Foreign Propaganda, Trust, and Public Policy: Evidence from Russian Misinformation in the Baltics *

Horacio Larreguy † J. David Martínez Hernández ‡

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Abstract

We study whether Russian state-sponsored misinformation and propaganda alter consequential behavior and political attitudes in former Soviet states. We exploit two salient disruptions to Western COVID-19 vaccines—the temporary suspension of AstraZeneca and the delayed Janssen rollout—that Russian state-backed media used to promote Sputnik V and discredit Western institutions. Combining online traffic, administrative vaccination records, survey data, and municipal ethnic composition, we estimate differential responses across Latvian municipalities. Following each vaccine-safety event, traffic shifts toward pro-Kremlin Russian-language outlets and Moderna/Pfizer vaccination falls more in municipalities with larger ethnic Russian shares. Both patterns reverse after Russia's invasion of Ukraine and Latvia's restrictions on Russian state-backed media. The vaccination effects are concentrated in first doses and cohorts partly schooled under Soviet rule, and we find no analogous pattern in Estonia or Lithuania. Eurobarometer estimates also show a relative worsening in attitudes toward Latvian democracy and the EU among Russian-language respondents following the vaccine-safety events.

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†Departments of Economics and Political Science, ITAM, and J-PAL (horacio.larreguy@itam.mx).

‡Department of Economics, Harvard University (jmartinezhernandez@fas.harvard.edu).

Introduction

Russia's efforts to shape public opinion within the European Union (EU) have become an increasingly salient policy concern. Since the fall of the Iron Curtain, the Russian government has engaged in sustained misinformation and propaganda campaigns, including the promotion of the *Russkiy Mir* (Russian World) narrative, which portrays Russia as the homeland and protector of ethnic Russians beyond its borders (Hollingsworth, 2023; Mejias and Vokuev, 2017). These campaigns seek, among other objectives, to erode trust in Western governments and institutions in former Soviet states and to bolster support for Russian geopolitical and military intervention. They have often targeted ethnic Russian communities whose political and socioeconomic integration after the dissolution of the Soviet Union has been difficult. Despite the geopolitical importance of these efforts—made especially visible by Russia's annexation of Crimea in 2014, its full-scale invasion of Ukraine in 2022, and documented interference in Western elections (Bail et al., 2020; Freelon and Lokot, 2020; Howard et al., 2019)—there remains limited causal evidence on whether Russian state-sponsored misinformation and propaganda change consequential attitudes and behavior.

We study Russian state-sponsored misinformation and propaganda in Estonia, Latvia, and Lithuania, three former Soviet republics with substantial ethnic Russian shares located at the strategic frontier between Russia and the EU. A substantial qualitative literature documents coordinated efforts to reach Russian-speaking audiences in the Baltic states (Cohen and Radin, 2019; Mölder and Sazonov, 2020). The recurring narratives portray Baltic national governments and EU institutions as incompetent, hostile to Russian speakers, or unable to protect their citizens; question the legitimacy of Baltic integration with Western institutions; and present Russia as the defender of ethnic Russians abroad. The COVID-19 pandemic provided a particularly salient setting for these narratives: Russian state-backed outlets contrasted the Russian Sputnik V vaccine with Western vaccines and used problems in Western vaccine rollouts to question the competence and intentions of Baltic and EU authorities.

Our main analysis focuses on Latvia, where ethnic Russians constitute roughly 25% of the population. Latvia's post-independence nation-building and citizenship policies have produced a particularly difficult integration trajectory for many ethnic Russians. As we document below, Russian-speaking respondents in Latvia report substantially lower confidence in and satisfaction with the national government than Latvian-speaking respondents,

whereas comparable gaps are absent or reversed in Estonia and Lithuania due to much more successful integration policies. COVID-19 vaccination provides a concrete manifestation of this divide: early vaccination intentions and subsequent take-up were markedly lower among Russian-speaking than Latvian-speaking residents. Latvia also has a highly segmented information environment, in which Russian-speaking residents disproportionately consume Russian-language media, and descriptive evidence points to weaker digital-information skills among ethnic Russians. The contrast across the three Baltic states therefore allows us to study not only whether Russian misinformation and propaganda are associated with changes in behavior, but also the conditions under which such influence appears most consequential.

Our empirical strategy exploits two highly salient vaccine-safety events in 2021: Latvia's temporary suspension of the AstraZeneca vaccine and the delayed rollout of the Janssen vaccine following reports of rare blood-clotting events. The novelty and rapid development of COVID-19 vaccines created an unusually fertile environment for vaccine misinformation. Russian state-backed media used concerns surrounding these Western vaccines to promote Sputnik V and to question the competence of Western health institutions. We combine the timing of these events with cross-sectional variation in the municipal share of ethnic Russians and estimate difference-in-differences (DiD) specifications. Our preferred vaccination outcome is take-up of Moderna and Pfizer, which were not directly affected by either event, thereby avoiding a mechanical effect of the AstraZeneca suspension or the Janssen rollout delay on the outcome itself.

We combine four complementary sources of data. First, Semrush provides monthly organic web traffic from each Baltic country to Russian-language news outlets, which we classify as pro-Kremlin—Russian state-owned or identified propaganda outlets (Mölder and Sazonov, 2020; Simonov and Rao, 2022)—or neutral Russian-language outlets. Second, administrative vaccination records provide weekly municipal vaccination counts and, in Latvia and Lithuania, the recipient's age, dose number, and vaccine manufacturer (AstraZeneca, Janssen, Moderna, or Pfizer).[1] Third, census and administrative data provide municipal ethnic Russian population shares and predetermined socioeconomic covariates. Finally, Eurobarometer microdata allow us to study attitudes toward Latvian democracy and the EU by survey language while adjusting for respondent characteristics.[2]

[1] For Estonia, the available municipal data report total vaccination rather than vaccination by manufacturer.

[2] We do not conduct the analogous Eurobarometer analysis for Lithuania because the relevant surveys

The media-traffic patterns move sharply around the events that motivate our design. In Latvia, traffic to pro-Kremlin Russian-language outlets rises relative to traffic to neutral Russian-language outlets following the AstraZeneca suspension and the Janssen rollout delay. The relative shift is driven by both an increase in traffic to pro-Kremlin sources and a decline in traffic to neutral sources. After Russia's invasion of Ukraine and Latvia's restrictions on access to Russian state-backed media, this pattern reverses sharply. These dynamics are consistent with the two forces that guide our mechanism analysis: changes in the intensity and accessibility of Russian misinformation and propaganda, and changes in demand for aligned information among Russian-speaking communities with low baseline trust in Latvian and EU institutions.

Turning to our main results, the DiD estimates show that both vaccine-safety events are followed by larger declines in Moderna and Pfizer vaccination in Latvian municipalities with greater ethnic Russian population shares. Event-study estimates show no evidence of differential pre-trends over the windows we study. The estimates are robust to interacting the post-event indicator with a broad set of predetermined municipal characteristics, when we add those covariates one at a time, and when we exclude the Latgale municipalities where ethnic Russians are especially concentrated. Because a continuous-treatment DiD requires stronger assumptions-parallel trends across every pair of treatment intensities or treatment-effect homogeneity-to interpret the TWFE estimate as the average causal response to the treatment (Callaway, Goodman-Bacon and Sant'Anna, 2024, 2025), we additionally show robustness to discretizing the ethnic Russian share at multiple cutoffs, and to the estimator of de Chaisemartin et al. (2026), which requires weaker parallel trend assumptions.

A series of additional exercises points to two complementary mechanisms: greater exposure to Russian misinformation and propaganda following concerns about Western vaccines, and greater susceptibility to such concerns and messages where baseline trust in Latvian and EU institutions is low. First, the negative vaccination gradient by ethnic Russian share reverses after Russia's invasion of Ukraine, when Latvia sharply restricted access to Russian state-backed media and Russian misinformation shifted toward the war, consistent with the importance of the information environment. Second, the vaccination effects are substantially larger for first doses—the margin at which previously unvaccinated individuals decide

did not offer Russian as an interview language, or for Estonia because the number of Russian-language respondents in the pre-period is too small for informative estimates: roughly 12% of respondents, compared with 28% in Latvia.

whether to enter the vaccination program—than for subsequent doses. Third, they are larger among cohorts old enough to have received substantial schooling under Soviet rule, who also experienced more of the pre-independence political and institutional environment. Fourth, we find no comparable effects in Estonia or Lithuania, where the trust gap between Russian and national populations is much smaller and post-independence integration has generally been less exclusionary. We also rule out two alternative interpretations—that the results are driven by non-ethnic Russians substituting toward Moderna and Pfizer after the vaccine-safety events, or by differential vaccine supply across municipalities—using manufacturer-specific outcomes and the distinct nature of the AstraZeneca and Janssen events. Finally, Eurobarometer estimates show a relative worsening in satisfaction with Latvian democracy and in views of the EU among Russian-language respondents after the vaccine-safety events. Together, these patterns are consistent with misinformation and propaganda being especially consequential when they reinforce pre-existing institutional distrust among less integrated populations.

The results have several policy implications. They point first to the value of policies that reduce the informational and institutional isolation of minority communities before a misinformation shock occurs. In the Baltic context, this includes improving digital and media literacy, and expanding access to credible and locally relevant Russian-language journalism. Where politically feasible, broader social and economic integration may also strengthen trust in national institutions and reduce the demand for hostile state-sponsored narratives. The Eurobarometer results further suggest that the stakes extend beyond compliance with a particular public-health policy: misinformation can reinforce dissatisfaction with democracy and with regional institutions. More broadly, Russian influence operations have targeted audiences well beyond the Baltics, including in the United States (Bail et al., 2020; Freelon and Lokot, 2020; Howard et al., 2019). Our findings therefore help identify conditions under which such campaigns may be most effective: a segmented media environment, low baseline institutional trust, and limited capacity to distinguish reliable from misleading information.

Our study contributes to three strands of literature. First, we add to research on media persuasion and propaganda. Early work on nondemocratic settings shows that state-controlled media can strengthen regime support and legitimacy (Adena et al., 2015; Bleck and Michelitch, 2017; Bowles et al., 2025).[3] More recent work studies foreign pro-

[3]Research also shows that opposition media can reduce support for ruling parties (Enikolopov, Petrova and Zhuravskaya, 2011; Knight and Tribin, 2022; Enikolopov et al., 2026).

paganda, showing that it can persuade audiences with affinities to the sender (Peisakhin and Rozenas, 2018; Kao, 2026),[4] while producing backlash among audiences antagonistic to it (DellaVigna et al., 2014). Closest to our setting, Peisakhin and Rozenas (2018) show that Russian television increased support for parties and candidates with a pro-Russian agenda in Ukraine, especially among voters with stronger pro-Russian priors, and Mader, Marinov and Schoen (2022) show experimentally that Russian propaganda is more persuasive among citizens who distrust their national government and are more prone to believe misinformation. We extend this work to consequential policy behavior and political attitudes: Russian misinformation and propaganda are associated with lower vaccination among ethnic Russian communities—who lack digital skills and credible, locally relevant Russian-language journalism, and whose baseline institutional distrust is greater—along with worsening views of Latvian democracy and the EU among Russian-language respondents.

Second, we contribute to research on the long-run effects of political regimes and schooling on economic and political attitudes. Exposure to successful democratic institutions increases support for democracy and market institutions (Grosjean and Senik, 2011; Fuchs-Sch´undeln and Sch´undeln, 2015; Acemoglu et al., 2025), whereas cohorts socialized under communist and socialist regimes remain less supportive of these institutions and more supportive of state intervention (Pop-Eleches and Tucker, 2017; Alesina and Fuchs-Schündeln, 2007). Schooling is one important channel through which states shape political socialization: curricula designed under authoritarian or socialist regimes have lasting effects on economic preferences and political orientations (Paglayan, 2022; Bandiera et al., 2019; Cantoni et al., 2017; Fuchs-Schündeln and Masella, 2016; Braghieri and Eichmeyer, 2024).[5] More recent work also finds long-run consequences of communist schooling for occupational choice, labor supply, and income (Costa-Font, García-Hombrados and Nicińska, 2024; Meriläinen and Mitrunen, 2025). Our evidence is consistent with these formative experiences shaping later receptiveness to state-sponsored information: the differential vaccination response by municipal ethnic Russian share is substantially larger among cohorts old enough to have been schooled under Soviet rule.

Third, we contribute to the literature on misinformation and vaccination. Content that

[4]Relatedly, Chen and Yang (2019) show that temporarily incentivized access to Western media can produce sustained consumption and more pessimistic views of China and its government.

[5]Relatedly, Voigtländer and Voth (2015) document persistent effects of Nazi indoctrination on anti-Semitic attitudes.

attacks political out-groups or elicits strong emotional responses is especially effective at generating social-media engagement (Rathje, Bavel and van der Linden, 2021; McLoughlin et al., 2024). Survey experiments show that exposure to anti-vaccine conspiracy theories and misinformation reduces vaccination intentions (Jolley and Douglas, 2014; Allen, Watts and Rand, 2024), with effects that are closely related to dissatisfaction with and mistrust of public authorities (Jolley and Douglas, 2014). Quasi-experimental evidence similarly shows that misinformation discrediting vaccines lowers actual take-up (Carrieri, Madio and Principe, 2019; Martinez-Bravo and Stegmann, 2022). We show that misinformation and propaganda surrounding Western COVID-19 vaccines can affect a consequential health behavior in a population characterized by low trust in the national government, while also coinciding with a deterioration in satisfaction with democracy and views of the EU. Thus, the same informational shock can weaken both policy compliance and attitudes toward the institutions implementing the policy.

The remainder of the paper proceeds as follows. Section 1 describes Russian misinformation in the Baltics, the integration and media environment of Russian-speaking communities, and the COVID-19 vaccination setting. Section 2 presents the empirical strategy, and Section 3 describes the data. Section 4 reports the main vaccination estimates, robustness exercises, mechanism evidence, and political-attitude results. Section 5 concludes.

1 Context

1.1 Russian misinformation and propaganda in the Baltics, and the context of COVID-19

Since the fall of the Iron Curtain, the Russian government has engaged in extensive misinformation and propaganda directed at audiences abroad (Hollingsworth, 2023; Mejias and Vokuev, 2017). A central organizing narrative is *Russkiy Mir* (Russian World), which casts Russia as the cultural homeland and protector of ethnic Russians and Russian speakers outside the Russian Federation and provides an ideological basis for maintaining Russian influence across former Soviet states. In the Baltic context, these campaigns seek to weaken confidence in national governments and Western institutions and to increase receptiveness to Russian foreign-policy objectives, including intervention on behalf of purportedly threatened Russian-speaking communities.

The Russian information strategy in the Baltics operates through a broader, coordinated ecosystem rather than through a single outlet. Russian state-owned and Kremlin-aligned news organizations play an important role in producing and amplifying common narratives (Cohen and Radin, 2019; Mölder and Sazonov, 2020; Simonov and Rao, 2022), while social-media networks and organized troll operations provide additional channels of dissemination (Mejias and Vokuev, 2017). Public reporting also describes centralized guidance over this ecosystem. A former editor of Sputnik Lithuania, later detained in Latvia in connection with alleged economic support to a sanctioned Kremlin outlet, stated that his "main goal [as editor] was to destabilise the situation in Lithuania" (LRT English, 2024). He further described regular coordination in which senior figures from state media and the Foreign Ministry received guidance from the Russian presidential administration about which narratives to emphasize and how to present them.

Across the Baltic states, these campaigns repeatedly combine historical revisionism with contemporary attacks on national and Western institutions (Cohen and Radin, 2019; Mölder and Sazonov, 2020; Brauß and Rácz, 2021; Cepurītis et al., 2021; Ahonen et al., 2024). One set of narratives manipulates the history of World War II and disputes the Baltic states' account of Soviet occupation. A second portrays Baltic governments and the EU as incompetent or harmful, exaggerates the threat of immigration, and depicts NATO as both ineffective and a source of regional instability. A third frames policies toward Russian-speaking residents as evidence of Russophobia and systematic discrimination. These narratives are mutually reinforcing: by portraying Russian-speaking communities as threatened and Western-aligned governments as illegitimate or incapable, they can increase support for separatism or Russian intervention, a strategy that has also been documented in the information environment surrounding Russia's actions in Ukraine.

The COVID-19 pandemic created an especially favorable environment for this strategy because uncertainty about the disease and the rapid development of new vaccines generated what became known as a COVID-19 "infodemic" and created substantial obstacles to vaccine take-up (Loomba et al., 2021). The Kremlin used this uncertainty to question Western governments' competence and the safety of Western vaccines while promoting Sputnik V (Mölder and Sazonov, 2020; DebunkEU, 2021). Debunk EU identified 1,403 COVID-19-related articles disseminated in February 2021 that contained false or misleading information and originated from 169 hostile media sources. The material appeared in Estonian, Latvian, Lithuanian, and especially Russian, with an estimated 478.3 million potential views (DebunkEU, 2021). Recurring claims portrayed Western and Baltic

governments as unable to manage the pandemic, asserted that Western vaccines had been inadequately tested and endangered recipients, and accused Baltic governments of Russophobia for denying Russian-speaking residents access to the supposedly superior Sputnik V vaccine.

1.2 Ethnic Russian minorities in the Baltics

The Baltic states regained independence from the Russian Empire after World War I in 1918. Soviet occupation and incorporation as the Estonian, Latvian, and Lithuanian Soviet Socialist Republics interrupted their independence in 1940, followed by Nazi German occupation from 1941 to 1944, before independence was restored in 1991 during the broader Singing Revolution. Ethnic Russians today account for approximately 22.5% of Estonia's population, 25% of Latvia's, and 5% of Lithuania's. Russian migration to the region occurred in several waves, including after the incorporation of parts of the Baltics into the Russian Empire and, more substantially, after World War II, when Soviet authorities encouraged in-migration and disproportionately employed Russian-speaking workers in administration, construction, and industry, particularly in Latvia and Estonia (Plakans, 2011).

Integrating Russian minorities into the post-independence state has been especially contentious in Latvia. Citizenship was automatically restored primarily to interwar citizens and their descendants, leaving many former Soviet residents with "non-citizen" status rather than Latvian or another citizenship. By 2021, non-citizens still represented a substantial share of this population. Naturalization for adults requires Latvian-language and civic-knowledge examinations, and institutional support has historically been limited; citizenship rules for children of non-citizens were liberalized only more recently (Schulze and Pupcenoks, 2025). Latvia has also progressively reduced the use of Russian as a medium of instruction, a policy often justified in terms of national integration and, increasingly, national security. Non-citizens cannot vote in national or local elections, stand for office, or hold many public-sector positions. Taken together, these policies have made post-independence integration particularly difficult for many Russian-speaking residents.

Estonia and especially Lithuania followed different post-independence integration paths. Lithuania granted citizenship broadly to permanent residents after independence and maintained minority-language schooling, producing a much smaller non-citizen population. Estonia initially adopted citizenship rules closer to Latvia's but created simplified naturaliza-

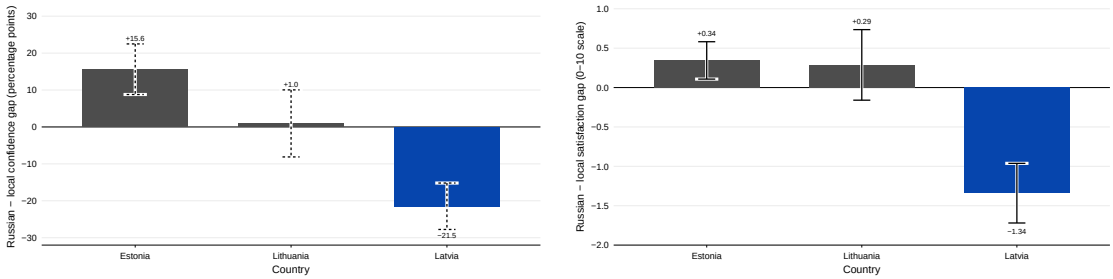
tion procedures for children born after independence and, since 2016, has generally granted citizenship automatically to children of non-citizens unless their parents opt out. Adult naturalization still requires Estonian-language proficiency, but language support and outreach have expanded, and the resulting non-citizen share is considerably smaller than in Latvia. Estonia has also begun phasing out Russian-language instruction, but the reform has been framed prominently around equal access to educational and labor-market opportunities, given persistent performance gaps between Estonian- and Russian-language schools. In addition, non-citizens have historically been able to vote in local elections, and public-sector citizenship restrictions are less encompassing. These institutional differences have left ethnic Russians more politically segregated and excluded in Latvia than in Estonia, and especially than in Lithuania (Auers, 2015).

These different integration trajectories coincide with striking differences in trust in national institutions. Figure 1 reports Russian-minus-national-language gaps in two surveys. In the European Values Study (EVS) and the World Values Survey (WVS) data, Russian-language respondents in Estonia are 15.6 percentage points more likely than Estonian-language respondents to report high confidence in the national government, while the corresponding gap is close to zero in Lithuania. In Latvia, by contrast, Russian-language respondents are 21.5 percentage points less likely than Latvian-language respondents to report high confidence. The European Social Survey (ESS) shows the same cross-country pattern for government satisfaction: Russian-home-language respondents are 0.34 points more satisfied on a 0–10 scale in Estonia and 0.29 points more satisfied in Lithuania, but 1.34 points less satisfied in Latvia.

1.3 Media consumption among Russian speakers in Latvia

Latvia's information environment is sharply segmented by language (Latvian Institute of International Affairs, 2016). Survey evidence summarized by Berzina (2018) indicates that 96.6% of respondents who speak Russian at home consume Russian-language media, while only 51.8% also consume Latvian-language media; 59.2% consume media originating in Russia, compared with 15.7% of respondents who speak Latvian at home. Russian-language consumption is not synonymous with pro-Kremlin media consumption, however, because Russian speakers also use independent and domestically oriented Russian-language outlets. To illustrate the extent of this, Figure 2 uses the online-traffic measure described in Section 3.3 to track the balance between outlets classified as pro-Kremlin and neutral

Figure 1: Confidence in and satisfaction with the national government in Estonia, Latvia, and Lithuania: Russian-minus-national-language differences



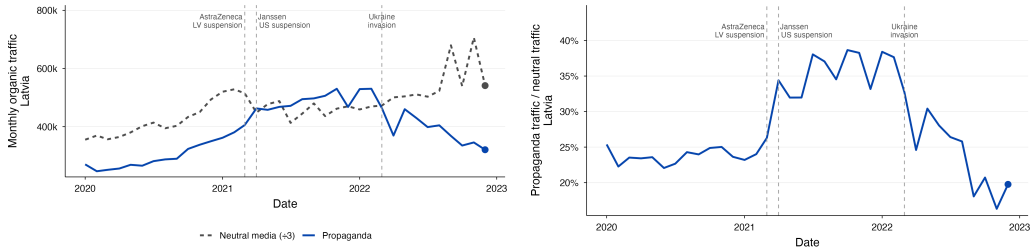
(a) Confidence in the national government (b) Satisfaction with the national government

Note: Own calculations using EVS/WVS wave 5 (2017–2022) for panel (a) and ESS round 9 (2018–2019) for panel (b). Points are survey-weighted Russian-minus-national-language differences in high confidence in the national government (panel a, percentage points) or mean satisfaction with the national government (panel b, 0–10 scale). Bars are 95% confidence intervals based on heteroskedasticity-robust standard errors.

Russian-language outlets. Traffic to Russian-language news rose during the pandemic, while the pro-Kremlin share remained roughly stable at about one quarter before the events we study. Around the AstraZeneca suspension and Janssen rollout delay, however, traffic shifted sharply toward pro-Kremlin outlets: their absolute traffic increased, while traffic to neutral outlets declined. These patterns likely reflect complementary supply and demand forces—greater production or salience of Russian state-sponsored content and greater demand for ideologically aligned information among Russian-speaking audiences concerned about Western vaccines—which we investigate more formally below.

Russia's invasion of Ukraine in February 2022 substantially changed this information environment. The Latvian National Electronic Mass Media Council quickly blocked access to several Russian state-owned or propaganda websites and television channels. Latvia later blocked the Russian social networks VKontakte and Odnoklassniki. Moreover, EU sanctions led to broader bans on Russian-based television channels across the Baltics. At the same time, Russian misinformation shifted away from COVID-19 and toward the war (European Digital Media Observatory, 2022). Figure 2 shows a sharp decline in traffic to pro-Kremlin outlets, both absolutely and relative to neutral Russian-language outlets. This decline is unlikely to reflect a wholesale political realignment among Russian-speaking Latvians. Eurobarometer data collected around the invasion show that 55.7% of Russian-language respondents still held a positive view of Russia, and 55.6% and 49.7% were dissat-

Figure 2: Organic traffic from Latvia to pro-Kremlin and neutral Russian-language news sources



(a) Absolute pro-Kremlin and neutral (b) Pro-Kremlin relative to neutral

Note: The left panel presents absolute organic traffic by source type, and the right panel presents traffic to pro-Kremlin news sources relative to neutral Russian-language news sources. The source is Semrush's organic traffic from Latvia to Russian propaganda or state-owned online news sources (Mölder and Sazonov, 2020; Simonov and Rao, 2022), and to neutral Russian-language news sources.

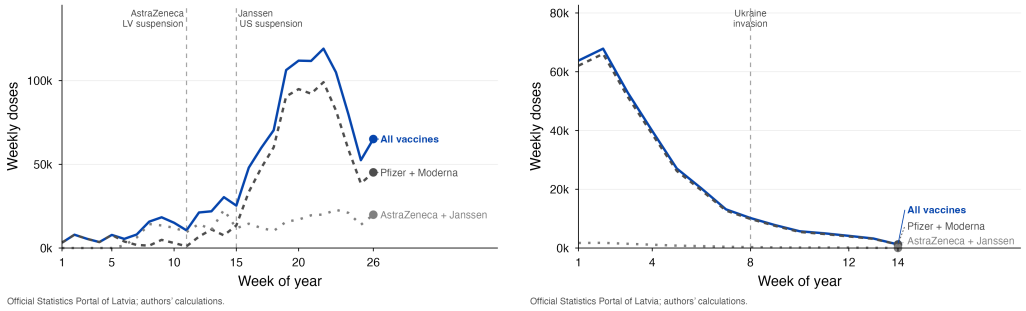
isfied with the Latvian government's and the EU's responses, respectively. In particular, 62.3% opposed the Russian-media ban, 52.9% the economic sanctions against Russia, and 54.9 % supplying military equipment to Ukraine, among other policies (Appendix Table B1). The combination of persistent pro-Kremlin attitudes and a sharp change in observed traffic is therefore consistent with access restrictions forcing at least some substitution away from pro-Kremlin sources, rather than the traffic decline being driven solely by a sudden loss of demand for them.

Russian-speaking communities in Latvia also also present limited ability to identify and evaluate misinformation encountered online. Eurostat data do not report ethnicity, but distinguish nationals from non-nationals, a category that captures an important part of the Russian-speaking population in Latvia and Estonia. Figure B1a shows that non-nationals in Latvia are about 5% more likely than nationals to lack basic digital skills, more than 25% less likely to report recognizing information they considered untrue or doubtful, and about 10% less likely to report fact-checking online information, thus exhibiting a limited ability to discern and fact-check misinformation. Estonia displays much smaller gaps in the same direction, while differences in Lithuania are limited.

1.4 COVID-19 vaccination in Latvia

COVID-19 vaccination began in Latvia on December 28, 2020, and eligibility was opened to the general population on May 5, 2021. The vaccination program used four Western vaccines: AstraZeneca, Janssen, Moderna, and Pfizer. On March 16, 2021, Latvia temporarily suspended AstraZeneca as a precaution after reports of rare blood-clotting events; vaccination resumed on March 19. On April 13, Latvia delayed the Janssen rollout following similar safety concerns and recommendations from the U.S. Food and Drug Administration and the European Medicines Agency; rollout began on April 23. Figure 3 plots weekly doses per 10,000 inhabitants for all vaccines, for AstraZeneca and Janssen—the vaccines directly implicated in the two events—and for Moderna and Pfizer, which were unaffected. AstraZeneca accounted for a large share of early doses, while Moderna and Pfizer became increasingly important after the two vaccine-safety events.

Figure 3: COVID-19 vaccine doses by manufacturer in Latvia during the first semester of 2021 and 2022



(a) First semester of 2021 (b) First semester of 2022

Note: COVID-19 vaccine doses are shown for all manufacturers, for Moderna and Pfizer (unaffected by either vaccine-safety event), and for AstraZeneca and Janssen (directly affected by the suspension or rollout delay). Own computation with data from the National Health Service made available through the Latvian Open Data Portal (National Health Service, 2021)

Early vaccination attitudes and subsequent take-up differed substantially by language. At the start of the rollout, 58% of Latvian-speaking respondents reported intending to vaccinate, compared with 37% of Russian-speaking respondents; definite willingness was 37% versus 15%, and perceived vaccine safety was also markedly lower among Russian speakers (Latvia Public Service Media, 2021*a*). Russian-speaking residents initially had less access to official COVID-19 information because government communications were generally pub-

lished only in Latvian, although the government subsequently expanded Russian-language communication across media platforms (Struberga and Ozoliņa, 2022). The vaccination gap nevertheless persisted: by September 2021, 62% of Latvian-speaking respondents reported having been vaccinated, compared with 46% of Russian-speaking respondents (Latvia Public Service Media, 2021*b*).

2 Empirical Strategy

Our baseline DiD specification is a two-way fixed-effects (TWFE) regression:

$$Y_{i,t} = \beta^{TWFE}\big(\text{Post}_{i,t} \times D_i\big) + \Gamma X_{i,t} + \delta_t + \eta_i + \varepsilon_{i,t}, \tag{1}$$

where $Y_{i,t}$ denotes vaccination in municipality i and week t; $\text{Post}_{i,t}$ indicates the post-event period for the AstraZeneca suspension or Janssen rollout delay; and D_i is the standardized municipal share of ethnic Russians. $X_{i,t}$ contains predetermined municipal characteristics interacted with the post-event indicator,[6] together with an indicator for the period after vaccination eligibility was extended to the general population when relevant. The terms δ_t and η_i denote week and municipality fixed effects, respectively. We cluster standard errors at the municipality level.[7]

The coefficient β^{TWFE} captures the differential post-event change in vaccination associated with a one-standard-deviation increase in the municipal ethnic Russian share. A causal interpretation requires that, absent the event, municipalities with different ethnic Russian shares would have followed parallel counterfactual trends; that there is no anticipation; and that no contemporaneous shock differentially affects municipalities as a function of their ethnic Russian share.

To assess pre-event dynamics and possible anticipation, we estimate the corresponding event-study specification:

$$Y_{i,t} = \sum_{\substack{k=-T \\ k\neq -1}}^{T} \theta_k \left(D_i \times \mathbf{1}[t-\tau = k]\right) + \Gamma X_{i,t} + \delta_t + \eta_i + \varepsilon_{i,t}, \tag{2}$$

[6] These predetermined characteristics include standardized municipality-level population density, share of the adult population with secondary or tertiary education, median wage, the unemployment rate, and crime rate.

[7] Appendix Figure D4 provides permutation tests indicating that our inference is not affected by a potentially small number of clusters.

where τ denotes the event week and $k = -1$ is the omitted reference period. In this specification, $X_{i,t}$ includes the corresponding interactions between predetermined municipal characteristics and event-time indicators.

A central concern is that the ethnic Russian share is correlated with other municipal characteristics. Ethnic Russian communities are, on average, concentrated in municipalities that differ socioeconomically from the rest of Latvia. Our baseline specification therefore interacts the post-event indicator with a battery of predetermined covariates. We also show that the estimates are similar without these interactions, when covariates are added one at a time, and when municipalities in Latgale, where ethnic Russians are especially concentrated, are excluded.

Two more specific interpretation concerns are particularly relevant in our setting. First, residents who are not ethnic Russian could react to the AstraZeneca suspension or Janssen rollout delay by substituting toward Moderna and Pfizer, generating a municipal composition pattern that need not reflect behavior among ethnic Russians. Second, vaccine supply could evolve differentially across municipalities with different ethnic Russian shares. We address these concerns using manufacturer-specific outcomes and by exploiting the distinct nature of the two events: AstraZeneca temporarily interrupted an already active vaccine, whereas the Janssen event delayed the introduction of a vaccine that had not yet entered routine use in Latvia.

The continuous nature of D_i raises an additional identification issue. Under standard parallel trends, comparisons of post-event changes across treatment intensities need not identify an average causal response (ACR) to the treatment. Interpreting the TWFE estimator as such requires parallel counterfactual trends across every pair of treatment intensities or treatment-effect homogeneity (Callaway, Goodman-Bacon and Sant'Anna, 2024, 2025). We therefore report two complementary robustness exercises. First, following Callaway, Goodman-Bacon and Sant'Anna (2024), we discretize the municipal ethnic Russian share at the 25th, 50th, and 75th percentiles and compare municipalities above and below each cutoff. Second, we apply the estimator proposed in de Chaisemartin et al. (2026). While TWFE uses comparisons across the full exposure distribution and summarizes them with a single linear slope, `DIDHAD` uses municipalities with ethnic Russian shares close to zero as a quasi-control group. `DIDHAD` then compares this quasi-control with the average observed change across all municipalities, producing a weighted average of municipalities' actual-versus-zero responses while allowing those responses to vary with the Russian population share. Relative to TWFE, the method relaxes global linearity

and effect homogeneity, and requires parallel trends only near the zero-exposure boundary, together with sufficient support and continuity at that boundary.

We then conduct a series of additional exercises to probe the mechanisms behind, and implications of, our results. First, we analyze the Russian invasion of Ukraine, with $\text{Post}_{i,t}$ indicating the period after February 24, 2022. Second, we separate first doses from second or higher doses. Third, we split vaccination outcomes between cohorts that received a meaningful share of schooling under Soviet rule and cohorts educated primarily after Latvian independence.

Finally, we use Eurobarometer microdata to examine whether the vaccine-safety events are also associated with changes in political attitudes. The specification parallels the municipal analysis, but observations are individuals and the differential effect is estimated for Russian-language respondents relative to Latvian-language respondents. We use Eurobarometer survey weights and heteroskedasticity-robust standard errors. Because relatively few interviews fall close to either vaccine-safety event, we use a two-week window around each event and pool observations across the two events.

3 Data Sources and Outcome Variables

3.1 Census and administrative data

Our main vaccination data for Latvia come from the National Health Service (NVD) and are made available through the Latvian Open Data Portal (National Health Service, 2021). The records report municipality of residence, vaccination date, age, dose number, and vaccine manufacturer (AstraZeneca, Janssen, Moderna, or Pfizer).[8] We aggregate the individual records to the municipality-week level and express vaccination as doses per 10,000 inhabitants. Our preferred outcome is Moderna and Pfizer vaccination because those vaccines were not directly affected by the AstraZeneca suspension or Janssen rollout delay. When the data permit, we further separate first from second-or-higher doses and split outcomes by whether recipients were old enough to have received substantial exposure to schooling under Soviet rule.[9]

[8] The analogous Lithuanian data come from Statistics Lithuania (now the State Data Agency) through the Lithuanian Open Data Portal (Statistics Lithuania, 2021). Estonian vaccination data come from the Health and Welfare Information Systems Centre (TEHIK), but are already aggregated at the municipality-day level (Health and Welfare Information Systems Centre, 2025).

[9] We classify individuals aged 40 or older in 2021 as the Soviet-schooling cohort and those younger than 40 as the post-independence cohort. The cutoff corresponds to being at least ten years old at the time of

For Latvia, municipality-level covariates include population by age group, educational attainment, population density, median wage, unemployment, and crime. These measures come primarily from the 2021 Population and Housing Census conducted by the Central Statistical Bureau of Latvia and are available through its Official Statistics Portal.[10]

3.2 Survey data

We use several survey sources for the attitudinal analysis and descriptive evidence. Eurobarometer microdata for Latvia serve two purposes. Around the 2021 vaccine-safety events, we use satisfaction with democracy in Latvia and respondents' image of the EU as outcomes, and interview language (Russian or Latvian) to define the comparison of interest. After the 2022 Russian invasion of Ukraine, we use Eurobarometer questions on views of Russia and on the Latvian government's and the EU's responses to the invasion to characterize the political attitudes of Russian- and Latvian-language respondents (Appendix Table B1).

For the cross-country descriptive comparisons, we use the fifth wave (2017–2022) of the joint European Values Study (EVS) and World Values Survey (WVS) for Estonia, Latvia, and Lithuania. We measure confidence in the national government and distinguish respondents by interview language. We also use round 9 (2018–2019) of the European Social Survey (ESS), which measures satisfaction with the national government and distinguishes respondents by reported home language. Finally, 2021 Eurostat aggregates report the share of nationals and non-nationals who lack basic digital skills, who report encountering information they considered untrue or doubtful online, and who report checking the truthfulness of online information.

3.3 Online traffic data

We use Semrush to proxy online news consumption of pro-Kremlin and neutral Russian-language outlets in Estonia, Latvia, and Lithuania. Semrush is a search-engine-optimization platform that estimates monthly organic traffic from a country to a website. Organic traffic excludes paid visits and traffic identified as automated. We use online traffic because it is the media-consumption measure available at the country-by-outlet-by-month frequency

restored independence in 1991.

[10] For Estonia, analogous covariates come primarily from the 2021 Population and Housing Census conducted by Statistics Estonia; for Lithuania, they come primarily from the 2021 Population and Housing Census conducted by Statistics Lithuania. Appendix Section C provides details for each country.

needed to study the events in our design, but we consider it a proxy for broader news consumption.[11]

We classify Russian-language news outlets into two groups. The pro-Kremlin category includes Russian state-owned outlets and websites identified as propaganda sources by Mölder and Sazonov (2020) and Simonov and Rao (2022). The comparison category consists of neutral Russian-language outlets identified by Cooper (2020) and other widely used national Russian-language news sources that are not classified as pro-Kremlin. Appendix Tables A2, A1, and A3 list the outlets in each category.

4 Results

We begin with the main vaccination estimates in Latvia, then assess robustness to alternative controls, samples, and estimators for continuous treatment intensity. We next examine the mechanisms using online traffic, the invasion of Ukraine, cohort and dose heterogeneity, and comparisons with Estonia and Lithuania. We conclude with the Eurobarometer evidence on political attitudes.

4.1 Vaccination outcomes

Table 1 presents the TWFE estimates for the AstraZeneca suspension and establishes the column and panel structure used throughout the vaccination tables. Column (1) uses all vaccine doses per 10,000 inhabitants. Column (2), our preferred outcome, restricts the dependent variable to Moderna and Pfizer, which were not directly affected by either vaccine-safety event. Column (3) isolates AstraZeneca, the vaccine directly affected by the suspension, while column (4) includes all other vaccines. Panel A reports specifications without interacted municipal controls, and Panel B adds the post-event interactions with predetermined socioeconomic covariates.

Across specifications, vaccination falls relatively more after the AstraZeneca suspension in municipalities with larger ethnic Russian shares. In our preferred specification—Moderna and Pfizer vaccination with the full set of interacted controls—a one-standard-deviation increase in the ethnic Russian share is associated with 9.05 fewer doses per 10,000 inhabitants, approximately 36% of the 25.12 outcome mean. The left panel of Figure 4

[11] We are not aware of analogous high-frequency, outlet-level measures of traditional-media consumption that can be consistently separated by outlet type across the three Baltic countries.

shows no evidence of differential pre-trends over the four pre-event weeks. The stability of the estimate across Panels A and B also weighs against predetermined socioeconomic differences as the main explanation: adding the controls more than doubles the R^2 while increasing, rather than attenuating, the absolute coefficient by about 8%.

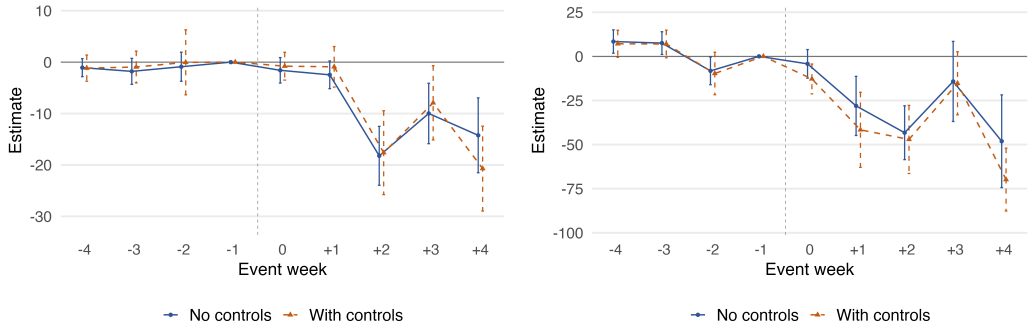
Table 1: Difference-in-differences estimates of the AstraZeneca suspension on COVID-19 vaccination in Latvia, by municipal ethnic Russian share

	Dependent variable:			
	All	Moderna & Pfizer	AstraZeneca	Janssen, Moderna & Pfizer
	(1)	(2)	(3)	(4)
Panel A: Without control variables				
$\text{Post}_{AZ} \times$ *ethnic Russian share*	-14.005^{***}	-8.358^{***}	-5.657^{*}	-8.349^{***}
	(3.102)	(1.144)	(2.843)	(1.145)
R^2	0.054	0.086	0.011	0.086
Panel B: With control variables				
$\text{Post}_{AZ} \times$ *ethnic Russian share*	-14.012^{**}	-9.049^{***}	-4.975	-9.038^{***}
	(4.927)	(1.334)	(4.617)	(1.336)
Outcome mean	98.55	25.12	73.42	25.13
Observations	386	386	386	386
R^2	0.269	0.216	0.279	0.216

Notes: Observations are at the municipality-week level, four weeks before and after the AstraZeneca suspension from March 16–19, 2021 by the Latvian government. Outcomes are vaccines per 10,000 inhabitants for all vaccine manufacturers in column 1; for Moderna and Pfizer in column 2; for AstraZeneca in column 3; and for Janssen, Moderna, and Pfizer in column 4. The share of ethnic Russians is standardized. All specifications include municipality and week fixed effects. Estimates in Panel A have no controls, and in Panel B they include the interaction of the relevant post-event indicator with standardized municipality-level covariates, including population density, the share of the adult population with secondary or tertiary education, the median wage, the unemployment rate, and crime rate. Standard errors, clustered at the municipality level, are in parentheses (43 clusters). * p<0.1, ** p<0.05, *** p<0.01.

Table 2 reports the analogous estimates around the Janssen rollout delay. The pattern is again negative: municipalities with larger ethnic Russian shares experience a larger decline in vaccination following the event. In column (2) of Panel B, a one-standard-deviation increase in the ethnic Russian share is associated with 37.20 fewer Moderna and Pfizer doses per 10,000 inhabitants, about 21% of the 175.18 outcome mean. The right panel of Figure 4 shows little evidence of differential pre-trends. As in the AstraZeneca analysis, adding the interacted socioeconomic controls substantially increases explanatory

Figure 4: Event studies of the AstraZeneca suspension and Janssen rollout delay on Moderna and Pfizer vaccination in Latvia, by municipal ethnic Russian share



(a) AstraZeneca suspension

(b) Janssen rollout delay

Notes: The event study on the left (right) corresponds to column 2 of Panel B in Table 1 (Table 2). 95% confidence intervals are computed using standard errors clustered at the municipality level.

power without reducing the coefficient; its absolute magnitude rises by roughly 25%.

4.2 Robustness

We conduct several robustness checks for the main vaccination specifications. First, Appendix Tables D1 and D2 add the standardized municipal covariates one at a time. The preferred Moderna/Pfizer coefficients remain close to the baseline estimates. For the AstraZeneca event, none of the individual control interactions is statistically significant; for Janssen, the ethnic-Russian-share coefficient becomes materially smaller in only two specifications despite substantial increases in R^2.

Second, we exclude the seven Latgale municipalities, where ethnic Russians are especially concentrated. Table D3 reports the AstraZeneca estimates in Panel A and the Janssen estimates in Panel B. For the preferred Moderna/Pfizer outcome, excluding Latgale changes the AstraZeneca coefficient by less than 5% and the Janssen coefficient by about 2%. The corresponding event studies in Figure D1 again show no differential pretrends.

Finally, Appendix Section D.3 addresses the stronger restrictions required to interpret a continuous-treatment TWFE coefficient as a causal response across treatment intensities

Table 2: Difference-in-differences estimates of the Janssen rollout delay on COVID-19 vaccination in Latvia, by municipal ethnic Russian share

	Dependent variable:			
	All	Moderna & Pfizer	Janssen	AstraZeneca, Moderna & Pfizer
	(1)	(2)	(3)	(4)
Panel A: Without control variables				
$\text{Post}_{Janssen} \times$ *ethnic Russian share*	-20.086^{**}	-29.659^{***}	-0.014	-20.072^{**}
	(5.775)	(4.187)	(0.091)	(5.753)
Observations	559	559	559	559
R^2	0.091	0.081	0.142	0.071
Panel B: With control variables				
$\text{Post}_{Janssen} \times$ *ethnic Russian share*	-27.286^{***}	-37.202^{***}	0.125	-27.411^{***}
	(7.283)	(5.411)	(0.194)	(7.244)
Outcome mean	255.31	175.18	6.06	249.25
Observations	559	559	559	559
R^2	0.570	0.645	0.339	0.571

Notes: Observations are at the municipality-week level, six weeks before and after the delayed rollout of the Janssen COVID-19 vaccine from April 13–23, 2021. Outcomes are vaccines per 10,000 inhabitants for all vaccine manufacturers in column 1; for Moderna and Pfizer in column 2; for Janssen in column 3; and for AstraZeneca, Moderna, and Pfizer in column 4. The share of ethnic Russians is standardized. All specifications include municipality and week fixed effects. Estimates in Panel A include an indicator for the period after vaccination eligibility was extended to the general population, Panel B further includes the interaction of the relevant post-event indicator with standardized municipality-level covariates, including population density, the share of the adult population with secondary or tertiary education, the median wage, the unemployment rate, and the crime rate. Standard errors, clustered at the municipality level, are in parentheses (43 clusters). * p<0.1, ** p<0.05, *** p<0.01.

(Callaway, Goodman-Bacon and Sant'Anna, 2025). Following Callaway, Goodman-Bacon and Sant'Anna (2024), we first discretize the municipal ethnic Russian share at the 25th, 50th, and 75th percentiles. Tables D4 and D5, together with the event studies in Figure D2, show that the main pattern is robust to these alternative treatment definitions. We then apply the estimator of de Chaisemartin et al. (2026), which uses municipalities with treatment intensity local to zero as controls under a parallel-trends condition between the quasi-untreated group and the full population. Figure D3 yields qualitatively similar post-event patterns for Moderna/Pfizer vaccination.[12]

4.3 Mechanisms

These findings motivate two complementary channels. The first is an information-supply channel: Russian state-sponsored outlets intensified or made more salient narratives that used problems with Western vaccines to portray Sputnik V as superior and Western health authorities as incompetent. The second is a demand or susceptibility channel: the same narratives may have been more persuasive, or prompted more active search for aligned information, among Russian-speaking communities with lower baseline trust in Latvian and EU institutions. These channels need not operate separately. Greater propaganda supply can have larger behavioral effects precisely where prior institutional distrust raises demand for, and receptiveness to, that content.

We conduct a series of exercises to assess whether the evidence is consistent with these channels. We begin by estimating event-study and DiD specifications for online traffic to pro-Kremlin versus neutral Russian-language outlets around the two vaccine-safety events and the invasion of Ukraine. Around the AstraZeneca suspension and Janssen rollout delay, Table 3 shows increases of 0.376 and 0.394 log points, respectively, in traffic to pro-Kremlin outlets relative to neutral outlets in the specifications with controls—equivalent to approximately 46% and 48% increases. Figure 5 shows the associated dynamics and no pronounced differential pre-trends. These estimates establish a sizable relative shift in the information sources being consumed but cannot by themselves distinguish whether it was generated by greater Russian misinformation and propaganda supply or by increased demand among vaccine-concerned Russian speakers.[13]

[12]The current implementation of de Chaisemartin et al. (2026) used here does not include covariate adjustment since their package does not allow it.

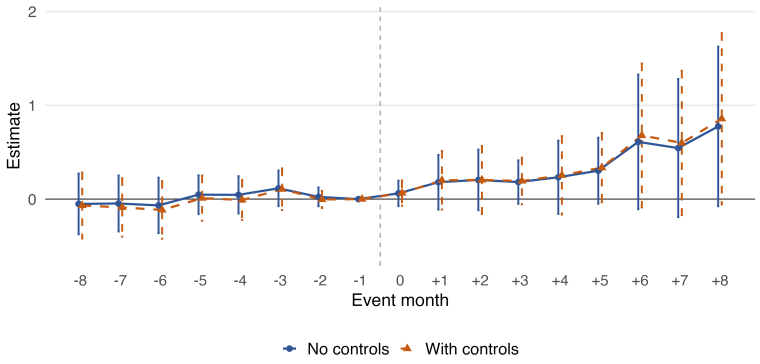
[13]The observed traffic shift is consistent with either, or both, mechanisms: Russian state-backed outlets may have produced or promoted more vaccine-related misinformation, and Russian-speaking users

Table 3: Difference-in-differences estimates of the AstraZeneca suspension, Janssen rollout delay, and Russian invasion of Ukraine on organic traffic to pro-Kremlin relative to neutral Russian-language news sources in Latvia

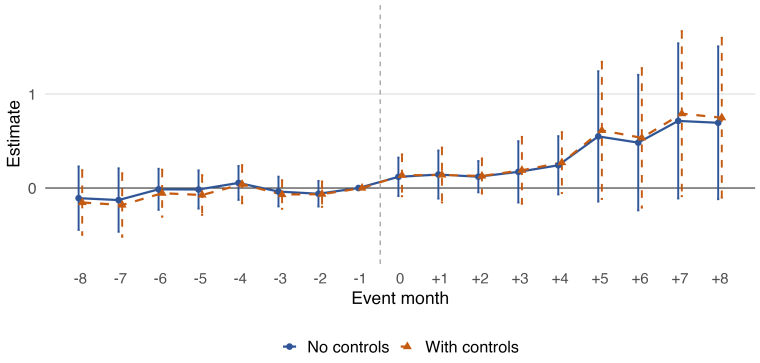
	Dependent variable: Organic traffic		
Event:	AstraZeneca suspension	Janssen delay	Ukraine invasion
	(1)	(2)	(3)
Panel A: Without control variables			
$\text{Post}_{\text{Event}} \times$ *pro-Kremlin*	0.344^{*}	0.360^{*}	-0.774^{*}
	(0.188)	(0.206)	(0.410)
Observations	663	663	663
R^2	0.053	0.056	0.056
Panel B: With control variables			
$\text{Post}_{\text{Event}} \times$ *pro-Kremlin*	0.376^{*}	0.394^{*}	-0.819^{*}
	(0.204)	(0.221)	(0.480)
Observations	663	663	663
R^2	0.122	0.124	0.123

Notes: Observations are at the news source-month level. All specifications include news-source and month fixed effects. Estimates in Panel A have no controls, and in Panel B they include the interaction of $Post_{Event}$ with predetermined news-source characteristics, including baseline organic-keyword volume, baseline organic traffic, and baseline paid traffic. The outcome is logged organic traffic to the news source. Standard errors are clustered at the news-source level. * p<0.1, ** p<0.05, *** p<0.01.

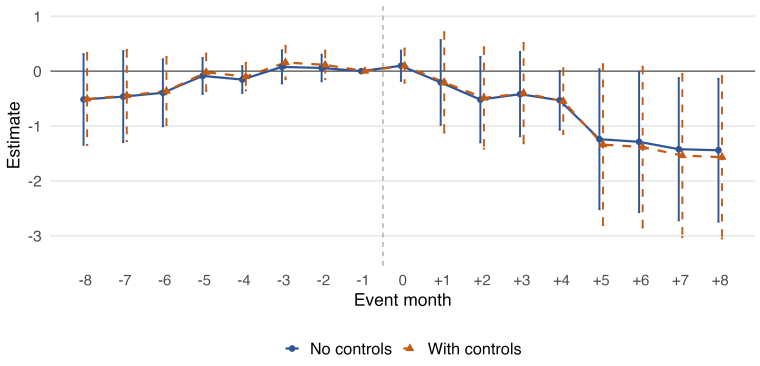
Figure 5: Event studies of the AstraZeneca suspension, Janssen rollout delay, and Russian invasion of Ukraine on organic traffic to pro-Kremlin relative to neutral Russian-language news sources in Latvia



(a) AstraZeneca suspension



(b) Janssen rollout delay



(c) Russian invasion of Ukraine

The event studies correspond to the specifications in Table 3. The solid blue series is estimated without controls. The dashed orange series adjusts for interacted predetermined news-source characteristics. 95% confidence intervals are computed with standard errors clustered at the news-source level.

The invasion of Ukraine is, however, informative about the importance of Russian misinformation and propaganda supply. Column (3) of Table 3 estimates a 0.819-log-point decline in traffic to pro-Kremlin outlets relative to neutral Russian-language outlets after the invasion, corresponding to an approximate 56% reduction. The timing coincides with Latvia's restrictions on Russian state-backed media and with a reorientation of Russian misinformation from COVID-19 toward the war. Because the invasion itself could also alter attitudes toward Russia, this exercise, in principle, might not isolate the media-access channel. Nevertheless, the descriptive evidence in Appendix Table B1 shows that Russian-language respondents remained substantially more favorable toward Russia and more opposed to Latvia's and the EU's responses than Latvian-language respondents, making a wholesale collapse in demand for pro-Kremlin viewpoints an unlikely explanation for the traffic decline.

To support the importance of the information-supply channel, we next examine vaccination around the invasion. Table 4 shows that, in contrast with the two vaccine-safety events, Moderna and Pfizer vaccination rises relatively more after February 24, 2022 in municipalities with larger ethnic Russian shares. In column (2) of Panel B, a one-standard-deviation increase in the ethnic Russian share is associated with 10.09 additional doses per 10,000 inhabitants, about 9.6% of the outcome mean.[14] Figure 6 shows that the post-invasion increase substantially narrows the pre-existing vaccination gap across municipalities. This reversal highlights the importance of Russian misinformation and propaganda supply.

Next we turn to evidence supporting the importance of the demand or susceptibility channel. First, we examine whether the response is stronger among cohorts whose formative political and educational experience occurred under Soviet rule, who we expect to be persuaded by pro-Russian narratives, or be more likely to search for aligned, pro-Russian information. We split vaccination outcomes between individuals aged 40 or older in 2021—who were at least ten years old at independence and therefore received a meaningful share of their schooling under the Soviet system—and younger cohorts educated primarily after Latvian independence. Tables E1 and E2 show substantially larger gradients for the older cohort. Following the AstraZeneca suspension, Moderna and Pfizer vaccination falls by about 38% of the outcome mean for the Soviet-schooling cohort in municipalities with

concerned about Western vaccines may have searched more intensively for ideologically aligned coverage.

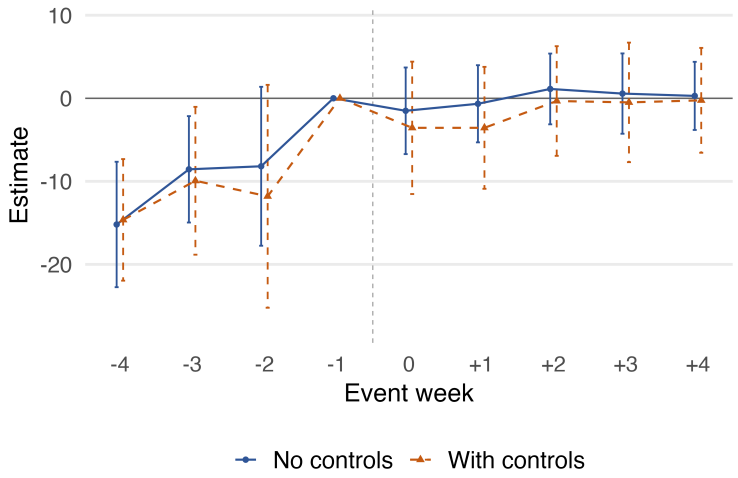
[14] By the time of the invasion, AstraZeneca and Janssen vaccination was negligible, as reflected in the similar outcome means for all vaccines and Moderna/Pfizer in Table 4; we therefore omit those manufacturer-specific estimates.

Table 4: Difference-in-differences estimates of the Russian invasion of Ukraine on COVID-19 vaccination in Latvia, by municipal ethnic Russian share

	Dependent variable:	
	All	Pfizer/Moderna
	(1)	(2)
Panel A: Without control variables		
$\text{Post}_{Ukraine} \times$ *ethnic Russian share*	14.390***	14.661***
	(3.597)	(3.690)
R^2	0.094	0.099
Panel B: With control variables		
$\text{Post}_{Ukraine} \times$ *ethnic Russian share*	10.454**	10.093**
	(3.146)	(3.128)
Outcome mean	108.22	105.37
Observations	559	559
R^2	0.428	0.441

Notes: Observations are at the municipality-week level, six weeks before and after the Russian invasion of Ukraine on February 24, 2022. Outcomes are vaccines per 10,000 inhabitants for all vaccine manufacturers in column 1; and for Moderna and Pfizer in column 2. The share of ethnic Russians is standardized. All specifications include municipality and week fixed effects. Estimates in Panel A have no controls, and in Panel B they include the interaction of the relevant post-event indicator with standardized municipality-level controls, including population density, the share of the adult population with secondary or tertiary education, the median wage, the unemployment rate, and crime rate. Standard errors, clustered at the municipality level, are in parentheses (43 clusters). * p<0.1, ** p<0.05, *** p<0.01.

Figure 6: Event study of the Russian invasion of Ukraine on Moderna and Pfizer vaccination in Latvia, by municipal ethnic Russian share



Notes: The event study corresponds to the specification in column 2 in Panel B of Table 4. 95% confidence intervals are computed using standard errors clustered at the municipality level.

a one-standard-deviation larger ethnic Russian share, compared with about 17% for the post-independence cohort. The corresponding figures after the Janssen rollout delay are approximately 27% and 9%. The associated event studies in Figure E1 show similar pre-event dynamics. These patterns are consistent with communities containing more residents whose formative experience occurred under Soviet rule being more responsive to the broader information shock.

We obtain a complementary pattern when separating first doses from subsequent doses. First-dose vaccination is the margin at which an unvaccinated individual decides whether to enter the vaccination program, so distrust of the national authorities and specific vaccine-safety concerns of less integrated individuals should be especially consequential there. Tables E3 and E4 show that the differential response by ethnic Russian share is indeed concentrated on first doses. After the AstraZeneca suspension, Moderna and Pfizer first doses fall by about 45% of the outcome mean in municipalities with a one-standard-deviation larger ethnic Russian share, while the corresponding estimate for second or higher doses is only about 2% and statistically insignificant. Following the Janssen rollout delay, the analogous declines are approximately 26% for first doses and 12% for later doses. Figure

E2 shows the corresponding event-study patterns. This concentration at the vaccination-entry margin is consistent with heightened distrust deterring less integrated individuals with lower baseline distrust the national authorities.

We finally turn to Estonia and Lithuania to assess whether the Latvian pattern generalizes to settings where Russian-speaking minorities exhibit smaller baseline trust deficits and post-independence integration has been less contentious. Despite documented Russian misinformation directed at Russian-speaking populations in both countries, we do not observe comparable increases in traffic to pro-Kremlin outlets relative to neutral Russian-language outlets around the vaccine-safety events (Appendix Table E5 and Figures E4, E7). Nor do we find the corresponding vaccination pattern by municipal ethnic Russian share. In Lithuania, overall vaccination does fall more in municipalities with larger ethnic Russian shares after the AstraZeneca suspension, but the decline is entirely accounted for by AstraZeneca itself and is absent for Moderna and Pfizer. In Estonia, where manufacturer-level vaccination data are unavailable, we find no aggregate decline after the AstraZeneca suspension and an increase after the Janssen rollout delay that is inconsistent with the mechanisms we probe in Latvia. The absence of the Latvian pattern in these comparison countries is consistent with baseline institutional trust and integration being important for resilience to Russian state-sponsored misinformation, while stopping short of identifying the causal effect of integration itself.

Lastly, we consider two alternative explanations for the vaccination results. The first is vaccine substitution by residents who are not ethnic Russian. If the AstraZeneca suspension or Janssen rollout delay induced these residents to switch toward Moderna and Pfizer, municipalities with smaller ethnic Russian shares could display larger Moderna/Pfizer increases even if ethnic Russian behavior did not change. The manufacturer-specific estimates are difficult to reconcile with this account. Around the AstraZeneca suspension, AstraZeneca vaccination itself also falls more in municipalities with larger ethnic Russian shares; in Panel B of Table 1, its coefficient is -4.975, about half the Moderna/Pfizer coefficient of -9.049. More conclusively, the Janssen coefficient in column (3) of Table 2 is a precise zero, because the product rolled out had been delayed, while the Moderna/Pfizer gradient changes immediately after the rollout delay.

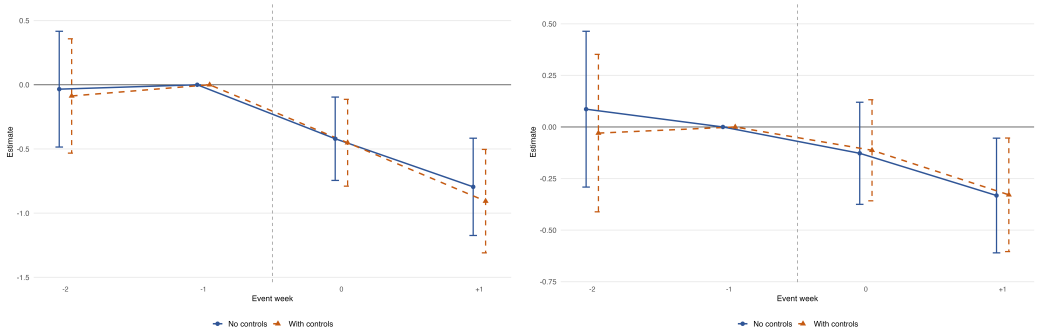
The second concern is differential vaccine supply across municipalities. A direct supply explanation would require Moderna/Pfizer availability to deteriorate selectively in municipalities with larger ethnic Russian shares at both event dates. We find this unlikely for two reasons. First, the main estimates focus on Moderna and Pfizer rather than on the vaccine

directly affected by each event. Second, the right panel of Figure 4 shows that the Moderna and Pfizer response begins immediately after the Janssen rollout delay, even though the Janssen delayed rollout did not entail withdrawing existing doses. These patterns make a common mechanical supply-reallocation explanation for both events unlikely.

4.4 Eurobarometer outcomes

Lastly, we examine whether the vaccine-safety events are associated with a worsening in the political attitudes of ethnic Russians. Table 5 pools two-week windows around the AstraZeneca suspension and Janssen rollout delay and compares Russian-language and Latvian-language respondents. The results indicate that Russian-language respondents showed increased dissatisfaction with Latvian democracy and worse views of the EU around the vaccine-safety events. In Panel B, which adjusts for respondent characteristics interacted with the post-event indicator, satisfaction with democracy in Latvia falls by 0.696 points among Russian-language respondents relative to Latvian-language respondents. Relative to the outcome mean of 2.827, this is about a 25% decline. The estimated relative change in respondents' image of the EU is -0.194 points, roughly 6% of the outcome mean of 3.313. The event studies in Figures 7a and 7b show no comparable differential movement before the pooled vaccine-safety events. These results highlight how misinformation and propaganda reinforce pre-existing institutional distrust among less integrated populations.

Figure 7: Event studies of the pooled vaccine-safety events for Russian-language respondents: satisfaction with democracy in Latvia and image of the European Union



(a) Satisfaction with democracy in Latvia (b) Image of the European Union

Notes: The event study on the left (right) corresponds to column 1 (2) of Panel B in Table 5.

Table 5: Difference-in-differences estimates of the pooled vaccine-safety events for Russian-language respondents: satisfaction with democracy in Latvia and image of the European Union

	Dependent variable:	
	Satisfaction with democracy in Latvia (1)	Image of the European Union (2)
Panel A: Without control variables		
$\text{Post}_{Event} \times$ Russian-language respondent	-0.608^{***}	-0.230^{*}
	(0.160)	(0.121)
Observations	2,195	2,195
R^2	0.118	0.053
Panel B: With control variables		
$\text{Post}_{Event} \times$ Russian-language respondent	-0.679^{***}	-0.221^{*}
	(0.168)	(0.119)
Outcome mean	2.827	3.313
Observations	2,195	2,195
R^2	0.169	0.113

Notes: Observations are at the Eurobarometer respondent level and cover two-week windows before and after either the AstraZeneca suspension (March 16–19, 2021) or the Janssen rollout delay (April 13–23, 2021), pooling both events. Outcomes are satisfaction with democracy in Latvia and image of the European Union, both measured on increasing scales from 1 to 5. Estimates in Panel A have no controls; Panel B additionally interacts Post_{Event} with standardized age, gender, indicators for perceived social class, and age groups when respondents stopped full-time education. Heteroskedasticity-robust standard errors are in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

5 Conclusion

Russian-speaking communities across Europe have long been targets of Russian state-sponsored misinformation and propaganda, but the Baltic experience shows that exposure need not translate uniformly into behavioral or political influence. Latvia provides a setting in which a large ethnic Russian minority has experienced a comparatively difficult post-independence integration process, substantial baseline distrust of national institutions, and a segmented Russian-language information environment. Exploiting two vaccine-safety events that Russian state-backed media used to discredit Western vaccines and institutions, we find that Moderna and Pfizer vaccination declined more in Latvian municipalities with larger ethnic Russian population shares. At the same time, online traffic shifted toward pro-Kremlin outlets relative to neutral Russian-language outlets.

Several pieces of evidence help characterize when these effects emerge. The vaccination gradient reverses after Russia's invasion of Ukraine and the subsequent restrictions on Russian state-backed media; it is substantially larger for first doses and for cohorts whose schooling occurred partly under Soviet rule; and it is absent in Estonia and Lithuania, where the descriptive trust deficit among better integrated Russian-speaking populations is much smaller. Eurobarometer evidence also shows that the vaccine-safety events coincide with a relative deterioration in satisfaction with Latvian democracy and views of the EU among Russian-language respondents. Taken together, the results are consistent with Russian misinformation being most consequential when a hostile information supply interacts with pre-existing institutional distrust and a segmented media environment.

These findings suggest that resilience to foreign misinformation depends on more than correcting individual false claims after they circulate. Policies that strengthen credible Russian-language information and digital and media literacy can reduce informational isolation. More broadly, policies that improve the social, political, and economic integration of minority communities may reduce the distrust on which external influence campaigns can build. The results also underscore a potential of restricting hostile state media: the post-invasion experience is consistent with access restrictions changing media consumption. Future work should directly evaluate interventions that strengthen trusted local information and institutional integration, and test whether the conditions identified here predict susceptibility to Russian influence operations in other regions and among other targeted groups.

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Appendix

A Websites classification

Table A1: Websites classification in Estonia

Website	Reason coded
Panel A: Websites classified as propaganda or state-owned	
russian.rt.com	Govt. Controlled (Simonov and Rao, 2022)
ntvmir.ntv.ru	Govt. Controlled (Simonov and Rao, 2022)
ria.ru	Govt. Controlled (Simonov and Rao, 2022)
vz.ru	Govt. Controlled (Simonov and Rao, 2022)
rg.ru	Govt. Controlled (Simonov and Rao, 2022)
1tv.ru	Govt. Controlled (Simonov and Rao, 2022)
ntv.ru	Govt. Controlled (Simonov and Rao, 2022)
tass.ru	Govt. Controlled (Simonov and Rao, 2022)
aif.ru	Govt. Controlled (Simonov and Rao, 2022)
vesti.ru	Govt. Controlled (Simonov and Rao, 2022)
dni.ru	Govt. Controlled (Simonov and Rao, 2022)
sputnikglobe.com/geo_Estonia	Propaganda (Mölder and Sazonov, 2020)
baltnews.com	Propaganda (Mölder and Sazonov, 2020)
inosmi.ru	Propaganda (Mölder and Sazonov, 2020)
vgtrk.ru	Gazprom or VGTRK owned
m24.ru	Gazprom or VGTRK owned
ukraina.ru	Gazprom or VGTRK owned
tvzvezda.ru	Russian Defense Min. owned
tvc.ru	Moscow City owned
pravda.ru	Vadim Gorshenin owned
Panel B: Websites put as comparison group	
narvaleht.ee	Popular commercial websites in EE
rus.err.ee	Popular commercial websites in EE
rus.postimees.ee	Popular commercial websites in EE
gazeta.ee	Popular commercial websites in EE
rus.lsm.lv	Official LV news outlet
newsru.com	Independent (Simonov and Rao, 2022)
newtimes.ru	Independent (Simonov and Rao, 2022)
rbc.ru	Independent (Simonov and Rao, 2022)
snob.ru	Independent (Simonov and Rao, 2022)
forbes.ru	Independent (Simonov and Rao, 2022)
the-village.ru	Independent (Simonov and Rao, 2022)
meduza.io	Independent (Shorenstein center)
tvrain.tv	Independent (Shorenstein center)
novayagazeta.ru	Independent (Shorenstein center)
bbc.com/russian	International (Simonov and Rao, 2022)
svoboda.org	International (Simonov and Rao, 2022)
dw.com/ru	International (Simonov and Rao, 2022)
unian.net	Ukranian media (Simonov and Rao, 2022)
korrespondent.net	Ukranian media (Simonov and Rao, 2022)
news.liga.net	Ukranian media (Simonov and Rao, 2022)

Table A2: Websites classification in Latvia

Website	Reason coded
Panel A: Websites classified as propaganda or state-owned	
russian.rt.com	Govt. Controlled (Simonov and Rao, 2022)
ntvmir.ntv.ru	Govt. Controlled (Simonov and Rao, 2022)
ria.ru	Govt. Controlled (Simonov and Rao, 2022)
vz.ru	Govt. Controlled (Simonov and Rao, 2022)
rg.ru	Govt. Controlled (Simonov and Rao, 2022)
1tv.ru	Govt. Controlled (Simonov and Rao, 2022)
ntv.ru	Govt. Controlled (Simonov and Rao, 2022)
tass.ru	Govt. Controlled (Simonov and Rao, 2022)
aif.ru	Govt. Controlled (Simonov and Rao, 2022)
vesti.ru	Govt. Controlled (Simonov and Rao, 2022)
dni.ru	Govt. Controlled (Simonov and Rao, 2022)
lv.sputniknews.ru	Propaganda (Mölder and Sazonov, 2020)
baltnews.com	Propaganda (Mölder and Sazonov, 2020)
inosmi.ru	Propaganda (Mölder and Sazonov, 2020)
vgtrk.ru	Gazprom or VGTRK owned
m24.ru	Gazprom or VGTRK owned
ukraina.ru	Gazprom or VGTRK owned
tvzvezda.ru	Russian Defense Min. owned
tvc.ru	Moscow City owned
pravda.ru	Vadim Gorshenin owned
Panel B: Websites put as comparison group	
rus.delfi.lv	Popular commercial websites in LV
rus.tvnet.lv	Popular commercial websites in LV
apollo.lv	Popular commercial websites in LV
rus.lsm.lv	Official LV news outlet
newsru.com	Independent (Simonov and Rao, 2022)
newtimes.ru	Independent (Simonov and Rao, 2022)
rbc.ru	Independent (Simonov and Rao, 2022)
snob.ru	Independent (Simonov and Rao, 2022)
forbes.ru	Independent (Simonov and Rao, 2022)
the-village.ru	Independent (Simonov and Rao, 2022)
meduza.io	Independent (Shorenstein center)
tvrain.tv	Independent (Shorenstein center)
novayagazeta.ru	Independent (Shorenstein center)
bbc.com/russian	International (Simonov and Rao, 2022)
svoboda.org	International (Simonov and Rao, 2022)
dw.com/ru	International (Simonov and Rao, 2022)
unian.net	Ukranian media (Simonov and Rao, 2022)
korrespondent.net	Ukranian media (Simonov and Rao, 2022)
news.liga.net	Ukranian media (Simonov and Rao, 2022)

Table A3: Websites classification in Lithuania

Website	Reason coded
Panel A: Websites classified as propaganda or state-owned	
russian.rt.com	Govt. Controlled (Simonov and Rao, 2022)
ntvmir.ntv.ru	Govt. Controlled (Simonov and Rao, 2022)
ria.ru	Govt. Controlled (Simonov and Rao, 2022)
vz.ru	Govt. Controlled (Simonov and Rao, 2022)
rg.ru	Govt. Controlled (Simonov and Rao, 2022)
1tv.ru	Govt. Controlled (Simonov and Rao, 2022)
ntv.ru	Govt. Controlled (Simonov and Rao, 2022)
tass.ru	Govt. Controlled (Simonov and Rao, 2022)
aif.ru	Govt. Controlled (Simonov and Rao, 2022)
vesti.ru	Govt. Controlled (Simonov and Rao, 2022)
dni.ru	Govt. Controlled (Simonov and Rao, 2022)
lt.sputniknews.ru	Propaganda (Mölder and Sazonov, 2020)
baltnews.com	Propaganda (Mölder and Sazonov, 2020)
inosmi.ru	Propaganda (Mölder and Sazonov, 2020)
vgtrk.ru	Gazprom or VGTRK owned
m24.ru	Gazprom or VGTRK owned
ukraina.ru	Gazprom or VGTRK owned
tvzvezda.ru	Russian Defense Min. owned
tvc.ru	Moscow City owned
pravda.ru	Vadim Gorshenin owned
Panel B: Websites put as comparison group	
delfi.lt/ru	Popular commercial websites in LT
lrt.lt/ru/novosti	Popular commercial websites in LT
kurier.lt	Popular commercial websites in LT
rus.lsm.lv	Official LV news outlet
newsru.com	Independent (Simonov and Rao, 2022)
newtimes.ru	Independent (Simonov and Rao, 2022)
rbc.ru	Independent (Simonov and Rao, 2022)
snob.ru	Independent (Simonov and Rao, 2022)
forbes.ru	Independent (Simonov and Rao, 2022)
the-village.ru	Independent (Simonov and Rao, 2022)
meduza.io	Independent (Shorenstein center)
tvrain.tv	Independent (Shorenstein center)
novayagazeta.ru	Independent (Shorenstein center)
bbc.com/russian	International (Simonov and Rao, 2022)
svoboda.org	International (Simonov and Rao, 2022)
dw.com/ru	International (Simonov and Rao, 2022)
unian.net	Ukranian media (Simonov and Rao, 2022)
korrespondent.net	Ukranian media (Simonov and Rao, 2022)
news.liga.net	Ukranian media (Simonov and Rao, 2022)

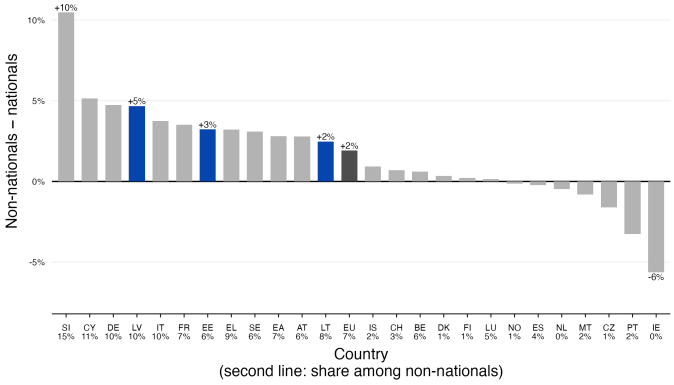
B Descriptive statistics

Table B1: Attitudes toward Russia and the EU response to Russia's invasion of Ukraine in Latvia

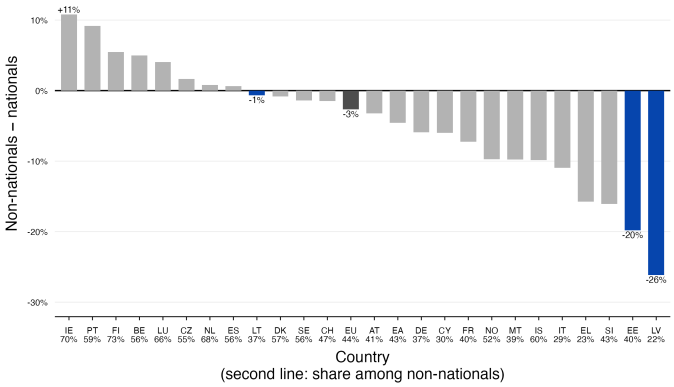
Outcome	**Russian-language % [N]**	**Latvian-language % [N]**
Positive attitude toward Russia	55.7 [210]	8.1 [803]
Dissatisfied with national response	55.6 [435]	20.2 [1,605]
Dissatisfied with EU response	49.7 [435]	33.1 [1,605]
Oppose Sputnik/RT media ban	62.3 [435]	18.4 [1,605]
Oppose economic sanctions to Russia	52.9 [435]	13.4 [1,605]
Oppose reducing Russian-energy dependence	53.4 [435]	11.4 [1,605]
Oppose supplying military equipment to Ukraine	54.9 [435]	10.1 [1,605]
Oppose greater defense spending	56.7 [435]	14.3 [1,605]

Notes: Own calculations using Eurobarometer data (2021-2022). Entries are weighted percentages by respondent language. Raw sample sizes are reported in brackets.

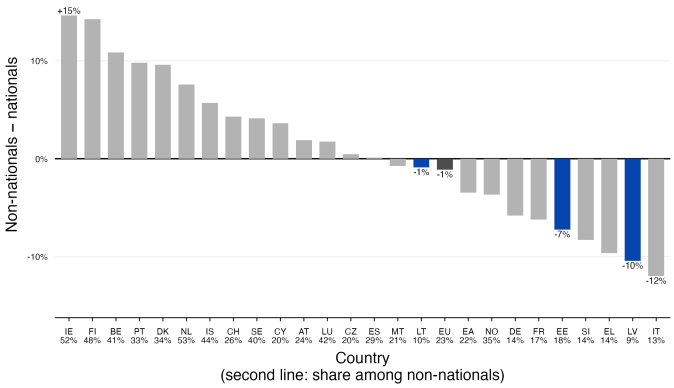
Figure B1: Non-national–national gaps in digital skills, recognition of likely misinformation, and fact-checking



(a) Low basic digital skills



(b) Recognition of untrue or doubtful online information



(c) Fact-checking of online information

Source: Eurostat (2021).

C Census and administrative data sources

C.1 Latvia

The Latvian census and administrative data come primarily from the 2021 Population and Housing Census conducted by the Central Statistical Bureau of Latvia and made available via its Official Statistics Portal.

The share of ethnic Russians is calculated as the 2021 municipal number of residents recorded as ethnic Russian divided by the total resident population, both taken from table `IRE071` (Central Statistical Bureau of Latvia, 2025).

The share of the population with terciary education is calculated as the 2021 municipal number of residents with upper-secondary education (ISCED 3) or tertiary education (ISCED 5–8) divided by the total population resident population aged 15 or above, both taken from table `IZT041` (Central Statistical Bureau of Latvia, 2023).

Crime rate is the number of recorded crimes between August 20 and December 31, 2021 produced by the Information Centre of the Ministry of the Interior and disseminated through the Official Statistics Portal's table `NOR023` (Central Statistical Bureau of Latvia, 2026*b*), divided by the total resident population.

We also consider 2021 population density from table `DNSTE` (Central Statistical Bureau of Latvia, 2026*a*), median wage is the 2021 median monthly wage from table `RIG110` (Central Statistical Bureau of Latvia, 2026*e*), and 2020 unemployment rate is from table `RIG090` (Central Statistical Bureau of Latvia, 2026*d*).

2021 municipal age counts used in additional empirical exercises come from table `RIG010` (Central Statistical Bureau of Latvia, 2026*c*).

C.2 Estonia

The Estonian municipal data come primarily from the 2021 Population and Housing Census conducted by Statistics Estonia and made available through its Statistical Database.

The share of ethnic Russians is calculated as the municipal number of residents recorded as ethnic Russian divided by population, both taken from table `RL21429` (Statistics Estonia, 2022*c*).

The municipal share of residents with basic education or less, and the share with higher education or secondary specialized education after secondary education, come from table `RL21302` (Statistics Estonia, 2022*b*). We divide this by the corresponding population taken

from table RL21429.

As a proxy for population density, we also use average municipal dwelling area per inhabitant from table RL21807 (Statistics Estonia, 2022*d*).

The municipal unemployment rate is calculated as the number of unemployed individuals divided by the economically active population, both taken from table RL21132 (Statistics Estonia, 2022*a*).

C.3 Lithuania

The Lithuanian municipal data come primarily from the 2021 Population and Housing Census conducted by Statistics Lithuania and made available through its Official Statistics Portal.

The share of ethnic Russians is calculated as the 2021 municipal number of residents recorded as ethnic Russian divided by the total resident population, both taken from the census table "Population by Ethnicity and Municipality" (Statistics Lithuania, 2022*c*).

The municipal shares of individuals aged 10 or over with basic education and with higher education are taken from the census table "Population (Aged 10 and Over) by Educational Attainment and Municipality" (Statistics Lithuania, 2022*b*).

We also consider the 2021 municipal employment rate for individuals aged 15–64 taken from "Employment rate" table, the 2021 municipal rate of criminal offenses recorded per 100,000 population taken from "Crimes and misdemeanours recorded per 100 000 population" table, and the 2021 municipal at-risk-of-poverty rate taken from the "At-risk-of-poverty rate (experimental statistics)" table (Statistics Lithuania, 2022*a*, 2023, 2026*a*).

Population density is calculated as the 2021 census total resident population divided by municipal land area at the beginning of 2021, taken from the "Area (land) at the beginning of the year" table (Statistics Lithuania, 2026*b*).

D Robustness

D.1 Alternative controls

Table D1: Difference-in-differences estimates of the effect of the AstraZeneca suspension by municipal ethnic Russian share on Moderna and Pfizer vaccination in Latvia with alternative controls

	Baseline	+ Unemployment	+ Higher education	+ Population density	+ Median wage	+ Crimes per capita	All controls
$\text{Post}_{AZ}\times$ *ethnic Russian share*	-8.358***	-8.098***	-8.764***	-9.124***	-8.376***	-8.187***	-9.048***
	(1.144)	(1.116)	(1.161)	(1.539)	(1.148)	(1.121)	(1.272)
$\text{Post}_{AZ}\times$ Unemployment		-1.025					-0.959
		(1.675)					(3.309)
$\text{Post}_{AZ}\times$ Higher education			1.138				1.976
			(1.585)				(3.754)
$\text{Post}_{AZ}\times$ Population density				1.276			0.530
				(1.041)			(1.741)
$\text{Post}_{AZ}\times$ Median wage					0.686		-1.752
					(1.489)		(4.554)
$\text{Post}_{AZ}\times$ Crimes per capita						-0.515	-0.129
						(1.567)	(1.552)
Outcome mean	25.12	25.12	25.12	25.12	25.12	25.12	25.12
Ethnic Russian share SD	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Observations	386	386	386	386	386	386	386
Within R^2	0.086	0.088	0.088	0.088	0.087	0.087	0.089

Notes: Observations are at the municipality-week level, four weeks before and after the AstraZeneca suspension from March 16–19, 2021. All specifications include municipality and week fixed effects. The outcome is Moderna and Pfizer COVID-19 vaccine doses per 10,000 inhabitants. Standard errors, clustered at the municipality level, are in parentheses (43 clusters). * p<0.1, ** p<0.05, *** p<0.01.

Table D2: Difference-in-differences estimates of the effect of the Janssen rollout delay by municipal ethnic Russian share on Moderna and Pfizer vaccination in Latvia with alternative controls

	Baseline	+ Unemployment	+ Higher education	+ Population density	+ Median wage	+ Crimes per capita	All controls
$\text{Post}_{Janssen}\times$ *ethnic Russian share*	-29.659***	-17.352**	-51.333***	-39.980***	-31.251***	-16.964**	-37.230***
	(4.187)	(7.706)	(8.223)	(7.190)	(8.064)	(6.550)	(7.629)
$\text{Post}_{Janssen}\times$ Unemployment		-48.845***					-11.014
		(10.843)					(9.222)
$\text{Post}_{Janssen}\times$ Higher education			60.530***				44.796***
			(4.660)				(15.289)
$\text{Post}_{Janssen}\times$ Population density				17.233*			0.221
				(8.779)			(5.715)
$\text{Post}_{Janssen}\times$ Median wage					53.494***		2.164
					(6.410)		(18.429)
$\text{Post}_{Janssen}\times$ Crimes per capita						-38.281***	-17.764***
						(8.553)	(6.438)
Outcome mean	175.18	175.18	175.18	175.18	175.18	175.18	175.18
Ethnic Russian share SD	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Observations	559	559	559	559	559	559	559
Within R^2	0.081	0.228	0.291	0.093	0.269	0.167	0.317

Notes: Observations are at the municipality-week level, six weeks before and after the delayed rollout of the Janssen COVID-19 vaccine from April 13–23, 2021. All specifications include municipality and week fixed effects and control for an indicator for the period after vaccination eligibility was extended to the general population. The outcome is Moderna and Pfizer COVID-19 vaccine doses per 10,000 inhabitants. Standard errors, clustered at the municipality level, are in parentheses (43 clusters). * p<0.1, ** p<0.05, *** p<0.01.

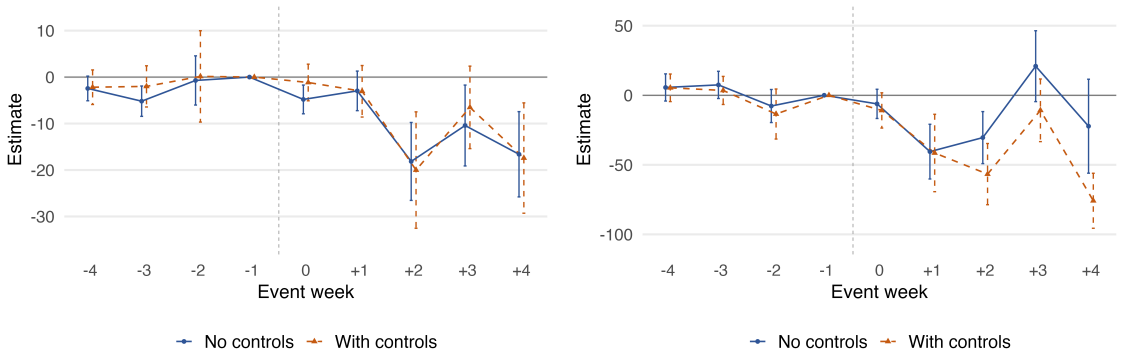
D.2 Without Latgale

Table D3: Difference-in-differences estimates of the effect of the AstraZeneca suspension and Janssen rollout delay by municipal ethnic Russian share on COVID-19 vaccines in Latvia without Latgale

	Dependent variable:			
	All	Moderna & Pfizer	Affected	Unaffected, Moderna & Pfizer
	(1)	(2)	(3)	(4)
Panel A: AstraZeneca suspension				
$\text{Post}_{AZ} \times$ *ethnic Russian share*	−10.502	−8.633***	−1.885	−8.620***
	(6.873)	(1.775)	(6.238)	(1.779)
Outcome mean	107.040	27.700	79.330	27.710
Observations	323	323	323	323
R^2	0.276	0.168	0.305	0.168
Panel B: Janssen rollout delay				
$\text{Post}_{Janssen} \times$ *ethnic Russian share*	−26.635**	−37.774***	0.224	−26.861**
	(9.122)	(6.609)	(0.302)	(9.052)
Outcome mean	275.400	189.280	6.350	269.040
Observations	468	468	468	468
R^2	0.462	0.572	0.309	0.478

Notes: Observations are at the municipality-week level. In Panel A, they include four weeks before and after the AstraZeneca suspension from March 16–19, 2021. In Panel B, they include six weeks before and after the delayed rollout of the Janssen COVID-19 vaccine from April 13–23, 2021. All specifications include municipality and week fixed effects, and the interaction of the relevant post-event indicator with municipality-level controls, including population density, the share of the adult population with secondary or tertiary education, the median wage, the unemployment rate, and crime rate. Estimates in Panel B also include an indicator for the period after vaccination eligibility was extended to the general population. Outcomes are vaccines per 10,000 inhabitants for all manufacturers in column 1; for Moderna and Pfizer in column 2; for the vaccine directly affected by the focal event (AstraZeneca in Panel A and Janssen in Panel B) in column 3; and for the other three manufacturers in column 4. Standard errors, clustered at the municipality level, are in parentheses (43 clusters). * p<0.1, ** p<0.05, *** p<0.01.

Figure D1: Event studies of the AstraZeneca suspension and Janssen rollout delay on Moderna and Pfizer vaccination in Latvia, by municipal ethnic Russian share without Latgale



(a) AstraZeneca suspension

(b) Janssen rollout delay

Notes: The event study on the right (left) corresponds to the specification in column 2 in panel A (B) of Table D3.

D.3 Alternative specifications

Table D4: Difference-in-differences estimates of the effect of the AstraZeneca suspension by municipal ethnic Russian share on Moderna and Pfizer vaccination in Latvia, using 25th-, 50th-, and 75th-percentile treatment cutoffs for the municipal ethnic Russian share

	Dependent variable:
	Moderna & Pfizer
	(1)
Panel A: High ethnic Russian share defined at or above the 25th percentile	
High ethnic Russian share	-12.568^{***}
	(4.384)
Outcome mean	25.12
Observations	386
Panel B: High ethnic Russian share defined at or above the 50th percentile	
High ethnic Russian share	-14.389^{***}
	(3.072)
Outcome mean	25.12
Observations	386
Panel C: High ethnic Russian share defined at or above the 75th percentile	
High ethnic Russian share	-7.661^{*}
	(4.026)
Outcome mean	25.12
Observations	386

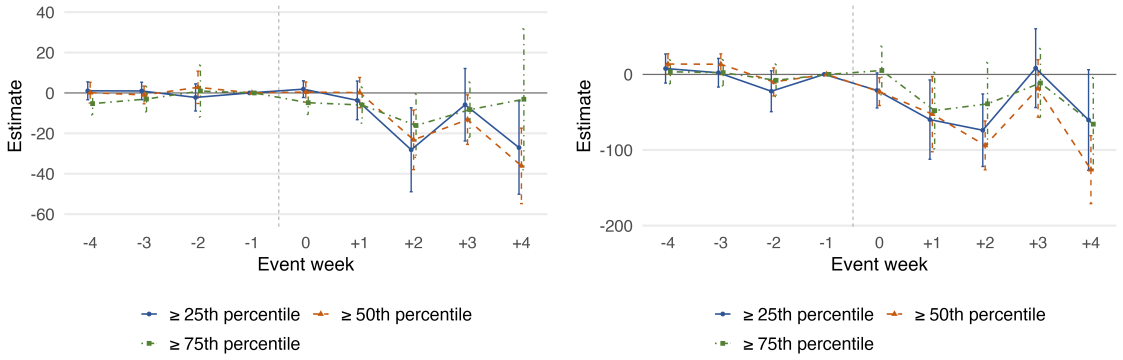
Notes: Observations are at the municipality-week level, four weeks before and after the AstraZeneca suspension from March 16–19, 2021 by the Latvian government. Outcomes are vaccines per 10,000 inhabitants for Moderna and Pfizer manufacturers. In every panel, municipalities with a high ethnic Russian share are defined as those at or above the stated cutoff: the 25th, 50th, and 75th percentiles of the municipal distribution of ethnic Russian share. All specifications include municipality and week fixed effects, and the interaction of the relevant post-event indicator with standardized municipality-level covariates, including population density, the share of the adult population with secondary or tertiary education, the median wage, the unemployment rate, and crime rate. Standard errors, clustered at the municipality level, are in parentheses (43 clusters). * p<0.1, ** p<0.05, *** p<0.01.

Table D5: Difference-in-differences estimates of the effect of the Janssen rollout delay by municipal ethnic Russian share on Moderna and Pfizer vaccination in Latvia, using 25th-, 50th-, and 75th-percentile treatment cutoffs for the municipal ethnic Russian share

	Dependent variable:
	Moderna & Pfizer
	(1)
Panel A: High ethnic Russian share defined at or above the 25th percentile	
High ethnic Russian share	-46.605^{***}
	(17.789)
Outcome mean	175.18
Observations	559
Panel B: High ethnic Russian share defined at or above the 50th percentile	
High ethnic Russian share	-64.499^{***}
	(13.671)
Outcome mean	175.18
Observations	559
Panel C: High exposure at or above the 75th percentile	
High ethnic Russian share	−32.137
	(21.976)
Outcome mean	175.18
Observations	559

Notes: Observations are at the municipality-week level, covering weeks −6 through +6 around the delayed rollout of the Janssen COVID-19 vaccine from April 13–23, 2021. Outcomes are vaccines per 10,000 inhabitants for Moderna and Pfizer manufacturers. In every panel, municipalities with a high ethnic Russian share are defined as those at or above the stated cutoff: the 25th, 50th, and 75th percentiles of the municipal distribution of ethnic Russian share. All specifications include municipality and week fixed effects, and an indicator for the period after vaccination eligibility was extended to the general population, and the interaction of the relevant post-event indicator with standardized municipality-level covariates, including population density, the share of the adult population with secondary or tertiary education, the median wage, the unemployment rate, and crime rate. Standard errors, clustered at the municipality level, are in parentheses (43 clusters). * p<0.1, ** p<0.05, *** p<0.01.

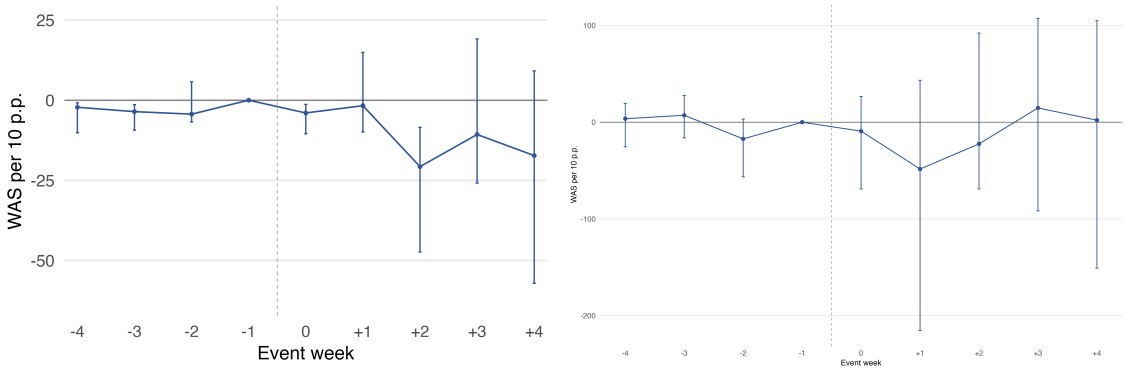
Figure D2: Event studies of the AstraZeneca suspension and Janssen rollout delay on Moderna and Pfizer vaccination in Latvia using 25th-, 50th-, and 75th-percentile treatment cutoffs for the municipal ethnic Russian share



(a) AstraZeneca suspension (b) Janssen rollout delay

Notes: The event studies on the left (right) correspond to the specifications in Table D4 (Table D5). 95% confidence intervals are computed using standard errors clustered at the municipality level.

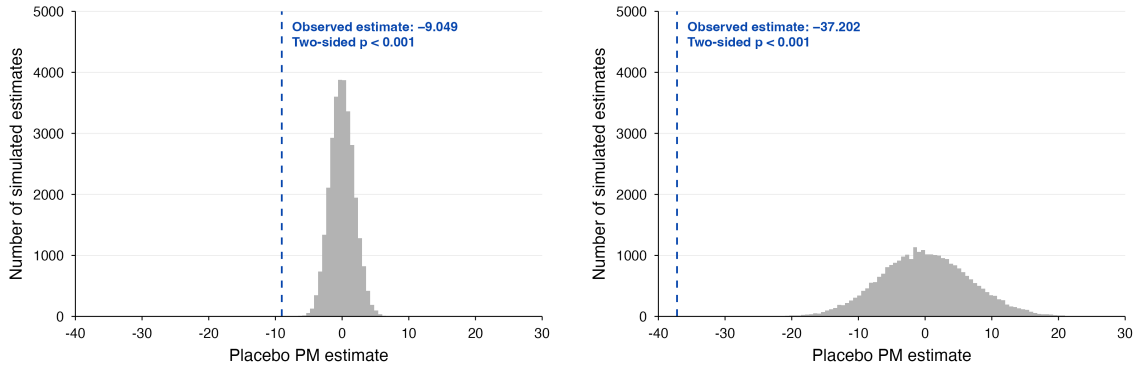
Figure D3: de Chaisemartin et al. (2026)'s event studies for the differential effect of the AstraZeneca suspension and Janssen rollout delay by municipal ethnic Russian share on Moderna and Pfizer vaccination in Latvia



(a) AstraZeneca suspension (b) Janssen rollout delay

Notes: de Chaisemartin et al. (2026)'s event study for the AstraZeneca suspension (Janssen rollout delay) on the right (left). Points are weighted average slopes (WAS) per 10-percentage-point increase in ethnic Russian share. 95% confidence intervals are robust bias-corrected, accounting for small-sample bias and heteroskedasticity.

Figure D4: Permutation tests for the AstraZeneca suspension and Janssen delayed rollout on Moderna and Pfizer vaccination in Latvia



(a) AstraZeneca suspension

(b) Janssen rollout delay

Notes: The histograms show placebo estimates from 30,000 Monte Carlo draws of municipal treatment intensity. In every draw, 43 standardized ethnic Russian shares are sampled from their distribution and assigned to all observations for the corresponding municipality. All placebo estimates correspond to our preferred estimates in column 2 of Panel B in Tables 1 and 2. The dashed vertical line denotes the observed coefficient in our main specifications.

E Mechanisms

E.1 Latvia

Table E1: Difference-in-differences estimates of the effect of the AstraZeneca suspension by municipal ethnic Russian share on COVID-19 vaccination in Latvia, by Soviet-schooling versus post-independence cohort

	Dependent variable:			
	All	Moderna & Pfizer	AstraZeneca	Janssen, Moderna & Pfizer
	(1)	(2)	(3)	(4)
Panel A: Soviet-schooling cohort				
$\text{Post}_{AZ} \times$ *ethnic Russian share*	-25.313^{**}	-17.475^{***}	-7.853	-17.460^{***}
	(9.105)	(2.389)	(8.445)	(2.391)
Outcome mean	186.750	46.260	140.480	46.270
Observations	386	386	386	386
R^2	0.294	0.261	0.294	0.261
Panel B: Post-independence cohort				
$\text{Post}_{AZ} \times$ *ethnic Russian share*	-3.330	-0.954^{*}	-2.385	-0.946^{*}
	(2.129)	(0.397)	(2.149)	(0.399)
Outcome mean	13.830	5.700	8.110	5.710
Observations	377	377	377	377
R^2	0.270	0.256	0.220	0.257

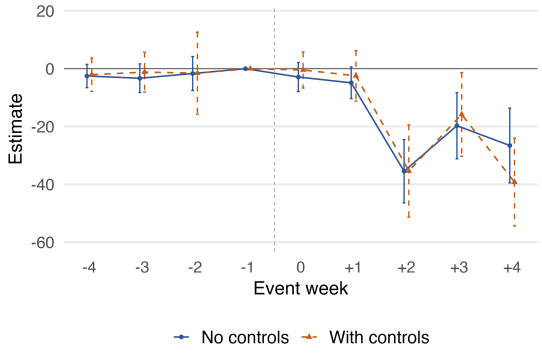
Notes: Observations are at the municipality-week level, four weeks before and after the AstraZeneca suspension from March 16–19, 2021. Outcomes are vaccines per 10,000 inhabitants for all vaccine manufacturers in column 1; for Moderna and Pfizer in column 2; for AstraZeneca in column 3; and for Janssen, Moderna, and Pfizer in column 4. The share of ethnic Russians is standardized. All specifications include municipality and week fixed effects, and include the interaction of the relevant post-event indicator with standardized municipality-level covariates, including population density, the share of the adult population with secondary or tertiary education, the median wage, the unemployment rate, and crime rate. Panel A considers the vaccination of individuals 40 years old or above in 2021, and Panel B the vaccination of individuals less than 40 years old. Standard errors, clustered at the municipality level, are in parentheses (43 clusters). * p<0.1, ** p<0.05, *** p<0.01.

Table E2: Difference-in-differences estimates of the effect of the Janssen rollout delay by municipal ethnic Russian share on COVID-19 vaccination in Latvia, by Soviet-schooling versus post-independence cohort

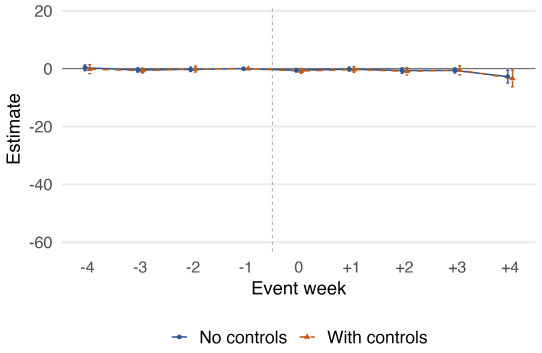
	Dependent variable:			
	All	Moderna & Pfizer	Janssen	AstraZeneca, Moderna & Pfizer
	(1)	(2)	(3)	(4)
Panel A: Soviet-schooling cohort				
$\text{Post}_{Janssen} \times$ *ethnic Russian share*	−47.979***	−70.199***	0.221	−48.200***
	(12.585)	(9.887)	(0.413)	(12.515)
Outcome mean	411.050	262.310	9.100	401.950
Observations	559	559	559	559
R^2	0.521	0.611	0.310	0.521
Panel B: Post-independence cohort				
$\text{Post}_{Janssen} \times$ *ethnic Russian share*	−10.493***	−8.167***	0.143	−10.637***
	(2.596)	(1.858)	(0.154)	(2.563)
Outcome mean	107.440	94.230	3.080	104.360
Share Russian SD	0.12	0.12	0.12	0.12
Observations	552	552	552	552
R^2	0.737	0.760	0.257	0.734

Notes: Observations are at the municipality-week level, six weeks before and after the delayed rollout of the Janssen COVID-19 vaccine from April 13–23, 2021. Outcomes are vaccines per 10,000 inhabitants for all vaccine manufacturers in column 1; for Moderna and Pfizer in column 2; for Janssen in column 3; and for AstraZeneca, Moderna, and Pfizer in column 4. The share of ethnic Russians is standardized. All specifications include municipality and week fixed effects, and controls for an indicator for the period after vaccination eligibility was extended to the general population and the interaction of the relevant post-event indicator with standardized municipality-level controls, including population density, the share of the adult population with secondary or tertiary education, the median wage, the unemployment rate, and crime rate. Panel A considers the vaccination of individuals 40 years old or above in 2021, and Panel B the vaccination of individuals less than 40 years old. Standard errors, clustered at the municipality level, are in parentheses (43 clusters). * p<0.1, ** p<0.05, *** p<0.01.

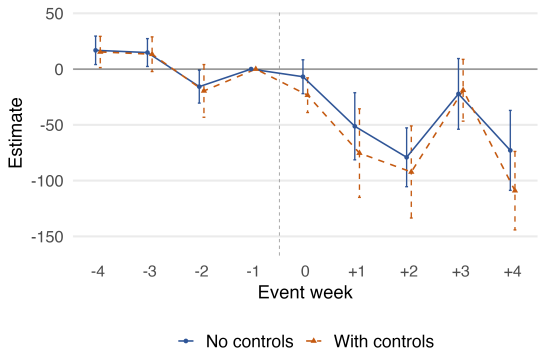
Figure E1: Event studies of the AstraZeneca suspension and Janssen rollout delay on Moderna and Pfizer vaccination in Latvia, by municipal ethnic Russian share, by whether Soviet-schooling and post-independence cohorts



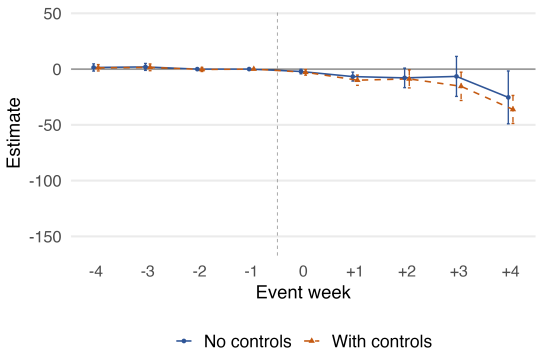
(a) AstraZeneca, SU Educated



(b) AstraZeneca, LV Educated



(c) Janssen Event, SU Educated



(d) Janssen Event, LV Educated

Notes: The event study on the right-(left-)top plot corresponds to the specification in column 2 in Panel A (B) of Table E1. The event study on the right-(left-)bottom plot corresponds to the specification in column 2 in Panel A (B) of Table 2.

Table E3: Difference-in-differences estimates of the effect of the AstraZeneca suspension by municipal ethnic Russian share on COVID-19 vaccination in Latvia, by first and second-or-higher doses

	Dependent variable:			
	All	Moderna & Pfizer	AstraZeneca	Janssen, Moderna & Pfizer
	(1)	(2)	(3)	(4)
Panel A: First-dose vaccines				
$\text{Post}_{AZ} \times$ *ethnic Russian share*	-14.448^{**}	-9.161^{***}	-5.299	-9.150^{***}
	(5.105)	(1.345)	(4.686)	(1.348)
Outcome mean	93.730	20.490	73.230	20.500
Observations	386	386	386	386
R^2	0.282	0.253	0.278	0.253
Panel B: Second or higher-dose vaccines				
$\text{Post}_{AZ} \times$ *ethnic Russian share*	0.267	-0.092	0.359	-0.092
	(1.139)	(0.903)	(0.294)	(0.903)
Outcome mean	5.540	5.320	0.220	5.320
Observations	336	336	336	336
R^2	0.531	0.551	0.121	0.551

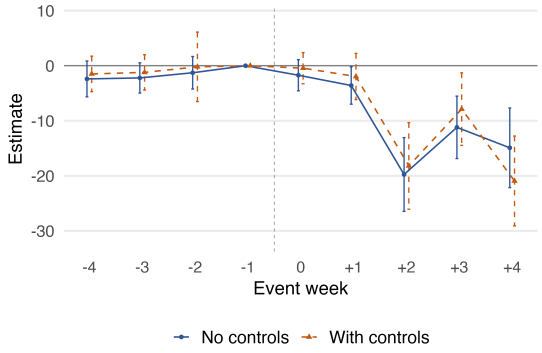
Notes: Observations are at the municipality-week level, four weeks before and after the AstraZeneca suspension from March 16–19, 2021. Outcomes are vaccines per 10,000 inhabitants for all vaccine manufacturers in column 1; for Moderna and Pfizer in column 2; for AstraZeneca in column 3; and for Janssen, Moderna, and Pfizer in column 4. The share of ethnic Russians is standardized. All specifications include municipality and week fixed effects, and include the interaction of the relevant post-event indicator with standardized municipality-level covariates, including population density, the share of the adult population with secondary or tertiary education, the median wage, the unemployment rate, and crime rate. Panel A considers first-dose vaccinations, and Panel B second- or higher-dose vaccinations. Standard errors, clustered at the municipality level, are in parentheses (43 clusters). * p<0.1, ** p<0.05, *** p<0.01.

Table E4: Difference-in-differences estimates of the effect of the Janssen rollout delay by municipal ethnic Russian share on COVID-19 vaccination in Latvia, by first and second-or-higher doses

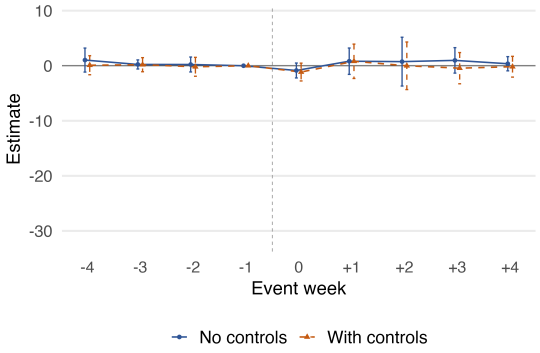
	Dependent variable:			
	All	Moderna & Pfizer	Janssen	AstraZeneca, Moderna & Pfizer
	(1)	(2)	(3)	(4)
Panel A: First-dose vaccines				
$\text{Post}_{Janssen} \times$ *ethnic Russian share*	-18.438^{*}	-31.495^{***}	0.125	-18.560^{*}
	(7.178)	(5.373)	(0.194)	(7.145)
Outcome mean	176.140	121.000	6.050	170.080
Observations	559	559	559	559
R^2	0.511	0.580	0.339	0.523
Panel B: Second or higher-dose vaccines				
$\text{Post}_{Janssen} \times$ *ethnic Russian share*	-9.922^{***}	-6.996^{***}	0.000	-9.924^{***}
	(2.014)	(1.442)	(0.000)	(2.015)
Outcome mean	84.620	57.920	0.000	84.620
Share Russian SD	0.12	0.12	0.12	0.12
Observations	523	523	523	523
R^2	0.542	0.538	0.103	0.542

Notes: Observations are at the municipality-week level, six weeks before and after the delayed rollout of the Janssen COVID-19 vaccine from April 13–23, 2021. Outcomes are vaccines per 10,000 inhabitants for all vaccine manufacturers in column 1; for Moderna and Pfizer in column 2; for Janssen in column 3; and for AstraZeneca, Moderna, and Pfizer in column 4. The share of ethnic Russians is standardized. All specifications include municipality and week fixed effects, and controls for an indicator for the period after vaccination eligibility was extended to the general population and the interaction of the relevant post-event indicator with standardized municipality-level controls, including population density, the share of the adult population with secondary or tertiary education, the median wage, the unemployment rate, and crime rate. Panel A considers first-dose vaccinations, and Panel B second- or higher-dose vaccinations. Standard errors, clustered at the municipality level, are in parentheses (43 clusters). * p<0.1, ** p<0.05, *** p<0.01.

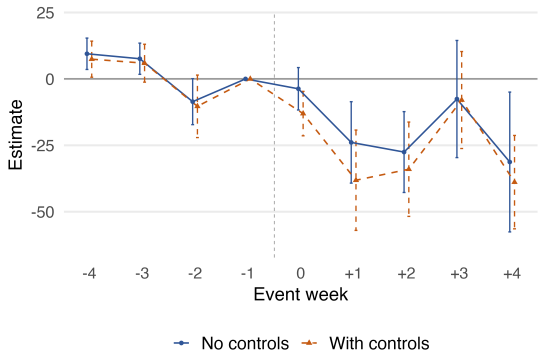
Figure E2: Event studies of the AstraZeneca suspension and Janssen rollout delay on Moderna and Pfizer vaccination in Latvia, by municipal ethnic Russian share, by first and second-or-higher doses



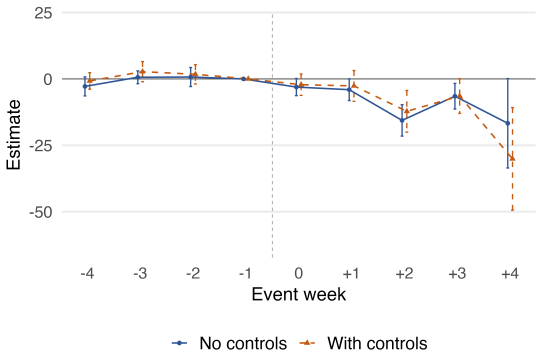
(a) AstraZeneca, First-dose



(b) AstraZeneca, Second or higher-dose



(c) Janssen Event, First-dose

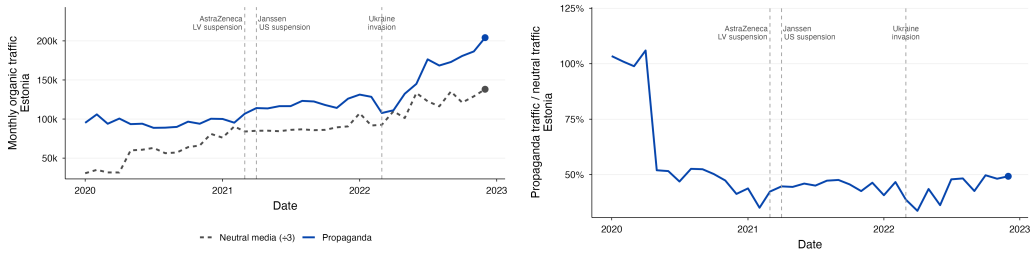


(d) Janssen Event, Second or higher-dose

Notes: The event study on the right-(left-)top plot corresponds to the specification in column 2 in Panel A (B) of Table E3. The event study on the right-(left-)bottom plot corresponds to the specification in column 2 in Panel A (B) of Table E4.

E.2 Estonia

Figure E3: Organic traffic from Estonia to pro-Kremlin and neutral Russian-language news sources



(a) Absolute pro-Kremlin and neutral

(b) Pro-Kremlin relative to neutral

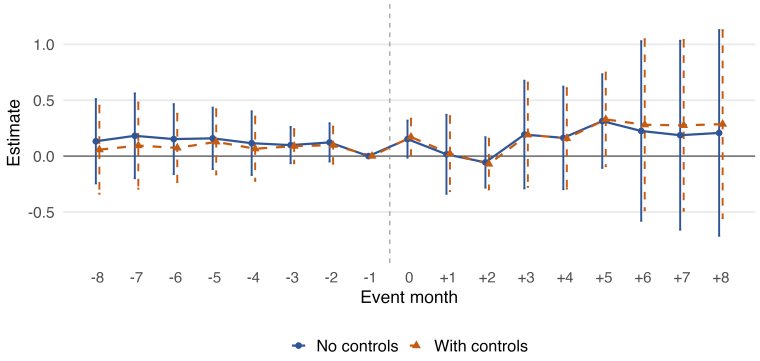
Note: The left panel presents absolute organic traffic by source type, and the right panel presents traffic to pro-Kremlin news sources relative to neutral Russian-language news sources. The source is Semrush's organic traffic from Estonia to Russian propaganda or state-owned online news sources (Mölder and Sazonov, 2020; Simonov and Rao, 2022), and to neutral Russian-language news sources.

Table E5: Difference-in-differences estimates of the effect of the AstraZeneca suspension, Janssen rollout delay and Russian invasion of Ukraine on organic traffic to pro-Kremlin news sources relative to neutral Russian-language news sources in Estonia

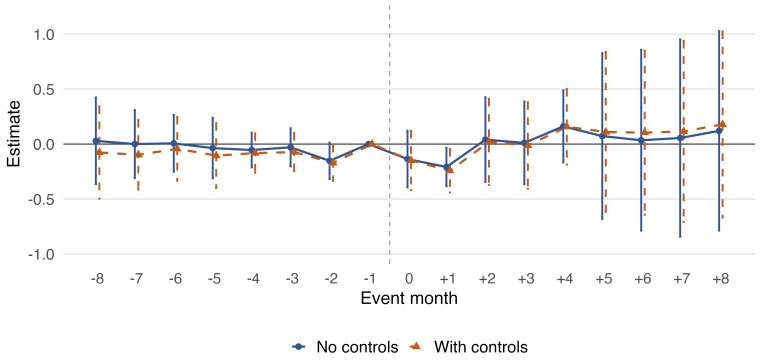
	Dependent variable: Organic traffic		
Event:	AstraZeneca suspension	Janssen delay	Ukraine invasion
	(1)	(2)	(3)
Panel A: Without control variables			
$\text{Post}_{\text{Event}} \times$ *pro-Kremlin*	0.156	0.017	−0.399
	(0.214)	(0.228)	(0.465)
R^2	0.006	0.006	0.012
Panel B: With control variables			
$\text{Post}_{\text{Event}} \times$ *pro-Kremlin*	0.182	0.032	−0.336
	(0.206)	(0.224)	(0.432)
Outcome mean	6.738	6.760	7.000
Observations	663	663	663
R^2	0.150	0.149	0.217

Notes: Observations are at the news source-month level. All specifications include news-source and month fixed effects. Estimates in Panel A have no controls, and in Panel B they include the interaction of $Post_{Event}$ with predetermined news-source characteristics, including baseline organic-keyword volume, baseline organic traffic, and baseline paid traffic. The outcome is logged organic traffic to the news source. Standard errors are clustered at the news-source level. * p<0.1, ** p<0.05, *** p<0.01.

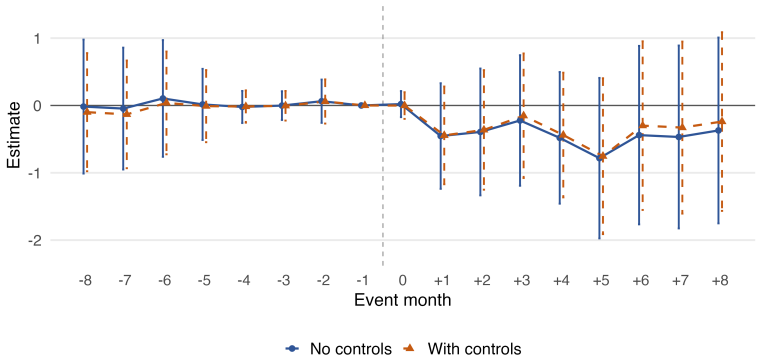
Figure E4: Event studies of the effect of the AstraZeneca suspension, Janssen rollout delay and Russian invasion of Ukraine on organic traffic to pro-Kremlin news sources relative to neutral Russian-language news sources in Estonia



(a) AstraZeneca



(b) Janssen rollout delay



(c) Russian invasion of Ukraine

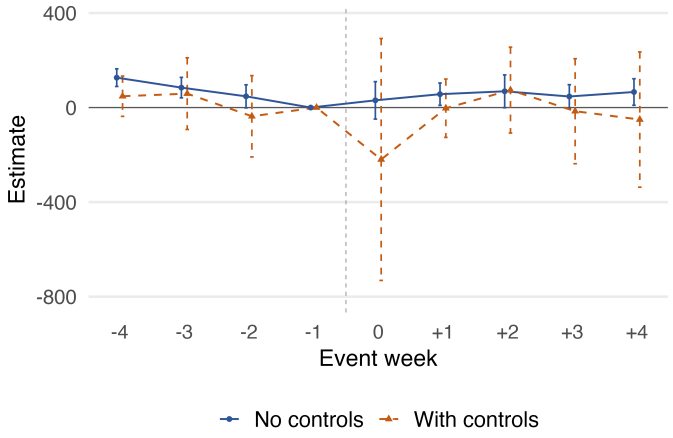
The event studies correspond to the specifications in Table E5. The solid blue series is estimated without controls. The dashed orange series adjusts for interacted predetermined news-source characteristics. 95% confidence intervals are computed with standard errors clustered by outlet.

Table E6: Difference-in-differences estimates of the effect of the AstraZeneca suspension, Janssen rollout delay and Russian invasion of Ukraine by municipal ethnic Russian share on COVID-19 vaccination in Estonia

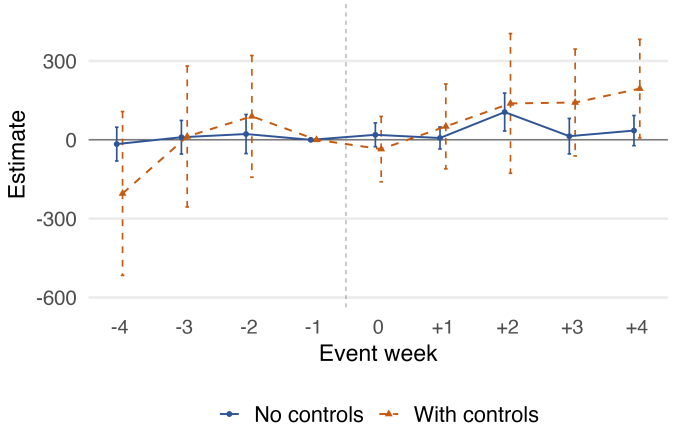
	Dependent variable: All vaccines		
Event:	AstraZeneca suspension	Janssen delay rollout	Ukraine invasion
	(1)	(2)	(3)
Panel A: Without control variables			
$\text{Post}_{\text{Event}} \times$ *ethnic Russian share*	−10.886	63.986***	−12.201***
	(18.634)	(14.937)	(3.752)
R^2	0.0003	0.011	0.012
Panel B: With control variables			
$\text{Post}_{\text{Event}} \times$ *ethnic Russian share*	−60.460	149.128***	−23.364
	(140.211)	(39.451)	(15.126)
Outcome mean	596.85	773.59	146.91
Observations	711	1,027	1,027
R^2	0.110	0.150	0.198

Notes: Observations are at the municipality-week level. Column 1 includes observations four weeks before and after the AstraZeneca suspension from March 16–19, 2021. Column 2 includes observations six weeks before and after the delayed rollout of the Janssen COVID-19 vaccine from April 13–23, 2021. Column 3 includes observations six weeks before and after the Russian invasion of Ukraine on February 24, 2022. All specifications include municipality and week fixed effects. Estimates in Panel A have no controls, and in Panel B they include the interaction of the relevant post-event indicator with municipality-level controls, including population density, the share of the adult population with secondary or tertiary education, the median wage, the unemployment rate, and crime rate. Outcomes are vaccines per 10,000 inhabitants for all vaccine manufacturers. Standard errors, clustered at the municipality level, are in parentheses (79 clusters). * p<0.1, ** p<0.05, *** p<0.01.

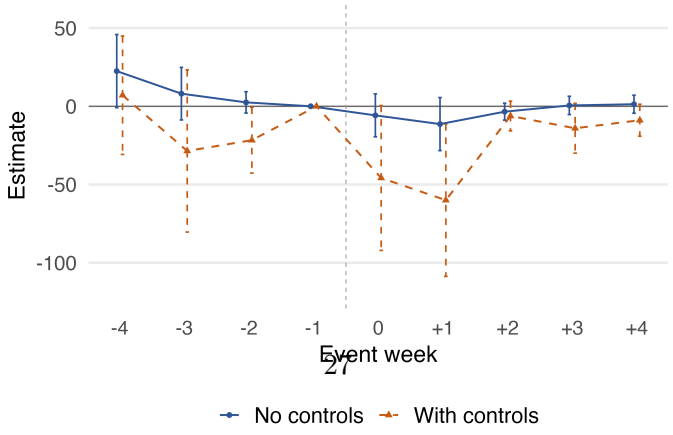
Figure E5: Event studies for the differential effect of the AstraZeneca suspension, Janssen rollout delay and Russian invasion of Ukraine by municipal ethnic Russian share on COVID-19 vaccination in Estonia



(a) AstraZeneca suspension



(b) Janssen rollout delay

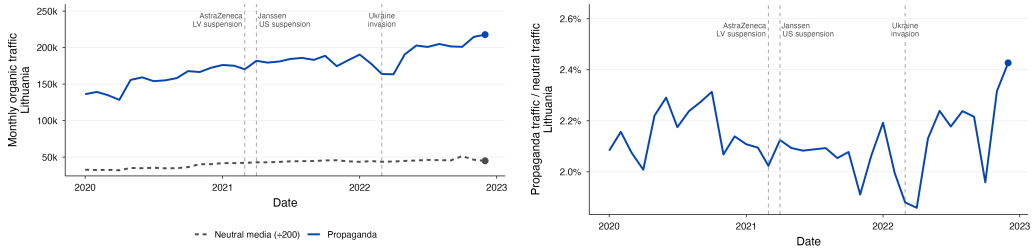


(c) Russian invasion of Ukraine

Notes: The event studies correspond to the specifications in Table E6.

E.3 Lithuania

Figure E6: Organic traffic from Lithuania to pro-Kremlin and neutral Russian-language news sources



(a) Absolute pro-Kremlin and neutral

(b) Pro-Kremlin relative to neutral

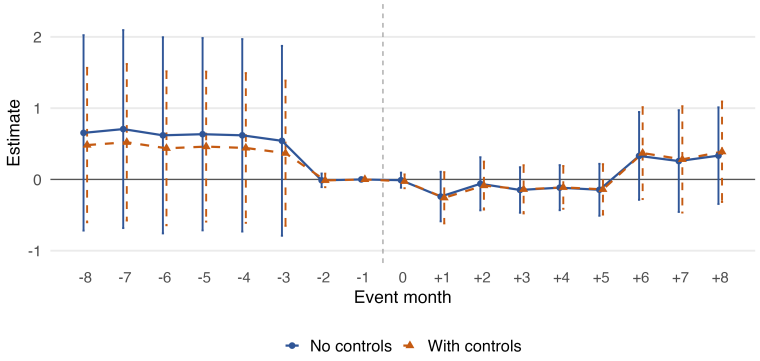
Note: The left panel presents absolute organic traffic by source type, and the right panel presents traffic to pro-Kremlin news sources relative to neutral Russian-language news sources. The source is Semrush's organic traffic from Lithuania to Russian propaganda or state-owned online news sources (Mölder and Sazonov, 2020; Simonov and Rao, 2022), and to neutral Russian-language news sources.

Table E7: Difference-in-differences estimates of the effect of the AstraZeneca suspension, Janssen rollout delay and Russian invasion of Ukraine on organic traffic to pro-Kremlin news sources relative to neutral Russian-language news sources in Lithuania

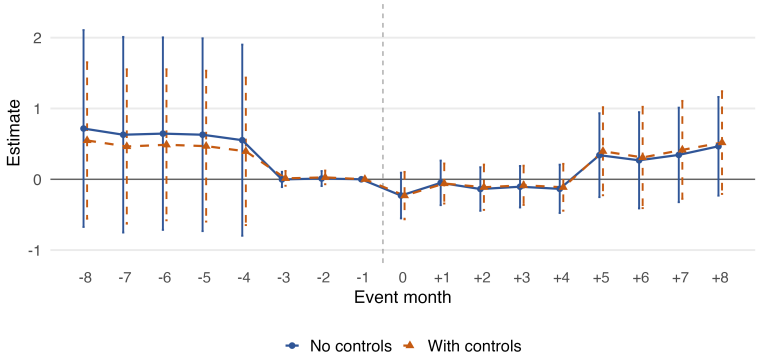
	Dependent variable: Organic traffic		
Event:	AstraZeneca suspension	Janssen delay	Ukraine invasion
	(1)	(2)	(3)
Panel A: Without control variables			
$\text{Post}_{\text{Event}} \times$ *pro-Kremlin*	0.022	0.085	−0.510
	(0.174)	(0.192)	(0.426)
Outcome mean	7.117	7.147	7.364
Observations	646	646	646
R^2	0.025	0.025	0.018
Panel B: With control variables			
$\text{Post}_{\text{Event}} \times$ *pro-Kremlin*	0.031	0.115	−0.463
	(0.173)	(0.192)	(0.440)
Outcome mean	7.117	7.147	7.364
Observations	646	646	646
R^2	0.160	0.160	0.139

Notes: Observations are at the news source-month level. All specifications include news-source and month fixed effects. Estimates in Panel A have no controls, and in Panel B they include the interaction of $Post_{Event}$ with predetermined news-source characteristics, including baseline organic-keyword volume, baseline organic traffic, and baseline paid traffic. The outcome is logged organic traffic to the news source. Standard errors are clustered at the news-source level. * p<0.1, ** p<0.05, *** p<0.01.

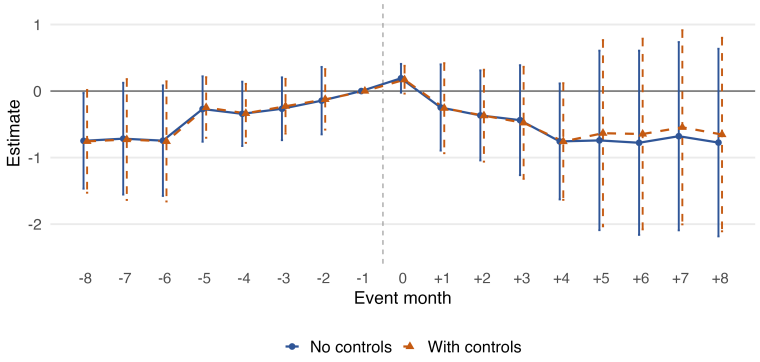
Figure E7: Event studies of the effect of the AstraZeneca suspension, Janssen rollout delay and Russian invasion of Ukraine on organic traffic to pro-Kremlin news sources relative to neutral Russian-language news sources in Lithuania



(a) AstraZeneca suspension



(b) Janssen rollout delay



(c) Russian invasion of Ukraine

The event studies correspond to the specifications in Table E7. The solid blue series is estimated without controls. The dashed orange series adjusts for interacted predetermined news-source characteristics. 95% confidence intervals are computed with standard errors clustered by outlet.

Table E8: Difference-in-differences estimates of the effect of the AstraZeneca suspension by municipal ethnic Russian share on COVID-19 vaccination in Lithuania

	Dependent variable:			
	All	Moderna & Pfizer	AstraZeneca	Janssen, Moderna & Pfizer
	(1)	(2)	(3)	(4)
Panel A: Without control variables				
$\text{Post}_{AZ} \times$ *ethnic Russian share*	−7.083*	−0.144	−6.938	−0.145
	(3.696)	(1.987)	(4.702)	(1.988)
R^2	0.004	0.000	0.008	0.000
Panel B: With control variables				
$\text{Post}_{AZ} \times$ *ethnic Russian share*	−12.024*	−0.244	−11.782	−0.242
	(6.691)	(3.118)	(7.483)	(3.118)
Outcome mean	241.49	168.02	73.46	168.03
Observations	540	540	540	540
R^2	0.185	0.144	0.139	0.144

Notes: Observations are at the municipality-week level, four weeks before and after the AstraZeneca suspension from March 16–19, 2021. All specifications include municipality and week fixed effects. Estimates in Panel A have no controls, and in Panel B they include the interaction of the relevant post-event indicator with municipality-level controls, including population density, the share of the adult population with secondary or tertiary education, the median wage, the unemployment rate, and crime rate. Outcomes are vaccines per 10,000 inhabitants for all vaccine manufacturers in column 1; for Moderna and Pfizer in column 2; for AstraZeneca in column 3; and for Janssen, Moderna, and Pfizer in column 4. Standard errors, clustered at the municipality level, are in parentheses (60 clusters). * p<0.1, ** p<0.05, *** p<0.01.

Table E9: Difference-in-differences estimates of the effect of the Janssen rollout delay by municipal ethnic Russian share on COVID-19 vaccination in Lithuania

	Dependent variable:			
	All	Moderna & Pfizer	Janssen	AstraZeneca, Moderna & Pfizer
	(1)	(2)	(3)	(4)
Panel A: Without control variables				
$\text{Post}_{Janssen} \times$ *ethnic Russian share*	−1.800	0.503	−0.389	−1.411
	(5.292)	(4.937)	(0.274)	(5.451)
R^2	0.0001	0.00002	0.001	0.0001
Panel B: With control variables				
$\text{Post}_{Janssen} \times$ *ethnic Russian share*	4.864	4.729	0.374	4.491
	(8.281)	(7.738)	(0.526)	(8.462)
Outcome mean	362.36	273.46	4.32	357.98
Observations	780	780	780	780
R^2	0.227	0.243	0.058	0.229

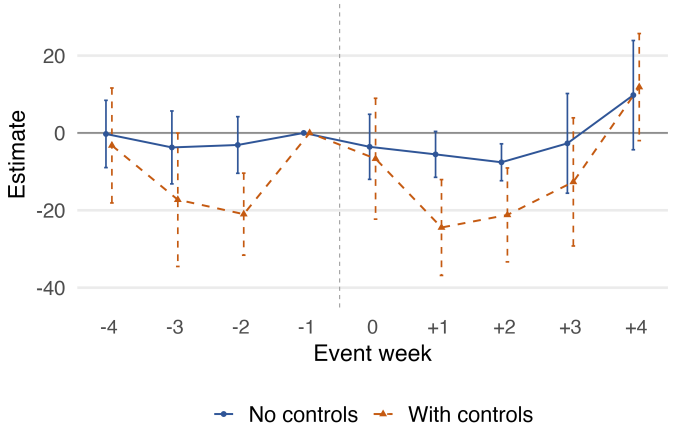
Notes: Observations are at the municipality-week level, six weeks before and after the delayed rollout of the Janssen COVID-19 vaccine from April 13–23, 2021. All specifications include municipality and week fixed effects. Estimates in Panel A include an indicator for the period after vaccination eligibility was extended to the general population, and in Panel B they further include the interaction of the relevant post-event indicator with municipality-level controls, including population density, the share of the adult population with secondary or tertiary education, the median wage, the unemployment rate, and crime rate. Outcomes are vaccines per 10,000 inhabitants for all vaccine manufacturers in column 1; for Moderna and Pfizer in column 2; for Janssen in column 3; and for AstraZeneca, Moderna, and Pfizer in column 4. Standard errors, clustered at the municipality level, are in parentheses (60 clusters). * p<0.1, ** p<0.05, *** p<0.01.

Table E10: Difference-in-differences estimates of the effect of the Russian invasion of Ukraine by municipal ethnic Russian share on COVID-19 vaccination in Lithuania

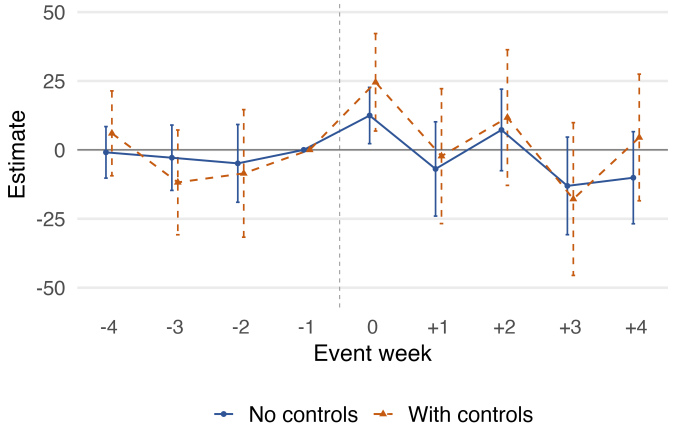
	Dependent variable:	
	All	Moderna & Pfizer
	(1)	(2)
Panel A: Without control variables		
$\text{Post}_{Ukraine} \times$ *ethnic Russian share*	−1.146	−0.857
	(1.810)	(1.709)
R^2	0.001	0.0005
Panel B: With control variables		
$\text{Post}_{Ukraine} \times$ *ethnic Russian share*	−2.302	−2.071
	(2.656)	(2.472)
Outcome mean	60.75	58.58
Observations	780	780
R^2	0.099	0.096

Notes: Observations are at the municipality-week level, six weeks before and after the Russian invasion of Ukraine on February 24, 2022. All specifications include municipality and week fixed effects. Estimates in Panel A have no controls, and in Panel B they include the interaction of the relevant post-event indicator with municipality-level controls, including population density, the share of the adult population with secondary or tertiary education, the median wage, the unemployment rate, and crime rate. Outcomes are vaccines per 10,000 inhabitants for all vaccine manufacturers in column 1 and for Moderna and Pfizer in column 2. Standard errors, clustered at the municipality level, are in parentheses (60 clusters). * p<0.1, ** p<0.05, *** p<0.01.

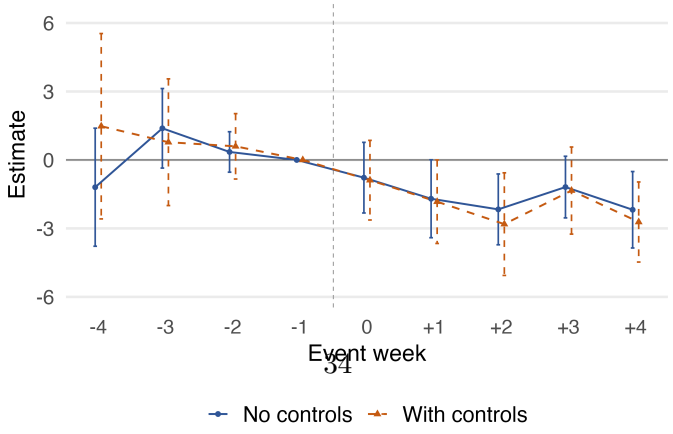
Figure E8: Event studies for the differential effect of the AstraZeneca suspension, Janssen rollout delay, and the Russian invasion of Ukraine by municipal ethnic Russian share on Moderna and Pfizer COVID-19 vaccination in Lithuania



(a) AstraZeneca suspension



(b) Janssen rollout delay



(c) Russian invasion of Ukraine

Notes: The event study at the top, middle and bottom, respectively, corresponds to the specification in column 2 in Panel B of Tables E8, E9, and E10.

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