anticorruption/Declaration	7	Privatization/Auction/Start/Price
5	Supreme/Council/Parliament	17	Budget/Billion/State/Minfin
8	Zelensky/President/Ukrainian	24	Exports/Goods/Cubies
19	Draft/Act/Law	27	Energy/Efficiency/Zubkogennadiy
34	MIP/Minister/Information Policy	31	Free Trade/Agrarian/Agricultural
41	Green/President/Volodymir	33	Fighting/Combating/Corruption
48	Reform/Reforms We Need/Government	39	Finance/Minister/Budget
49	Courts/Judicial/Anticorruption	46	Digital/Transformation/Ministry
Topic Grouping 9 - Social Issues		**Topic Grouping 10 - Cultural Issues**	
1	Education/Medical/Health/School	2	See/Welcome
14	COVID/Vaccinated/People/Cases	9	Christmas/Day/Christ
20	Children/Disabilities/Rehabilitation	32	Museum/Exhibition
29	Education/Science/Ukraine/Students	36	Memory/Maxshcherbyna/Respect
42	Pension/Reform/Pensioners	44	Video/Youtube/Like
		47	Good/Day/Morning

Table 5: Examples of Tweets within Different Topic Groups

Account holder	Position	Original Tweets
		Attacks
Inna Sovsun	MP	#Kyiv was bombed with Iranian drones this morning. At least 4 major explosions. I hope #Iran will be sanctioned for that!
Roman Hryshchuk	MP	Powerful shelling of Kharkiv: 10 people injured, three of them children. Russians hit private houses, a children's art house, a school, and a sports infrastructure facility were damaged. A kindergarten in the central part of the city is on fire.
Oleksiy Goncharenko	MP	#Russia has just fired missiles at a hotel in the central park of #Zaporizhzhia! People under the rubble! The Russians also fired at the TV tower and the electrical substation! Part of the district is without light. A total of 9 rockets were launched! #RussiaisATerroistState
		Humanitarian and Human Rights
Oleksandr Merezhko	MP	In the future International Tribunal on crimes committed against Ukraine Putin and his accomplices will face the charges for such crimes as: 1) crimes against peace (planning and starting war); 2) crime of aggression; 3) war crimes; 4) crimes against humanity.
Mykhailo Fedorov	Minister of Digital Transformation	During 15 days of war, Russian occupants killed 71 children in Ukraine! @Globecast isn't it enough to stop the broadcast of bloody Russian TV propaganda?
Eduard Proshchuk	MP	Russian troops ruthlessly kill Ukrainian children #stopputin #stopwar #stoprussia #BuchaMassacre #NATOCloseTheSky #PutinLies @POTU @jensstoltenberg @OlafScholz @EmmanuelMacron @BorisJohnson
		Russia and Putin
Mykola Kniazhytskyi	MP	Putin's statements today are a bid for leadership in an anti-Western world. But #Putin was wrong. He clearly does not understand that even third world countries do not want to deal with a country that threatens everyone with a #nuclear bat. #RussiaIsLosing #Ukraine
Lesia Vasylenko	MP	The sooner #Putin is stopped, the sooner the world can move on to better things. Putin's greed will only grow. As his resolve to solve the Ukrainian question. This only means that @NATO countries will have to keep increasing their defence budgets too
Dmytro Natalukha	MP	And if we sincerely want russia to change - it has to change not just from the top, but from the bottom as well. People, nurtured with propaganda, lies and hatred will not change their attitudes voluntarily, especially - if they feel untouchable, as sanctions don't affect them
		International Security
Ivanna Klympush	MP	Those talking about lift of #sanctions, have to remember #RU continues to send its weaponry to independent #European state.
Denys Shmyhal	Prime Minister	EU adopted 8th sanction package against rf. Another step to affect the aggressor's economy. Grateful to EU for solidarity with UK. We expect continued pressure, including a full energy embargo & disconnection of all banks from SWIFT. This is the only way to stop the war.
Alona Shkrum	MP	President Macron has supported #unrussiaUN and demanded that #UN Security Council should limit the right of veto "in case of mass war crimes". Merci pour votre soutien et position forte!
		National Defense
Pavlo Sushko	MP	Had a next meeting in the Verkhovna Rada. We voted also on: increased spending on national security and defense; to receive Ukrainian citizenship one has to know basics of the Constitution of Ukraine and the history of Ukraine.
Official channel	Ministry of Foreign Affairs	This time our shared victory should be followed by the establishment of a revised security system that will truly ensure that the war, occupation and aggression will really never happen again. The grounds for this new secure world have already been laid down now.
Andriy Yermak	Head of the Office of the President of Ukraine	Together with @AndersFoghR, we held the second meeting of the working group on security guarantees for UK. Discussed a draft plan of recommendations for future security guarantees for UK. The Group believes that @NATO and the Article 5 remain the gold standard of guarantees.

Account holder	Position	Original Tweets
		Infrastructure
Pavlo Sushko	MP	We are working with architects, the Ministry of Infrastructure and local authorities on the problems brought by the war. IDPs, destroyed cities, queues for apartments, housing for the military. We will do everything possible to resolve these issues as soon as possible.
Yulia Klymenko	MP	Today Rada Transport & Infrastructure Committee has supported draft law 1061 on implementation of road safety audit based on EU directive 2008/96/EC. Hope our roads will be safer.
Kira Rudik	MP	#Taiwan will help to rebuild the civil infrastructure of five Ukrainian cities. For this purpose $6 million will be sent to #Kharkiv,#Chernihiv, #Mykolaiv, #Sumy and #Zaporizhzhya. Thank you! It is necessary to begin cleaning up the traces of the war already now.
		Executive, Legislative, and Judicial Issues
Volodymyr Zelenskyy	President	IT solutions can be an effective step towards eliminating abuse and ensuring court transparency. Similar to public services in a smartphone, we seek to create a court in a smartphone. Jury trial is also among the effective tools.
Olga Stefanishyna	Deputy PM for European & Euro-Atlantic Integration	Ukraine continues anti-corruption reforms to build transparent, strong, and trustworthy state institutions. Despite the complexity of the task and growing resistance inside the system, it is the only way to ensure a truly democratic and resilient society.
Andrii Osadchuk	MP	#Verkhovna_rada adopted 14 laws to #StopRussianAgression. They include legislation on mobilization, armed forces, liability for looting, cancelling limitations on using weapons by civilians against Russian forces, seizure of assets in Ukraine owned by #Russia
		Economic and Business Issues
Serhiy Lyovochkin	MP	Draft #budget for 2019 is anti-social. The Gov continues its 2014-2018 policies of lowering social standards, under-financing education, #healthcare and utilities' subsidies, which has already put millions of #Ukrainians below the poverty line
Valentyn Nalyvaichenko	MP	Mogherini today in Kyiv repeated my statement from July; Ukraine needs only one reform: Against corruption.
Official channel	Cabinet of Ministers	Government transfers a record number of 431 state-run enterprises and 4 large objects for privatization
		Social Issues
Official channel	Ministry of Health of Ukraine	During quarantine period due to the #COVID19 outbreak, each of us can potentially become infected. So every time you leave the house, remember - you are endangering yourself and other people. The MOH advises to self-isolate and leave home only in case of urgent need.#StayAtHome
Rustem Umerov	Chair of the State Property Fund of Ukraine	The #EU allocated an additional €16 mln to support #Ukraine. The funds will be used to equip safe education spaces for learning. Part of the money will be used to help victims of violence.
Official Channel	Ministry of Education and Science of Ukraine	Foreign students to be admitted to Ukraine's higher educational institutions remotely this year. This means admission of foreign students to Ukraine's higher educational institutions would not be cancelled this year even despite the full-scale war.
		Cultural Issues
Volodymyr Ariev	MP	It's always a perfect sign to find a rainbow. Happy Eastern and pray God for peace and prosperity.
Tkachenko Oleksandr	Minister of Culture and Information Policy	Today on Kyiv Day visited museums in our city with my son. Cultural life flourishes even during the war. Ukrainian children now are interested in weapons more than lego they grow fast as grow strength of our country #kyivculturelife
Solomiia Bobrovska	MP	Merry Christmas! At Christmas, heaven opens and God brings magic into our hearts and teaches us how to love. Spread sparks of love around you, and it will be the best gift for the Son of God. For all welcoming the Star in the sky - Christ is born! #Christmas #love

6.3. The Language Shifts in Tweeting

We see a considerable shift in the language of tweets posted by Ukrainian officials in the post-invasion period. The results presented in Figure 3 show the shift in the volume of tweeting and retweeting across different languages around the time of Russia's invasion. Table 6 shows the share of tweet content (by topic) across different languages in the pre-invasion and post-invasion periods, and Table 7 provides statistics for Twitter accounts with various dominant languages in the two separate time windows.

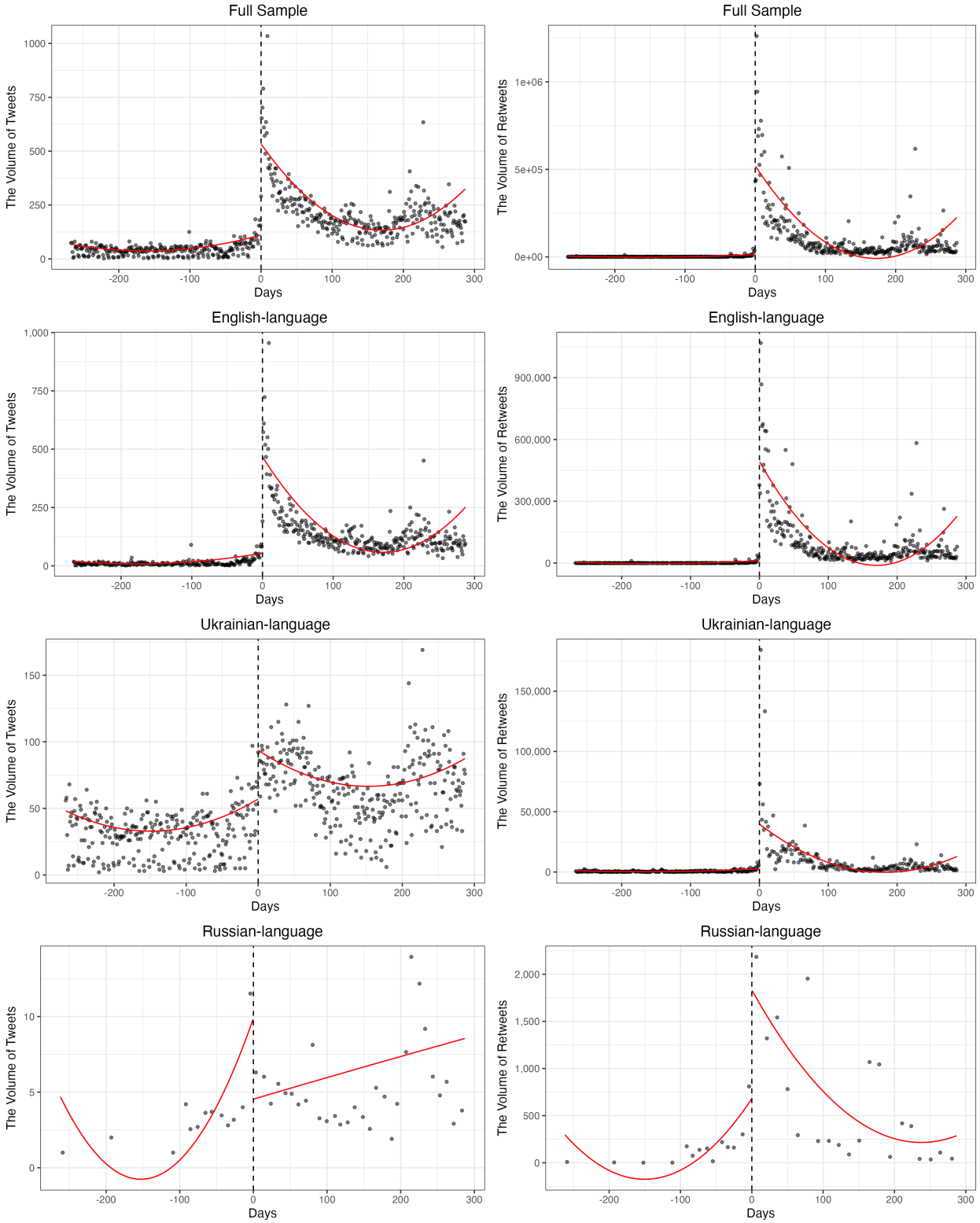
Table 6: Share of Tweet Content across Languages Before and After Invasion

	Pre-invasion			**Post-invasion**		
Main Topics	*English*	*Ukrainian*	*Russian*	*English*	*Ukrainian*	*Russian*
Attacks	0.957	0.264	0.421	4.972 ↑	1.282 ↑	0.792 ↑
Humanitarian	7.023	5.019	5.245	7.855 ↑	7.862 ↑	8.911 ↑
Russia	1.440	0.359	0.590	2.820 ↑	1.000 ↑	0.891 ↑
International Security	6.484	2.358	1.980	5.900 ↓	2.984 ↑	0.495 ↓
National Defense	0.270	1.419	0.506	0.239 ↓	1.141 ↓	0.198 ↓
Infrastructure	1.050	2.408	1.011	0.458 ↓	1.351 ↓	0.198 ↓
Executive & Legislative Issues	2.601	7.630	4.150	1.206 ↓	3.811 ↓	1.584 ↓
Economic & Business Issues	4.170	6.140	4.487	0.894 ↓	2.209 ↓	1.683 ↓
Social Issues	4.551	6.388	2.760	0.875 ↓	3.392 ↓	0.891 ↓
Cultural Issues	1.691	4.368	8.026	2.189 ↑	5.695 ↑	24.951 ↑

Table 7: Dominant Language Statistics Before and After the Invasion

	Accounts	**Tweets**				
Dominant Language	**N**	**N**	**Median**	**Mean**	**SD**	**Range**
Pre Invasion						
English	21	42	107	264.76	430.76	[2, 1644]
Ukrainian	55	136	1032	1255.98	1063.96	[8, 3174]
Russian	6	15	135	188.67	159.43	[63, 368]
Post Invasion						
English	63	139	73	204.51	358.65	[1, 1644]
Ukrainian	35	75	1756	1521.13	1087.78	[3, 3023]
Russian	0	0	-	-	-	-

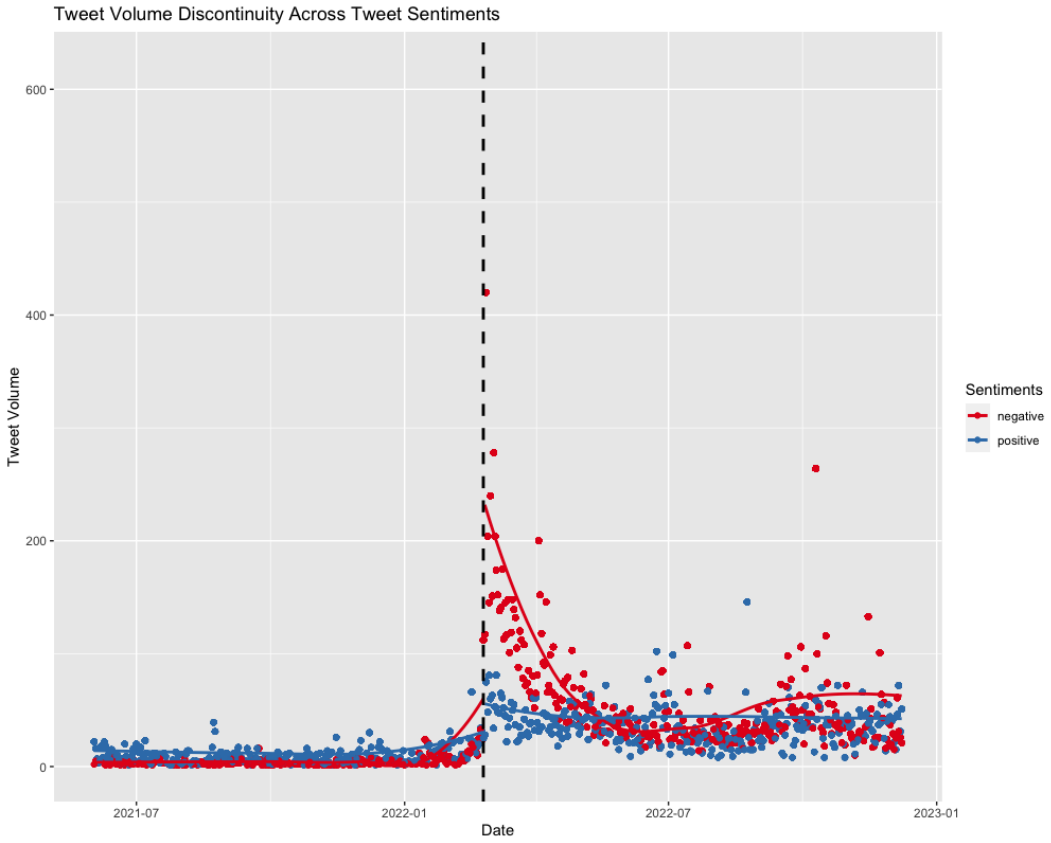
Figure 3: Tweet and Retweet Volume Discontinuities Across Languages



6.4. The Sentiment of Ukrainian Government Tweets

We observe a sudden increase in the volume of negative tweets from Ukrainian officials following the initial incursion. Figure 4 displays the sharp discontinuity in the volume of negative tweets at the cutoff. While we also observe a slight increase in the volume of positive-toned tweets due to the ubiquitous increase in the volume of posts, the discontinuity for positive tweets is not as significant and sharp as with the negative postings.

Figure 4: Tweet Volume Discontinuity Across Sentiment



6.5. Fixed-Effect Models: Topic and Sentiment Shifts in the Original Tweets

Findings from our initial fixed-effect models, provided in Tables 8 and 9, provide robust evidence for the increase in the volume of original social media postings of Ukrainian officials in the post-invasion period across a set of topics and sentiments. In line with our hypotheses, the results indicate a surge in tweets about attacks and humanitarian issues after the invasion. Importantly, the results also suggest that the tone of messages switched from positive to negative following the invasion.

Table 8: Fixed-Effects: Topics and Invasion

	Dependent variable:					
	Attacks			**Humanitarian**		
	(1)	(2)	(3)	(4)	(5)	(6)
Tweeted Post-invasion	2.206*	4.187**	2.671**	7.091***	7.932***	7.673***
	(1.335)	(1.383)	(1.341)	(2.701)	(2.851)	(2.730)
Number of Tweets	0.060	−0.115	0.087	0.250	−0.160	0.371*
	(0.086)	(0.070)	(0.098)	(0.174)	(0.145)	(0.199)
Observations	3,679	3,679	3,679	3,679	3,679	3,679
R^2	0.074	0.104	0.152	0.054	0.052	0.123
	Dependent variable:					
	Russia			**International Security**		
	(1)	(2)	(3)	(4)	(5)	(6)
Tweeted Post-invasion	1.329	1.482	1.56*	0.375	0.624	−0.749
	(0.925)	(0.931)	(0.924)	(2.139)	(2.213)	(2.195)
Number of Tweets	0.127**	0.069	0.062	0.193	−0.105	0.165
	(0.060)	(0.047)	(0.067)	(0.138)	(0.113)	(0.160)
Observations	3,679	3,679	3,679	3,679	3,679	3,679
R^2	0.084	0.083	0.172	0.069	0.070	0.111
	Dependent variable:					
	National Defense			**Infrastructure**		
	(1)	(2)	(3)	(4)	(5)	(6)
Tweeted Post-invasion	0.662	0.064	0.536	0.174	−0.380	0.171
	(1.015)	(1.199)	(1.000)	(1.137)	(1.505)	(1.145)
Number of Tweets	0.176***	0.263***	0.184**	−0.013	0.328***	−0.017
	(0.066)	(0.061)	(0.073)	(0.073)	(0.077)	(0.084)
Observations	3,679	3,679	3,679	3,679	3,679	3,679
R^2	0.076	0.049	0.185	0.045	0.035	0.121
	Dependent variable:					
	Executive, Legislative & **Judicial**			**Economic** & **Business**		
	(1)	(2)	(3)	(4)	(5)	(6)
Tweeted Post-invasion	−0.137	−0.374	0.698	−0.362	−1.984	−0.957
	(2.844)	(3.191)	(2.814)	(1.753)	(2.18)	(1.782)
Number of Tweets	−0.018	0.134	−0.210	0.727	0.942***	0.783***
	(0.184)	(0.163)	(0.206)	(0.113)	(0.111)	(0.130)
Observations	3,679	3,679	3,679	3,679	3,679	3,679
R^2	0.082	0.073	0.184	0.078	0.076	0.135
Account-level Controls	✓	✗	✓	✓	✗	✓
Month and Year FE	✓	✓	✓	✓	✓	✓
Account FE	✓	✗	✓	✓	✗	✓
Account trend	✗	✗	✓	✗	✗	✓

Note: Robust standard errors, clustered at the individual level, are reported in parentheses. Included observations reflect aggregated individual-month records. All models include different fixed effects and account-level covariates. Significance levels: *p $<$ 0.1; **p $<$ .05; ***p $<$ .01.

Table 9: Fixed-Effects: Sentiment and Invasion

	Dependent variable:					
	Negative			**Positive**		
	(1)	(2)	(3)	(4)	(5)	(6)
Tweeted Post-invasion	20.983***	29.852***	18.670**	−10.907***	−14.132**	−12.290**
	(4.279)	(4.868)	(4.249)	(4.980)	(5.709)	(4.984)
Number of Tweets	0.614**	−0.864***	0.371	-1.367***	−1.993***	−1.369***
	(0.277)	(0.070)	(0.310)	(0.322)	(0.291)	(0.364)
Observations	3,679	3,679	3,679	3,679	3,679	3,679
R^2	0.125	0.134	0.217	0.076	0.094	0.160
Account-level Controls	✓	✗	✓	✓	✗	✓
Month and Year FE	✓	✓	✓	✓	✓	✓
Account FE	✓	✗	✓	✓	✗	✓
Account trend	✗	✗	✓	✗	✗	✓

Note: Robust standard errors, clustered at the individual level, are reported in parentheses. Included observations reflect aggregated individual-month records. All models include different fixed effects and account-level covariates. Significance levels: *p < 0.1; **p < .05; ***p < .01.

6.6. The Communities Consuming Ukrainian Government Tweets

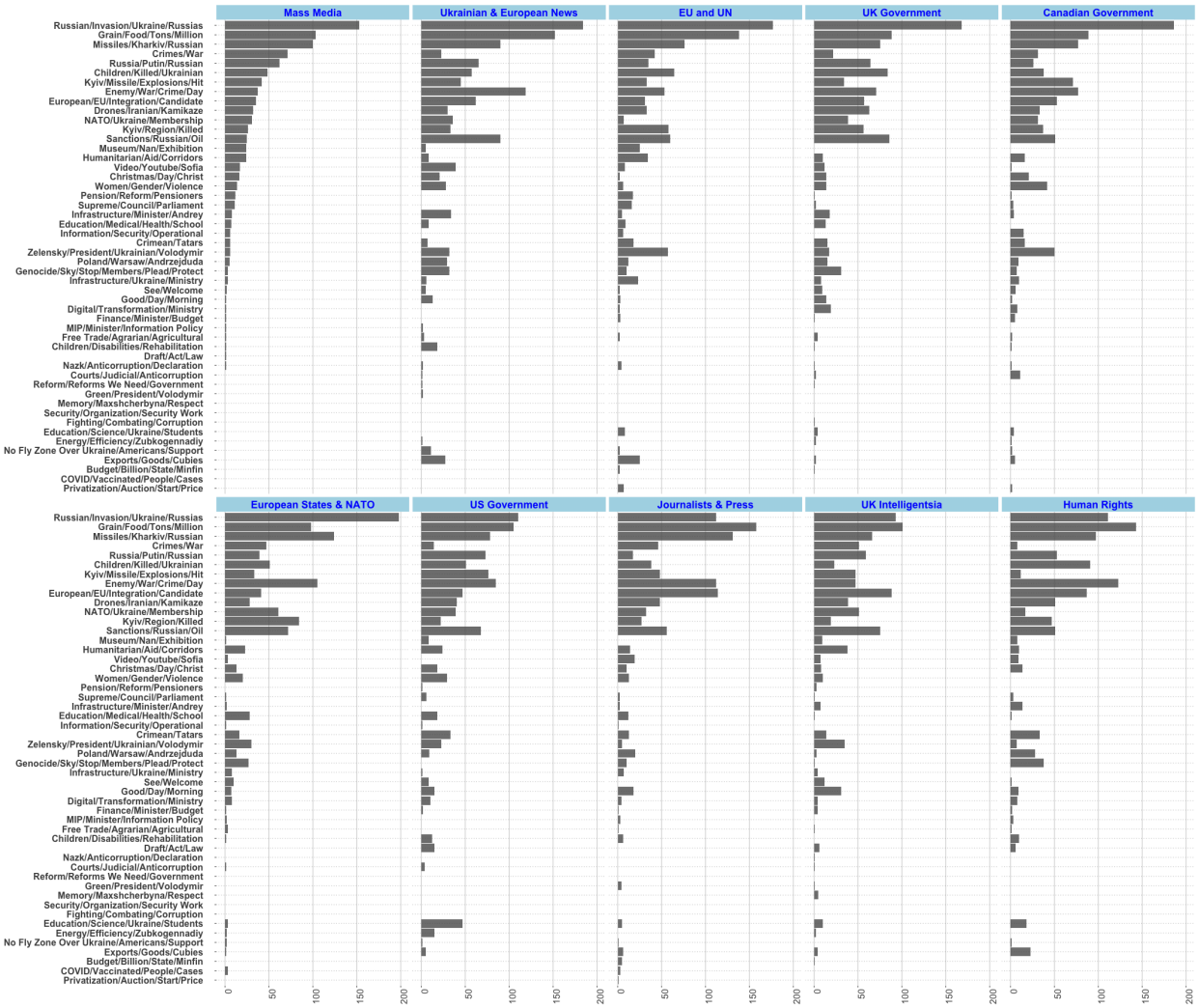
Although our community detection analysis yields over 20 individual communities, we rely on the top 10 communities with over 20 members each in our final analysis. Table 10 lists the top 10 communities and the number of individual accounts identified in each. For our main community retweeting models, we merge the "Canadian Government" (community 5) and "US Government" (community 7) into a single community and drop the last three communities because of the small number of accounts associated with them.

Table 10: List of Communities

N	Community	Members	N	Community	Members
1	Mass Media	710	6	European States and NATO	115
2	Ukrainian and European News	656	7	US Government	84
3	EU and UN	305	8	Policy Think Tanks	58
4	Ukrainian Government	267	9	UK Intelligentsia	42
5	Canadian Government	126	10	Human Rights	17

In Figure 5, we provide information about the count frequency with which each detected community in our Twitter data retweets the topics under study.

Figure 5: Retweet Frequency of Topics by Various Communities



Total retweet count by communities per topic

6.7. How Topics and Sentiment Impact Retweeting Across Key International Communities

In Figure 6, we plot discontinuities in the volume of retweeting (amplification and engagement) across different topic groups. This figure provides strong evidence for the increase in engagement with tweets focusing on humanitarian issues, attacks, and matters of international security and defense and decreased engagement with domestic economic, legislative, social, and cultural topics.

The findings from the event count models testing the association between topics and engagement and sentiment and engagement are reported in Tables 11 and 12. To present these patterns visually, Figures 7 and 8 display the coefficients for tweet amplification across different communities by topic and sentiment.

Figure 6: Retweet Volume Discontinuities Across Topics

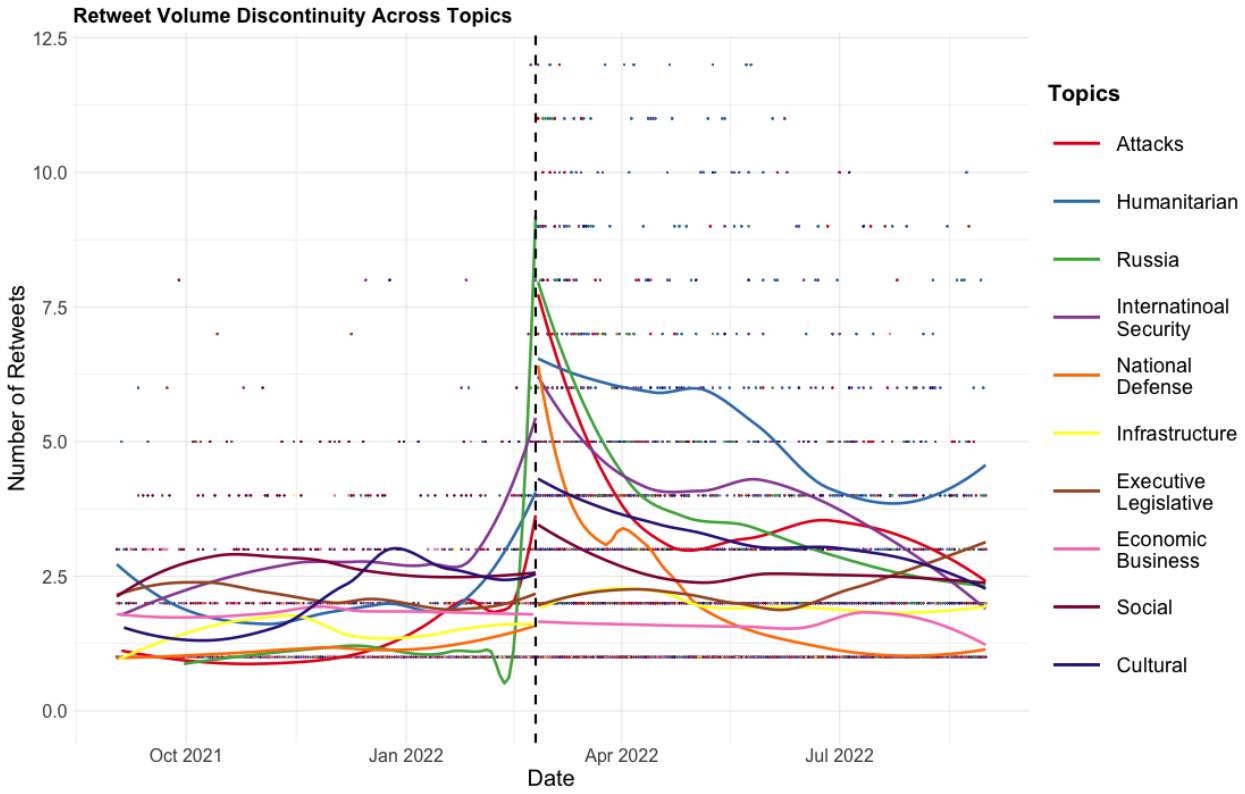


Table 11: Negative Binomial Regressions: Topics and Amplification

Foreign Policy Topics	*Dependent variable: Community Amplification*					
	Mass Media	**UKR & European News**	**EU & UN**	**Ukrainian Government**	**European States & NATO**	**Canadian & US Government**
Attacks	0.434***	0.189***	−0.146	0.194**	−0.1471	0.102
	(0.179)	(0.085)	(0.233)	(0.072)	(0.289)	(0.153)
Humanitarian	−0.075	−0.002	−0.002	0.133**	−0.397	0.246**
	(0.154)	(0.064)	(0.172)	(0.055)	(0.249)	(0.094)
Russia	−0.425*	−0.362***	−0.556**	−0.483***	−0.955**	0.004
	(0.276)	(0.082)	(0.238)	(0.064)	(0.462)	(0.109)
International Security	−0.402**	−0.381***	−0.495***	0.088	0.126	−0.263*
	(0.208)	(0.091)	(0.215)	(0.075)	(0.234)	(0.146)
Observations	14,623	14,623	14,623	14,623	14,623	14,623
Tweet-level Controls	✓	✓	✓	✓	✓	✓
Date and Account FE	✓	✓	✓	✓	✓	✓

Note: Robust standard errors, clustered at the individual level, are reported in parentheses. All models include different fixed effects and tweet-level covariates. Significance levels: *p < 0.1; **p < .05; ***p < .01.

Figure 7: Tweet Amplification Across Communities per Topic

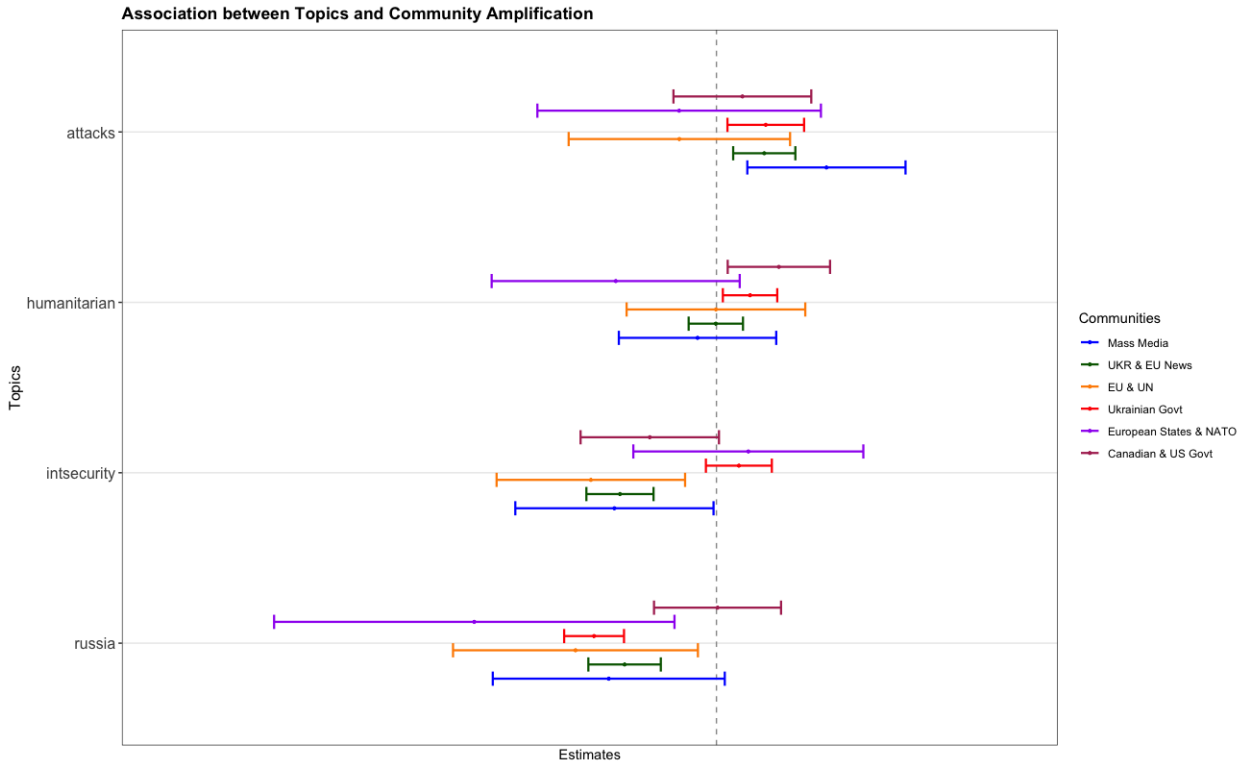
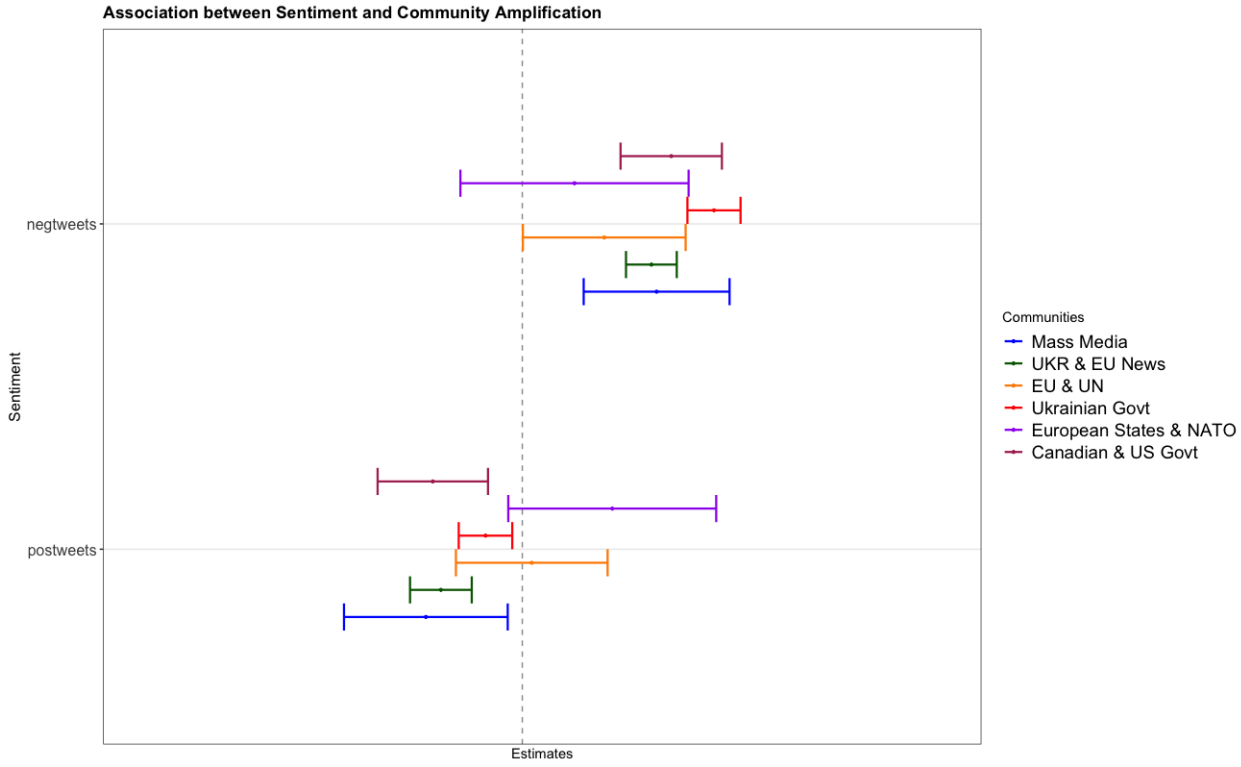


Table 12: Negative Binomial Regressions: Sentiment and Amplification

Sentiments	*Dependent variable: Community Amplification*					
	Mass Media	**UKR & European News**	**EU & UN**	**Ukrainian Government**	**European States & NATO**	**Canadian & US Government**
Negative	0.335***	0.322***	0.204**	0.478***	0.130	0.371***
	(0.099)	(0.042)	(0.104)	(0.034)	(0.137)	(0.064)
Positive	−0.240**	−0.203***	0.024	−0.092***	0.224*	0.223***
	(0.104)	(0.044)	(0.100)	(0.037)	(0.136)	(0.075)
Observations	14,623	14,623	14,623	14,623	14,623	14,623
Tweet-level Controls	✓	✓	✓	✓	✓	✓
Date and Account FE	✓	✓	✓	✓	✓	✓

Note: Robust standard errors, clustered at the individual level, are reported in parentheses. All models include different fixed effects and tweet-level covariates. Significance levels: *p < 0.1; **p < .05; ***p < .01.

Figure 8: Tweet Amplification Across Communities per Tone



7. Discussion and Conclusions

This paper analyzes over 150,000 individual government tweets from metadata of 14 million tweets about the war in Ukraine posted between 2010 and 2023 to offer new insight into the strategic use of social media by government actors in times of crisis. The volume and content of posts by Ukrainian officials provided unprecedented, micro-level evidence on how states go about soliciting international support in today's information age. Our findings suggest that leaders and elites do indeed use social media channels to mobilize supporters for their cause and shape the narrative of war. We find evidence of this strategic use in the volume, language and content of tweets in the aftermath of the Russian invasion.

Our findings improve our understanding of how social media strategies tailored to promote foreign support succeed (or fail) in the short run. For both the United States and its allies, building domestic support for efforts to resist Russian aggression overseas will be critical to maintaining an effective democratic coalition over the long run. These results will help inform the design of effective social media campaigns, in Ukraine and other countries threatened by authoritarian aggression, that can appeal to international audiences and preserve and expand positive attitudes toward these efforts.

It goes without saying that while our evidence provides unique insights into how government officials craft foreign messages, it is drawn from a single conflict. While the external validity of our findings must await work on the use of social media in other conflict settings, we have reason to believe that our findings are likely to extend to other settings involving violent conflict among asymmetric opponents who feel the need to message international audiences. Indeed, whether one looks at the recent civil war in Ethiopia, the Israeli Foreign Ministry's use of Twitter to frame the Arab-Israeli conflict, or the Turkish government's messaging around the 'safe zones' it has occupied in Syria since 2016, we suspect the basic social media dynamics we have uncovered in Ukraine are likely to hold across a wide range of conflicts.

While we have provided some initial insights into how governments and foreign audiences use social media during a time of war, there is enormous scope for future research. First, while we have focused on Ukrainian government tweets and the international networks that consume and amplify their messages, we have the corresponding data for supporters of Russia. Most importantly, our huge corpus of tweets allows us to identify the sources of Russian disinformation and their role in broader disinformation networks. Analysis of those tweets and networks will provide important insights into when disinformation threatens to move from narrow pro-Russian social media users into the broader

media ecosystem. Second and more broadly, the Russian invasion of Ukraine unleashed broader forces across the post-Soviet media space. On one hand, post-soviet countries face strong incentives to provide official support for Russia's invasion. Russia has increased its projection of military power and sought to increase diplomatic and economic integration with many of these countries. This makes many neighboring countries vulnerable to retaliation from Moscow and incentivizes their use of state-controlled media to advance pro-Russian views and stifle dissenting voices. On the other hand, there are important reasons for post-Soviet countries to support international efforts to punish Russia for the invasion. The willingness of Russia to entangle its allies in military aggression has exposed many countries to threats of international sanction and isolation. Furthermore, the official promotion and amplification of pro-Russian narratives risks encouraging existent pro-Russian separatist movements in several of these countries. In related work, we are analyzing how governments in the region have impacted state-sponsored and independent media coverage in an effort to resolve these deep tensions. In doing so, we hope to add additional insight into how digital media is reshaping international politics.

References

Acemoglu, Daron, Tarek A Hassan and Ahmed Tahoun. 2018. "The power of the street: Evidence from Egypt's Arab Spring." *The Review of Financial Studies* 31(1):1–42.

Aruguete, Natalia, Ernesto Calvo and Tiago Ventura. 2023. "News by popular demand: Ideological congruence, issue salience, and media reputation in news sharing." *The International Journal of Press/Politics* 28(3):558–579.

Bail, Christopher A, Lisa P Argyle, Taylor W Brown, John P Bumpus, Haohan Chen, MB Fallin Hunzaker, Jaemin Lee, Marcus Mann, Friedolin Merhout and Alexander Volfovsky. 2018. "Exposure to opposing views on social media can increase political polarization." *Proceedings of the National Academy of Sciences* 115(37):9216–9221.

Barberá, Pablo, Andreu Casas, Jonathan Nagler, Patrick J Egan, Richard Bonneau, John T Jost and Joshua A Tucker. 2019. "Who leads? Who follows? Measuring issue attention and agenda setting by legislators and the mass public using social media data." *American Political Science Review* 113(4):883–901.

Barberá, Pablo, Anita R Gohdes, Evgeniia Iakhnis and Thomas Zeitzoff. 2022. "Distract and divert: How world leaders use social media during contentious politics." *The International Journal of Press/Politics* p. 19401612221102030.

Barberá, Pablo and Thomas Zeitzoff. 2018. "The new public address system: Why do world leaders adopt social media?" *International studies quarterly* 62(1):121–130.

Barbieri, Francesco, Jose Camacho-Collados, Leonardo Neves and Luis Espinosa-Anke. 2020. "Tweeteval: Unified benchmark and comparative evaluation for tweet classification." *arXiv preprint arXiv:2010.12421* .

Bradshaw, Samantha, Renée DiResta and Carly Miller. 2022. "Playing both sides: Russian state-backed media coverage of the# BlackLivesMatter movement." *The International Journal of Press/Politics* p. 19401612221082052.

Data4Ukraine Project. 2022.

Di Tella, Rafael and Ignacio Franceschelli. 2011. "Government advertising and media coverage of corruption scandals." *American Economic Journal: Applied Economics* 3(4):119–51.

Dietrich, Simone and Joseph Wright. 2015. "Foreign aid allocation tactics and democratic change in Africa." *The Journal of Politics* 77(1):216–234.

Digital 2022: Ukraine. 2022. *Kepios* .

Dreher, Axel, Andreas Fuchs, Roland Hodler, Bradley C Parks, Paul A Raschky and Michael J Tierney. 2019. "African leaders and the geography of China's foreign assistance." *Journal of Development Economics* 140:44–71.

Enikolopov, Ruben, Alexey Makarin and Maria Petrova. 2020. "Social media and protest participation: Evidence from Russia." *Econometrica* 88(4):1479–1514.

Esberg, Jane and Alexandra A Siegel. 2021. "How exile shapes online opposition: Evidence from venezuela." *American Political Science Review* pp. 1–18.

Fan, Yingjie, Jennifer Pan and Jaymee Sheng. 2023. "Strategies of Chinese State Media on Twitter." *Political Communication* pp. 1–22.

Fazekas, Zoltan, Sebastian Adrian Popa, Hermann Schmitt, Pablo Barberá and Yannis Theocharis. 2021. "Elite-public interaction on twitter: EU issue expansion in the campaign." *European Journal of Political Research* 60(2):376–396.

Feezell, Jessica T. 2018. "Agenda setting through social media: The importance of incidental news exposure and social filtering in the digital era." *Political Research Quarterly* 71(2):482–494.

Feldstein, Steven. 2022. "Russia's War in Ukraine Is a Watershed Moment for Internet Platforms.".

Flores-Macías, Gustavo A and Sarah E Kreps. 2013. "The foreign policy consequences of trade: China's commercial relations with Africa and Latin America, 1992–2006." *The Journal of Politics* 75(2):357–371.

Garbe, Lisa. 2023. "Pulling through elections by pulling the plug: Internet disruptions and electoral violence in Uganda." *Journal of Peace Research* p. 00223433231168190.

Gehring, Kai, Lennart C Kaplan and Melvin HL Wong. 2019. "China and the World Bank: How Contrasting Development Approaches Affect the Stability of African States.".

Gilardi, Fabrizio, Theresa Gessler, Maël Kubli and Stefan Müller. 2022. "Social media and political agenda setting." *Political Communication* 39(1):39–60.

Gleditsch, Kristian Skrede, Martín Macías-Medellín and Mauricio Rivera. 2023. "A Double-Edge Sword? Mass Media and Nonviolent Dissent in Autocracies." *Political Research Quarterly* 76(1):224–238.

González-Bailón, Sandra, Javier Borge-Holthoefer, Alejandro Rivero and Yamir Moreno. 2011. "The dynamics of protest recruitment through an online network." *Scientific reports* 1(1):1–7.

González-Bailón, Sandra, Valeria d'Andrea, Deen Freelon and Manlio De Domenico. 2022. "The advantage of the right in social media news sharing." *PNAS nexus* 1(3):pgac137.

Grootendorst, Maarten. 2022. "BERTopic: Neural topic modeling with a class-based TF-IDF procedure." *arXiv preprint arXiv:2203.05794* .

Guriev, Sergei and Daniel Treisman. 2019. "Informational autocrats." *Journal of Economic Perspectives* 33(4):100–127.

Isaksson, Ann-Sofie and Andreas Kotsadam. 2018. "Chinese aid and local corruption." *Journal of Public Economics* 159:146–159.

Jungherr, Andreas, Oliver Posegga and Jisun An. 2019. "Discursive power in contemporary media systems: A comparative framework." *The International Journal of Press/Politics* 24(4):404–425.

King, Gary, Jennifer Pan and Margaret E Roberts. 2013. "How censorship in China allows government criticism but silences collective expression." *American Political Science Review* pp. 326–343.

Kishi, Roudabeh and Clionadh Raleigh. 2017. "Chinese official finance and state repression in Africa.".

Knight, Brian and Ana Tribin. 2019*a*. "The limits of propaganda: Evidence from chavez's venezuela." *Journal of the European Economic Association* 17(2):567–605.

Knight, Brian and Ana Tribin. 2019*b*. Opposition Media, State Censorship, and Political Accountability: Evidence from Chavez's Venezuela. Technical report National Bureau of Economic Research.

Knutsen, Tora and Andreas Kotsadam. 2020. "The political economy of aid allocation: Aid and incumbency at the local level in Sub Saharan Africa." *World Development* 127:104729.

Kowalski, Adam. 2022. "Disinformation and Russia's war of aggression against Ukraine: Threats and governance responses.".

Kümpel, Anna Sophie, Veronika Karnowski and Till Keyling. 2015. "News sharing in social media: A review of current research on news sharing users, content, and networks." *Social media+ society* 1(2):2056305115610141.

Larson, Jennifer M. 2021. "Networks of conflict and cooperation." *Annual Review of Political Science* 24:89–107.

Pacheco, Diogo, Alessandro Flammini and Filippo Menczer. 2020. Unveiling coordinated groups behind white helmets disinformation. In *Companion proceedings of the web conference 2020*. pp. 611–616.

Pan, Jennifer and Alexandra A Siegel. 2020. "How Saudi crackdowns fail to silence online dissent." *American Political Science Review* 114(1):109–125.

Rozenas, Arturas and Denis Stukal. 2019. "How autocrats manipulate economic news: Evidence from Russia's state-controlled television." *The Journal of Politics* 81(3):982–996.

Schelling, Thomas C. 1980. *The Strategy of Conflict: with a new Preface by the Author*. Harvard university press.

Steinert-Threlkeld, Zachary C. 2017. "Spontaneous collective action: Peripheral mobilization during the Arab Spring." *American Political Science Review* 111(2):379–403.

Strange, Austin M, Axel Dreher, Andreas Fuchs, Bradley Parks and Michael J Tierney. 2017. "Tracking underreported financial flows: China's development finance and the aid–conflict nexus revisited." *Journal of Conflict Resolution* 61(5):935–963.

Stukal, Denis, Sergey Sanovich, Joshua A Tucker and Richard Bonneau. 2019. "For whom the bot tolls: a neural networks approach to measuring political orientation of Twitter bots in Russia." *Sage Open* 9(2):2158244019827715.

Szeidl, Adam and Ferenc Szucs. 2021. "Media capture through favor exchange." *Econometrica* 89(1):281–310.

Traag, Vincent A, Ludo Waltman and Nees Jan Van Eck. 2019. "From Louvain to Leiden: guaranteeing well-connected communities." *Scientific reports* 9(1):5233.

Tufekci, Zeynep and Christopher Wilson. 2012. "Social media and the decision to participate in political protest: Observations from Tahrir Square." *Journal of communication* 62(2):363–379.

Uysal, Nur and Jared Schroeder. 2019. "Turkey's Twitter public diplomacy: Towards a "new" cult of personality." *Public Relations Review* 45(5):101837.

Valenzuela, Sebastián, Martina Piña and Josefina Ramírez. 2017. "Behavioral effects of framing on social media users: How conflict, economic, human interest, and morality frames drive news sharing." *Journal of communication* 67(5):803–826.

Wilson, Tom and Kate Starbird. 2020. "Cross-platform disinformation campaigns: lessons learned and next steps." *Harvard Kennedy School Misinformation Review* 1(1).

Zaharna, Rhonda S, Amelia Arsenault and Ali Fisher. 2014. *Relational, networked and collaborative approaches to public diplomacy: The connective mindshift*. Routledge.

Zeitzoff, Thomas. 2017. "How social media is changing conflict." *Journal of Conflict Resolution* 61(9):1970–1991.